



**Portland General Electric Company**  
121 SW Salmon Street • 1WTC0306 • Portland, OR 97204  
portlandgeneral.com

June 26, 2020

***Via Electronic Filing***

Public Utility Commission of Oregon  
Attention: Filing Center  
P.O. Box 1088  
Salem, OR 97308-1088

**Re: PGE 2019 R&D Retrospective Report on Research & Development Projects (UE-294)**

Dear Filing Center:

Enclosed pursuant to OPUC Commission Order 15-536, is Portland General Electric Company's annual retrospective look at Research and Development Projects for 2019.

Should you have any questions or require further information please call me at (503) 464-7002.

All formal correspondence should be e-mailed to [pge.opuc.filings@pgn.com](mailto:pge.opuc.filings@pgn.com).

Sincerely,

/s/ Jay Tinker  
Jay Tinker  
Director, Rates and Regulatory Affairs

Enclosure

cc: Jay Landstrom  
Stefan Brown



# Research & Development EPRI Program Summary

Date: 01/14/2020

## EPRI Program/Project Name: Program 62 Occupational Safety and Health, Project # 14

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2020
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Bill Messner</p> <p><b>Sponsoring Department:</b> Safety, Security &amp; Resiliency</p> <p><b>Project Team (internal):</b> Rob Roloson</p> <p><b>Project Team (external):</b> Eric Bauman, EPRI Senior Technical Leader</p> <p><b>Project Description:</b> EPRI's Program 62 provides members with research relative to current and anticipated occupational health and safety (OH&amp;S) issues. Deliverables derived from PGE's engagement are on-going and will be used to build, update and sustain our occupational health program. Deliverables relate directly to influence worker protective clothing (heat/cold stress) economic evaluation of ergonomic interventions, economic safety metrics/indicators and the development of an exposure database. Additional deliverables include monthly webcasts (recorded), a technical workshop and access to EPRI technical staff. By utilizing EPRI, PGE has an information resource that will allow for better short- and long-term safety planning and strategizing. The program is designed to address both current issues and anticipate those of tomorrow.</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$50,450/\$42,882 FY19: \$51,963/\$45,054 FY20: \$46,856/0</p> <p><b>Cost Share Total:</b> (if applicable)</p> <p><b>Cost Share Percent:</b></p> <p>PGE's 1-year leverage for P62 is 28:1. For every dollar PGE invests, it is being leveraged by \$28 from other utilities.</p>
<p><b>Benefit to PGE:</b></p> <ul style="list-style-type: none"> <li>- Program 62 Occupational Safety and Health - Ergonomics delivered a new and updated Handbook for Awkward Postures and Ergonomics in 2018: Overhead, Underground,</li> </ul>	<p><b>Strategic Alignment:</b></p> <p>Deliver exceptional customer experience Pursue excellence in our work</p>



# Research & Development EPRI Program Summary

<p>Substation job tasks incl. ergonomic solutions for reducing risk factors for Sprains and Strains</p> <ul style="list-style-type: none"> <li>- Sprains and Strains, the largest category of on-the-job injuries at PGE, is affecting every day productivity, lost time and DART rates, and morale at our company with potential to impact overall Customer Experience</li> </ul> <p><b>Customer Benefit:</b> Participation in Program 62 will provide PGE with past, current and future research designed to address safety and health issues facing PGE. Implementing these research findings will lead to enhanced customer service and operational efficiency through the development of improved safety practices and procedures</p>	<p>Participation in EPRI's Program 62 fully meets the company strategies of:</p> <ul style="list-style-type: none"> <li>a) Delivering an exceptional customer experience (See (Customer Benefits below)</li> <li>b) Investing in a reliable and clean energy future by supporting plans to build infrastructure where we anticipate safety and health being issues.</li> <li>c) Building a smarter, more resilient grid by developing and implementing design criteria to support safety and health issue being part of new construction.</li> <li>d) Pursuing excellence in our work by having access to information and tools needed to support external shareholder engagement around safety and health issues.</li> </ul>
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## Value

<p><b>PGE Participation:</b></p> <p>PGE Participation 2018-2019: active in the Workgroup for Ergonomics and the new handbook.</p> <p>2020:</p> <ul style="list-style-type: none"> <li>- Participate in the Heat Stress and Applications and Tools working groups</li> <li>- Engage more with workgroups for Human Performance and Fatigue Management Projects</li> </ul>	<p><b>Value Derived:</b></p> <p>2018 Handbook Awkward Postures and Recommendations</p> <p>2018 Three brief Safety Videos for training and safety discussions</p> <p>2019 Heat Stress infographic and video shared across PGE.</p> <p>2020 Technology Transfer Award won for use of the Heat Stress infographic and video. Fatigue management information shared with work groups.</p>
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## FLOWTECH TRIAL PLAN

### PURPOSE

To determine the effectiveness of the FlowTech non-chemical treatment program on the Port Westward cooling tower. This document will outline the goals and objectives, staff training, chemistry sampling requirements, cooling tower chemistry transition plan, the acceptance criteria that will be used to determine a successful trial and provide basic description of cooling tower chemistry changes expected to be seen.

### HISTORY

Non-chemical treatment has been around for a long time but has never proven to be effective. Older versions of this technology involved wrapping a wire around a metal pipe and running a current through the wire. The electro-magnetic field (EMF) generated would change the characteristics of the water while it remained in the EMF. On either side of the EMF, the characteristics of the water would be unaffected. These systems have never performed as advertised. The FlowTech system is unique in that FlowTech has figured out how to propagate the low-frequency radio waves throughout the system. The radio waves travel through the water, making pipe materials irrelevant, and act on the water from the time it leaves the cooling tower basin until it returns.

The radio waves decrease the saturation point of the hardness minerals in the water and cause them to come out of solution as a flocculant (floc) in the bulk water well before they would come out of solution as scale on pipe. The floc travels through the system and settles out in the basin. The floc also acts like a polymer that might be added to a clarifier. It has a cationic charge that attracts negatively charged particles and can help to clear up cooling tower water and reduce turbidity. The radio waves also disrupt slime that has formed on pipe and force the colonies back into the bulk water where they can be killed with bleach, and they also disrupt the microbe's cellular structure, essentially poking holes in the microbes, which force the bacteria to repair themselves instead of reproducing. There is most likely a certain amount of microbial kill associated with the radio waves as well. Some microbes will be removed as they get encapsulated in the hardness floc.

### GOALS AND OBJECTIVES

**GOAL:** To reduce or eliminate cooling tower chemical costs. By eliminating cooling tower chemicals not only will PGE realize a substantial savings in O&M spend, they will significantly reduce the amount of chemical being discharged to waste streams. If this trial is successful at Port Westward the technology will be put into use at all four combined cycles plants.

#### Objectives:

- Training for personnel involved in operation and maintenance of the equipment and cooling water testing.
- Installation of the FlowTech equipment.
- Commencement of FlowTech trial with continuation of current chemistry program including anti-scalant, corrosion inhibitor and biocide.
- Continuation of routine weekly cooling tower testing with addition of daily dip slides and swabs. Additional cooling tower testing to be performed on Tuesdays and Thursdays with anticipation of reducing sampling to twice a week, the returning to once a week.
- Consideration of utilizing a contract water technician to perform independent weekly water testing.
- Slow controlled reduction of chemistry feeds until the only water treatment is the FlowTech equipment.
- Continued monitoring cooling tower parameters until confidence is high that FlowTech equipment is protecting assets.

## TRAINING

FlowTech will provide up to three (3), four-hour training sessions for Port Westward personnel. Training will include operation and maintenance and theory of operation of the FlowTech equipment. We will also discuss additional sampling requirements necessary to prove the trial is a success or failure.

## TRIAL AND CHEMISTRY TESTING

**PHASE 1** – For the first 1 – 2 weeks of FlowTech operations:

- The current chemistry program will remain in effect.
- There may be additional or increased biocide additions as the FlowTech system will release bacterial slime colonies, if present, from pipe walls and deposit the colonies into the basin.
- There may initially be a slight increase in cooling tower dip slide bacteria counts, which may require an increase in biocide feed, temporarily.

### SAMPLING FREQUENCY – PHASE 1

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Routine Weekly Testing + Dip Slide and Swab LSI/RSI*	Dip Slide & Swab	pH Conductivity Hardness Alkalinity Temperature (°C) LSI/RSI*	Dip Slide & Swab	pH Conductivity Hardness Alkalinity Temperature (°C) LSI/RSI*	Dip Slide & Swab	Dip Slide & Swab

\*The data collected will be used to calculate the Langelier Saturation Index (LSI) and Ryznar Saturation Index (RSI). These indices are used to determine if water is scale forming or corrosive. Sample temperature is needed to make these calculations. Be sure to record circ water temp when performing analytical tests other than dip slides and swabs.

**PHASE 2** – Weeks 3 – 6:

- As cooling tower chemistry changes, chemical addition will begin to be reduced.
- As dip slide and swab results show decreasing colony counts, bleach addition will decrease.
- As cooling tower turbidity and hardness decrease, anti-scalant usage will be decreased.
- Conductivity should decrease during this time, due to reduced chemical feed and removal of dissolved solids from the bulk water. Cycles of concentration will remain constant (i.e. blowdown should not be reduced) until we are off chemical feed.
- As hardness decreases there may be an increase in alkalinity which will increase pH. An increase in pH is acceptable if hardness levels decrease. The risk of a scaling event at higher pH levels decreases as hardness levels decrease.
- The LSI & RSI calculations will help determine if the cooling water is scale forming or corrosive as the pH levels increase.
- FlowTech will also help calculate optimum cycles. *(Keep in mind PGE does not pay for the water taken out of the river or for the water returned to the river so increasing cycles and using less water or reducing blowdown will not show a monetary benefit. The only monetary benefit comes from reducing or eliminating chemical feed.)*
- As chemical feed is reduced and cooling tower chemistry stabilizes, the Tuesday sampling will be reduced to bio-control testing only.

**SAMPLING FREQUENCY – PHASE 2**

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Routine Weekly Testing + Dip Slide and Swab LSI/RSI*	Dip Slide & Swab	Dip Slide & Swab	Dip Slide & Swab	pH Conductivity Hardness Alkalinity Temperature (°C) LSI/RSI*	Dip Slide & Swab	Dip Slide & Swab

**PHASE 3 – Week 7 – 12:**

- In the early part of Phase 3, if chemical injection is not completely turned off, it should be very minute.
- By the end of week 8, the hope is that all chemical feed will be secured and the only treatment the cooling water is receiving is from the FlowTech equipment.
- Testing will continue as in Phase 2 and as results stabilize and hold steady, the frequency of testing will be reduced to weekly as it was prior to the FlowTech trial.

**NOTE:** The Trasar panel will be utilized for pH, conductivity, turbidity and corrosion. The inline corrosion probes will be monitored for real-time corrosion. The installed coupons will also be used and will be analyzed every 3 months (90 days). New corrosion coupons should be installed the same day the FlowTech trial begins.

- The daily swabs will be performed on the corrosion coupons which will allow for a daily inspection.

**SAMPLING FREQUENCY – PHASE 3**

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Routine Weekly Testing + Dip Slide and Swab LSI/RSI*		Dip Slide & Swab		pH Conductivity Hardness Alkalinity Temperature (°C) LSI/RSI*		Dip Slide & Swab

The frequency of dip slides and swabs will depend on the results of those analyses. If colony counts are consistently low, the frequency will be reduced, however, if colony counts are high or increasing, the frequency will continue, and steps will be taken to reduce colony counts.

**CHEMISTRY TRANSITION PLAN**

The rate at which chemical feed is reduced in the cooling tower will depend on the rate at which the FlowTech system cleans the tower. The reason for the increased analytical testing is to allow for small, incremental, step-changes in chemical feed so assets continue to be protected. Even if the FlowTech system shows immediate improvement in cooling tower chemistry, it is in Port Westward’s best interest to slowly reduce chemical feed as the most telling results won’t be known until the next outage when the condenser and cooling tower basin can be inspected. The final goal will be a completely chemical free tower.

**ACCEPTANCE CRITERIA**

The acceptance criteria will be based on the chart below and will rely on good analytical data and at a minimum, the LSI and RSI. A brief description of the table below:

**Makeup:** These are the results of a makeup water analysis performed on 06/27/2019.

**Minimum:** The saturation column is based on 3.37 cycles of concentration which is where calcium carbonate saturation is expected to occur without any chemical feed.

**Maximum (Conservative):** This is a conservative optimization of cooling tower cycles of concentration. This would allow for good cycling of the tower with plenty of distance from upper control limits (again, based on no chemical feed, only FlowTech).

**Maximum (Upper Limit):** This is the maximum concentration that could be safely achieved without scaling the tower or causing corrosion, without chemical feed. Running at these levels would not leave much room should there be a sudden increase in makeup water hardness for example. Port Westward would most likely run somewhere between the conservative range and the upper limit.

**PWW Averages for June 2019:** This column shows Port Westward chemistry averages for the month of June, the month the makeup water test was taken. These values are based on current chemical feed.

**Caveat:** Except for the far-right column, the data provided below was from FlowTech’s software and are only estimates. Port Westward may see different results. The key to success is good data gathered at the specified frequencies above. Chloride values will be used to determine cycles of concentration as chloride is not affected by the FlowTech system.

Index			Water Activity
LSI	RSI	PSI	
3.0	3.0	3.0	High
2.0	4.0	4.0	Scale Forming
1.0	5.0	5.0	
0.5	5.5	5.5	
0.2	5.8	5.8	
0.0	6.0	6.0	Low
-0.2	6.5	6.5	Scale Dissolving
-0.5	7.0	7.0	
-1.0	8.0	8.0	
-2.0	9.0	9.0	
-3.0	10.0	10.0	

ACCEPTANCE CRITERIA						PWW Averages for June 2019
	Minimum	Maximum		Limits		
95°F/85°F (Tower supply/discharge)	Makeup	Saturation	Conservative	Upper Limit		
Cycles of Concentration (CoC)	1	3.37	8.00	12.70		5.69
pH (S.U.)	8.10	8.01	8.29	8.46	9	9
Conductivity $\mu\text{S}/\text{cm}$	170	573	955	1,310		993
Calcium Hardness as $\text{CaCO}_3$ {mg/L (ppm)}	45	152	169	171		162
Magnesium Hardness as $\text{CaCO}_3$ {mg/L (ppm)}	25	84	200	318		106
Total Hardness as $\text{CaCO}_3$ {mg/L (ppm)}	70	236	369	489		267
m-Alkalinity (total) as $\text{CaCO}_3$ {mg/L (ppm)}	69	233	361	476		37
Chloride as $\text{Cl}^-$ {mg/L (ppm)}	5	15	36	57	900	900
Sulfate as $\text{SO}_4^{-2}$ {mg/L (ppm)}	13.0	43.8	104.0	165.1		
Silica as $\text{SiO}_2$ {mg/L (ppm)}	11.0	37.1	88.0	139.7	140	140
Phosphate as $\text{PO}_4^{-3}$ {mg/L (ppm)}	0.1	0.3	0.8	1.3	15	15
[Ca] * [ $\text{SO}_4^{-2}$ ]	610	6,931	18,340	29,479	500,000	

**Precipitate Formation (This water is considered moderately hard)**

Calcium Carbonate (mg/L)	0.0	127.6	212.0	<b>&gt;.63 Filtration or cleaning required</b>	
Magnesium Silicate (mg/L)	0.0	0.0	0.0		
Precipitate Formation Factor	0.0	1.06	1.77		

**Simple Indexes**

Langelier Scaling	-0.17	0.95	1.17	1.28
Ryznar Scaling	8.43	6.21	5.76	5.53
Puckorius Scaling	9.30	6.30	5.58	5.17
Larson-Skold Corrosion Index	0.29	0.29	0.44	0.53

**ANALYTICAL ACCEPTANCE CRITERIA**

The Port Westward cooling tower can achieve 8 cycles of concentration with analyte concentrations equal to or less than those estimated in the "Conservative" column above, without the addition of corrosion or scale inhibitor.

**MICROBIAL ACCEPTANCE CRITERIA**

> 90% of dipslide results shall be <  $10^4$  cfu/mL (10,000 colony forming units/mL).



## PRE-TRIAL PREPERATIONS

**FlowTech Equipment Location:** The FlowTech representative will determine the best location for the installation of equipment prior to the equipment's arrival on site. Port Westward personnel will be responsible for installation of the equipment with guidance from the FlowTech representative. The tentative plan is to either install 2, FTS-4800 units inside the building close to where the circ water pipe enters and 1, FTS-2400 unit. FlowTech likes to have the units at least 30' from the condenser inlet(s). The second location under consideration is outside where the circ water pipe comes above grade before entering the building. The third location would be on the circ water pump deck at the tower.

**Pre-Trial Analysis:** In order to establish a ratio of cooling tower conductivity to cooling tower total dissolved solids (TDS), a series of TDS samples will be analyzed by Nalco. Cooling tower conductivity shall be recorded at the time the TDS samples are taken. TDS analysis has a 7 day hold time so samples will need to be shipped the day they are collected. Nalco has agreed to provide shipping labels and containers to accommodate this.

FlowTech needs a current cooling tower and makeup water sample analyzed for the parameters listed on the attached FlowTech Water Sample Instructions and Form. (These samples will be collected and delivered to the lab on Monday August 12<sup>th</sup>, with results expected on Wednesday, August 14<sup>th</sup>. The Fleet Chemist will collect and deliver these samples.)

### Pre-Trial Lab Equipment and Reagents:

Reagent	Vendor	Catalog/Part No.	Stock	Re-Order Point	UoM	Price	Notes
Sani-Check B Dipslides <a href="http://www.biosan.com/bacteria-test-kit">http://www.biosan.com/bacteria-test-kit</a>	BioSan Laboratories	<b>Product #210</b>	3	1 box remaining	pk/10	\$49.99	Dip slides for Bacteria only
Millipore Sigma™ Microbial Count Samplers <a href="https://www.fishersci.com/shop/products/emd-millipore-microbial-count-samplers-2/mhpc10025?searchHijack=true&amp;searchTerm=MHPC10025&amp;searchType=RAPID&amp;matchedCatNo=MHPC10025">https://www.fishersci.com/shop/products/emd-millipore-microbial-count-samplers-2/mhpc10025?searchHijack=true&amp;searchTerm=MHPC10025&amp;searchType=RAPID&amp;matchedCatNo=MHPC10025</a>	Fisher	<b>MHPC10025</b>	2	10 Tests remaining	pk/25	\$153.00	Swabs for total bacteria
Fisherbrand™ Automatic Burets with Stopcock <a href="https://www.fishersci.com/shop/products/fisherbrand-automatic-burets-stopcock-3/038422b?keyword=tr">https://www.fishersci.com/shop/products/fisherbrand-automatic-burets-stopcock-3/038422b?keyword=tr</a> <a href="https://www.fishersci.com/shop/products/fisherbrand-automatic-burets-stopcock-3/038422b?keyword=tr">ue</a>	Fisher	<b>03-842-2B</b>	1	N/A	Each	\$322.00	Reservoir and burette for chloride titration

Silver Nitrate, 0.0141N	Hach	31653	1	1/2	1L	\$32.49	Titrant for chloride titration
Chloride 2 Indicator PP	Hach	105766	2	1 bag	pk/50	\$25.09	Chloride 2 Indicator PP

**CURRENT CHEMICALS AND USAGE**

**Nalco**

3DT-134: Anti-scalant – 18.4 GPD

3DT-185: Corrosion Inhibitor (Phosphoric acid) – 3.53 GPD

7408: Dechlorination – 2.61 GPD

Sodium Hypochlorite: Biocide – 121 GPD



# Research & Development Project Summary

Date: 05/26/2020

**Project Name:** EPRI Incubatenergy Labs

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2020
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Jay Landstrom</p> <p><b>Sponsoring Department:</b> R&amp;D</p> <p><b>Project Team (internal):</b> Jay Landstrom, Darren Murtaugh, David Worth, Larry Bekkedahl, Jake Wise, Aaron Milano, Andy Macklin</p> <p><b>Project Team (external):</b> EPRI</p> <p><b>Project Description:</b> Incubatenergy® Labs is built for startups to engage utilities in paid demonstration projects. A utilities summit and collaborative demonstrations program in one, the program links startup companies leading the advancement of electrification, decarbonization and grid modernization with utilities from around the world. Innovative companies are encouraged to submit products and projects from selected areas of interest in:</p> <ul style="list-style-type: none"> <li>• Customer and Community Engagement</li> <li>• The Digital Utility</li> <li>• Integration of Distributed Energy Resources</li> <li>• Electric Mobility</li> <li>• Customer and Community Resilience</li> <li>• Workforce of the Future</li> </ul>	<p><b>PGE Budget/Actual:</b> FY19: \$50,000 FY20: \$TBD</p> <p><b>Cost Share Total:</b> \$50,000</p> <p><b>Cost Share Percent:</b> Approximately 10%</p> <p>Costs are shared between participating utilities: American Electric Power (AEP), Con Edison, Edison International, Enel, Nebraska Public Power District, New York Power Authority, Portland General Electric (PGE), Xcel Energy, Ameren, Tennessee Valley Authority (TVA), and Southern California Edison (SCE)</p>
<p><b>Benefit to PGE:</b> PGE will have access to and engage with cutting edge companies that will shape the next generation electrical grid.</p>	<p><b>Strategic Alignment:</b> Perform and Customer Satisfaction</p>



# Research & Development Project Summary

## Customer Benefit:

Many of the new technologies in this effort are directed directly at the customer. As these technologies become more available PGE could offer them to customers to enhance their interaction with the grid.

## Summary

### Synopsis of Project as Implemented:

PGE participated in the review and selection of companies that were chosen to develop demonstration projects with participating utilities. The finalists were:

- **Kognitiv Spark** (Fredericton, New Brunswick, Canada) – Augmented reality-enabled app to help utility workers learn new skills on the job.
- **Switched Source** (Vestal, N.Y.) – Power electronics based distribution-automation solutions to help manage distribution system load and improve power quality.
- **RWI Synthetics** (Edmonton, Alberta, Canada) – AI-driven intelligent systems modeling tool to help grid planners with scenario planning and distributed energy resource integration.
- **Sharc Energy Systems** (Port Coquitlam, British Columbia, Canada) – Multifamily building wastewater heat recovery systems.
- **ev.energy** (Palo Alto, Calif.) – Wireless platform that optimizes electric vehicle charging to save customers money, fully utilize renewable energy, and delivers an alternative to expensive grid upgrades.
- **IND Technology, Inc.** (New York, N.Y.) – Technology that detects electrical faults before they occur, which could prevent power losses, wildfires, and other consequences.
- **PingThings** (El Segundo, Calif.) – Artificial intelligence platform that processes, stores, and uses high-definition sensor data from across the electric power system in real-time, at grid scale.
- **Recurve** (Mill Valley, Calif.) – Software as a Service tool that analyzes how to use energy more efficiently and effectively in response to cost, carbon reduction, and other customer data.
- **LineVision** (Somerville, Mass.) – Non-contact, overhead line sensor technology that

### Decisions to be Made:

PGE is investigating possible pilot projects with IND Technology and Kognitiv Spark.

### Next Steps:

Attend the final demonstration project report out in October. Investigate companies that will bring value to customers and PGE as possible pilot projects.



## Research & Development Project Summary

provides situational awareness, asset health monitoring, and increases capacity.

- **GridFruit** (Pittsburgh, Pa.) – Grid-responsive scheduling of machine cycles to provide demand management and flexibility from commercial foodservice refrigeration systems.

### **Performance Against Objectives/Deliverables:**

The Project is on track to deliver the final demonstration results in October 2020.



# Research & Development Project Summary

Date: 12/12/2019

**Project Name:**

**Project Status: OSU Microgrid Synchrophaser**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2021

Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Ian Beil</p> <p><b>Sponsoring Department:</b> Transmission Planning</p> <p><b>Project Team (internal):</b> Ian Beil, Shauna Jensen, Jennifer Galaway</p> <p><b>Project Team (external):</b> Eduardo Cotilla-Sanchez, School of EECS Graduate Student</p> <p><b>Project Description:</b> Advance protection of the next generation power transmission and distribution infrastructure. With assistance from the growing PMU network at OSU, a composite dynamic load model can be estimated in real time and provide useful insight into the design of microgrid protection schemes. This will address challenges such as reverse flows, automatic reclosing, or delayed relay tripping.</p>	<p><b>PGE Budget/Actual:</b> FY18: \$30k/\$30k FY19: \$30k/\$30k FY20: \$30k/\$0k</p> <p><b>Cost Share Total:</b> (if applicable) <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b> The scope of this project is to use synchrophasor data to develop model parameters for the “Composite Load Model,” which is a WECC-approved model beginning to be used in transmission planning studies. Having these parameters would allow PGE to model behind-the-meter load components that are not typically visible from a transmission perspective, such as solar PVs and batteries. This would create more accurate system-wide models, and allow PGE Transmission Planning to better anticipate issues related to the increased deployment of distributed energy resources.</p>	<p><b>Strategic Alignment:</b> <b>Decarbonization</b> – this project will lead to better planning models, which will aid in determining the best investment decisions for the future as PGE seeks to reduce its carbon footprint  <b>Perform</b> – the transmission models developed in planning are passed on to the operations group, and the increased accuracy of these models allows operations to have better visibility into the PGE system</p>



# Research & Development Project Summary

**Customer Benefit:** More accurate models allow PGE transmission planners to better determine the needs of the future transmission system, optimizing capital investments and keeping rates affordable.

## Summary

### Synopsis of Project as Implemented:

Date	Years 1-2 Milestone Description
07/18	Data and microgrid model trustworthiness analysis  Performance of PMU datastreams
12/18	Dynamic load model development
12/19	Python code and all supporting files and programs for baseline microgrid

### Performance Against Objectives/Deliverables:

Date	Years 3-5 Milestone Description
07/20	Analysis of microgrid strategy research
12/20	OSU synchrophasor network expansion
12/21	Analysis of each use case, including a recommendation of the best protection schemes for each use case.
12/22	Overall microgrid analysis and benchmarking of use cases with best practices. Python code and all supporting files and programs for all use cases

### Decisions to be Made:

We are on track with the research project milestones as implemented so far and as planned for the complete period. In 2019 we built toward the analysis of microgrid strategies by focusing on partitioning of the PGE system while balancing resources. An important accelerator to these tasks was the completed NDA that allowed to test the algorithms in the realistic PGE footprint.

### Next Steps:

Advancing the research tasks toward the 07/20 deliverable of a microgrid strategy analysis, we will put together the following tasks:

- Compile locations for optimal composite load models within the microgrid.
- Define potential balanced microgrid boundaries and recommended synchrophasor locations.

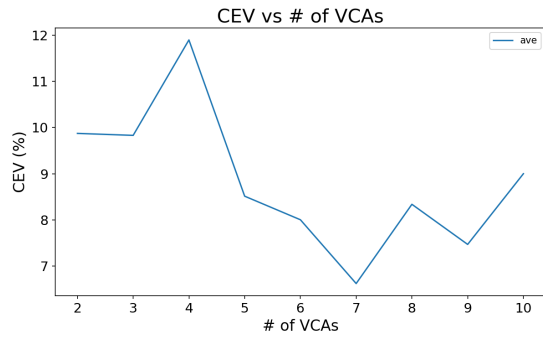


# Research & Development Project Summary

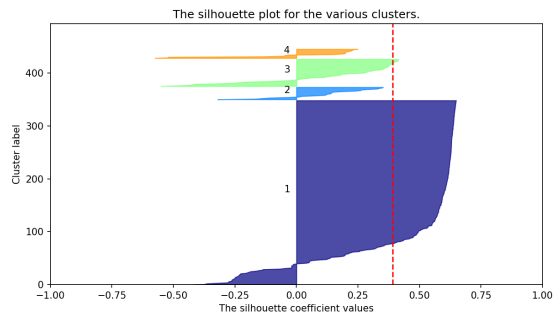
including compliance with NERC CIP cases.

Result highlights from 2019 tasks:

Microgrid strategy potential with 4 coherent areas with respect to reactive power:



Size distribution:







# Research & Development Project Summary

Date: 02/09/2020

**Project Name: Investigating Ductile Iron Poles for T&D Infrastructure – DIST35**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: **2021**

Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Jerry Donovan</p> <p><b>Sponsoring Department:</b> RC364</p> <p>Utility Asset Management / FITNES</p> <p><b>Project Team (internal):</b> Jerry Donovan</p> <p><b>Project Team (external):</b> OSU School of Civil &amp; Construction Engineering</p> <p>Jason H. Ideker, Ph.D. – Associate Professor</p> <p>Oregon State University, School of Civil &amp; Construction Engineering</p> <p>101 Kearney Hall, Corvallis, OR 97331-3212</p> <p><b>Project Description:</b></p> <p>Evaluate the use of ductile iron as a viable support structure material in PGE’s system, including as an alternative to wood for wildfire damage mitigation. PGE is soliciting the research capabilities of Oregon State University’s College of Civil Engineering. This work will support a graduate research assistant for general investigations into the long-term performance of ductile iron poles. This will include a thorough literature review as well as accelerated testing of ductile iron pole sections conducted under three types of degradation scenarios: (1) Corrosive environment using OSU’s Qfog system. (2) Sulfate rich soil environment using either OSU’s Qfog or MCMEC system1. (3) Placement and initial measurements at OSU’s long-term outdoor exposure site. During and after the accelerated aging, OSU will do electrochemical surface measurements (Eis) and scanning electron microscopy (SEM). Additionally, after accelerated aging, all specimens will be placed on OSU’s outdoor long-term exposure site for continued monitoring. This will provide PGE with a repository of samples that can be measured periodically and will allow them continual updates, ahead of time, as to the long-term performance of ductile iron pipes. PGE has provided sections of ductile iron pipe and “comparison” pole material samples.</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY19: \$20K/\$20K</p> <p>FY20: \$20K/\$0</p> <p><b>Cost Share Total:</b> N/A</p> <p><b>Cost Share Percent:</b> N/A</p>
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# Research & Development Project Summary

<p><b>Benefit to PGE:</b> Ductile iron poles have the potential to improve reliability and resiliency by eliminating woodpecker damage as one of the leading causes of premature wood pole failure. Additionally, the use of ductile iron poles addresses the growing concern around use of treated wood poles in environmentally sensitive areas. Provides an alternative to wood support structures in wildfire zones.</p>	<p><b>Strategic Alignment:</b> Deliver operational excellence and competitive financial returns</p>
<p><b>Customer Benefit:</b> A safe, reliable and environmentally beneficial alternative to treated wood support structures. Ductile iron poles may also be a good alternative to wood poles for use in wildfire zones.</p>	

## Summary

<p><b>Synopsis of Project as Implemented:</b> Verify ductile iron pole resistance to corrosion under various environmental scenarios.  Establish outdoor placement of pole samples to evaluate long-term performance of ductile iron poles.  Testing of ductile iron poles for resistance to fire damage.</p>	<p><b>Decisions to be Made:</b> Continued decisions on when and where to place additional ductile iron poles, possibly including as replacements for wood structures in certain environments and wildfire zones.  <b>Next Steps:</b> Next report to include comparison of ductile iron performance to galvanized steel coupons.  OSU/PGE to determine placement of pole samples in outdoor environment to evaluate long-term performance of ductile iron poles.  Expand testing to include simulation of wildfire conditions to test resistance capabilities and determine limitations.</p>
<p><b>Performance Against Objectives/Deliverables:</b> Testing for resistance to corrosion under various environmental scenarios continued.  Galvanized steel samples procured and received by OSU.</p>	



# Research & Development EPRI Program Summary

Date: 12/16/2019

## EPRI Program/Project Name: P193B Wind Generation and Performance Monitoring Supplemental Project

**Project Status:**

- Complete
- Will Continue Next Year

- Year to be Completed: EPRI P193B participation will continue through 2021

Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Alex Triplett</p> <p><b>Sponsoring Department:</b> PSES</p> <p><b>Project Team (internal):</b> Alex Triplett, Scott Phares, Greg Bingham</p> <p><b>Project Team (external):</b> Brandon Fichett, Raja Pulikollu</p> <p><b>Project Description:</b> The objective of EPRI Program 193B is to reduce capital and O&amp;M costs, increase capacity factors, and increase component reliability for wind turbine owners. Participation in Program 193B provides PGE the opportunity to stay informed of best practices for operating, monitoring, and maintaining a wind fleet.</p> <p>The Wind Turbine Performance Monitoring Demonstration is a supplemental project associated with the Wind Generation Program. The goal of this project is to improve wind turbine production and reduce Levelized Cost of Electricity (LCOE). This is done by tracking turbine performance over time using operational and maintenance data. The deliverable is a final report identifying under-performing wind turbines and recommending actions to increase production. Part of the project deliverable was a knowledge transfer enabling PGE to conduct this analysis internally on other wind turbines.</p>	<p><b>PGE Budget/Actual:</b> FY19: Annual Research Program: \$121,156 Performance Monitoring Supplemental: \$50,000</p> <p><b>Cost Share Total:</b> NA <b>Cost Share Percent:</b> NA</p>
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# Research & Development EPRI Program Summary

<p><b>Benefit to PGE:</b> Tools and techniques to better manage maintenance, as well as track and optimize site output.</p> <p><b>Customer Benefit:</b> Wind energy plays a major role in PGE’s vision for a clean energy future. It is important to take actions to make our wind fleet a reliable and cost effective renewable generating resource. Participation in Program 193B provides PGE the tools to pursue excellence in operating, monitoring, and maintaining our wind turbine fleet.</p>	<p><b>Strategic Alignment:</b> Perform, Decarbonize</p>
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## Value

<p><b>PGE Participation:</b> Attended Renewable O&amp;M Workshop in Charlotte, NC and Generation Advisory Meetings in Tuscon, AZ. Numerous web conferences with knowledge transfer specific to the Performance Monitoring project. Also distributed wind generation webinars to PGE stakeholders.</p>	<p><b>Value Derived:</b> The Performance Monitoring project identified several turbines that were yawing much more than neighboring towers, increasing wear on components. Site is planning to switch primary anemometer devices to see if this mitigates the issue. The project confirmed that grid curtailments are by far the primary cause of wind turbine underperformance. Algorithms for filtering data and flagging performance outliers were also made available. These will likely be used in further efforts to monitor performance. The opportunity to discuss wind issues with other operators and industry experts has been very valuable.</p>
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# Research & Development EPRI Program Summary

Date: 2/9/2020

## EPRI Program/Project Name: Program 88 – HRSG & BOP

**Project Status:**

- Complete
- Will Continue This Year
  - Year to be Completed: 2020
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor: Dan Peterson</b></p> <p><b>Sponsoring Department:</b>PSES</p> <p><b>Project Team (internal): Dan Peterson, Brent Lee, Brad Hanna, TJ Mulqueen</b></p> <p><b>Project Team (external): N/A</b></p> <p><b>Project Description:</b> Subscription to program 88 provides best practice guidelines for HRSG and balance of plant equipment operation, maintenance and optimization for cyclic operation. This project will use the research provided by Program 88 to refine the core activities encompassing a Covered Piping Program (CPP), optimize HRSG inspection and repair through the use of new technology, NDE guidelines, and techniques for improving access, and increasing HRSG reliability through better understanding of thermal cycling and transients.</p>	<p><b>PGE Budget/Actual:</b> FY18: \$77,235/\$77,235 FY19: \$81,097/\$81,097 FY20: \$85,152/\$85,152</p> <p><b>Cost Share Total:</b> (if applicable) <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b> Access to Program 88 provides access to research and data on programs, technology, and equipment that directly relates to our generating fleet. Access to this information will improve our programs and engineering design for related projects.</p> <p><b>Customer Benefit:</b> Benefit to the customer has been and will be realized through best use of capital and O&amp;M resources. Involvement in this program informs our inspections during planned outages and allows us to address industry concerns and potential issues during planned outages, which is economical when compared to possibly needing to repair with a forced outage. EPRI also advises on operational strategies, which improves expected life of equipment,</p>	<p><b>Strategic Alignment:</b> Perform – Delivering operational excellence</p>



# Research & Development EPRI Program Summary

<p>plant availability, and flexibility to meet the changing demand associated with increased renewable energy.</p>	
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## Value

<p><b>PGE Participation:</b> We have completed the following items:</p> <ul style="list-style-type: none"> <li>• Accessing EPRI historical documents</li> <li>• Review FAC inspection guidelines</li> <li>• Implement learnings into FAC inspection program</li> <li>• Review Covered Piping Program (CPP) reports</li> <li>• Implement learnings into CPP documentation</li> <li>• Gathered CO and SCR procurement guidelines</li> <li>• Attended Generation Advisory and Council meetings in Portland in 2018 and Indianapolis in 2019</li> <li>• Investigated SCR procurement guidelines for Coyote Springs upgrade (deferred project in 2019)</li> <li>• Utilized information around risk ranking for high energy piping and CPP for Carty, Port Westward, and Coyote Springs</li> <li>• Identified and evaluated attemperator issues utilizing information available via P88</li> </ul> <p>We plan to complete the following in 2020:</p> <ul style="list-style-type: none"> <li>• Evaluate CO and SCR procurement guidelines/considerations for the possible SCR upgrade for Port Westward</li> <li>• Continue to evaluate improvements to Generation’s FAC program and CPP based on historical and current information available to EPRI members</li> <li>• Continue to develop/refine risk ranking tool for high energy piping as it relates to the CPP (focus on Coyote Springs and eventually Beaver)</li> </ul>	<p><b>Value Derived:</b> PGE has utilized technical data provided in the forms to apply to our programs, developed internal forms based on EPRI provided examples, and incorporated guidelines into our project and program work. Specifics include the risk ranking for our high energy piping (e.g., where should we focus our efforts) and being able to identify and address dissimilar metal weld concerns before they become a significant event based on industry experience.</p>
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# Research & Development Project Summary

Date: 01/18/2019

**Project Name:** Cascadia Lifelines Project

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2020
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> James Landstrom</p> <p><b>Sponsoring Department:</b> Generation Engineering</p> <p><b>Project Team (internal):</b> Chris Dieterle</p> <p><b>Project Team (external):</b> Dan Cox, Mike Olsen, Armin Stuedlein, Vishvas Chalishazar (OSU)</p> <p><b>Project Description:</b></p> <p>Cascadia Lifelines Program is a targeted research consortium aimed at improving Oregon’s infrastructure resilience in a cost and value informed manner. Professor Dan Cox is the director of the program. Regular members at a cost of \$50,000/year are ODOT, PGE, NWN, BPA, Port of Portland. Being at this level provides a seat on the Joint Management Committee. This is an important because the Joint Management Committee determines the research projects. This is a continuation of PGE’s support over the last five years.</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$50,000/\$50,000</p> <p>FY19: \$50,000/\$50,000</p> <p>FY20: \$50,000</p> <p><b>Cost Share Total:</b> \$150,000</p> <p><b>Cost Share Percent:</b> 20%</p>
<p><b>Benefit to PGE:</b></p> <p>Data derived from Cascadia Lifelines will be used to develop economic risk values that will directly inform the budgeting for T&amp;D retrofits (near and long-term planning initiatives). This will in turn reduce the overall economic risk, make the grid more resilient and benefit the region.</p> <p><b>Customer Benefit:</b></p> <p>At the customer level, PGE will be able to prioritize projects that increase resiliency of our system which</p>	<p><b>Strategic Alignment:</b></p> <p>Build and operate a smarter, more resilient grid.</p>



# Research & Development Project Summary

serves the critical loads like hospitals, fire stations and rescue centers.

## Summary

### Synopsis of Project as Implemented:

In 2018, OSU in part used data from Cascadia Lifelines to complete a model that used additional data such as geo-spatial information, fragility functions, and the asset databases (type and location), to assign the probability of failures to all assets in scope. 100,000 Monte Carlo simulations (MC) were performed. Each MC simulation also enveloped the execution of the load-flow analysis. The model output gave the probability distribution of lost load which directly led to two main findings of the proof of concept. First, it led to development of the probability distribution of the consequence cost and second it identified PGE's 8 most consequential substations in the POC area. The MC simulation results also led to the development of a generalized restoration model. A working Monte Carlo model was also developed for the transmission consequences for blue sky day events.

### Performance Against Objectives/Deliverables:

Detailed Project Reports were delivered, including cost-benefit analysis. Two of three critical objectives were addressed:

1. Determine what parts of the Grid/Infrastructure are most vulnerable during a severe seismic event
2. Determine what changes to components/operations can increase Grid resiliency

### Decisions to be Made:

#### Next Steps:

Address the third major objective:

3. Determine how collaboration/cooperation between stakeholders can improve Grid resiliency.





# Research & Development EPRI Program Summary

Date: 01/31/2020

## EPRI Program/Project Name: EPRI P64 Boiler and Steam Turbine Cycle

**Project Status:**

- Complete
- Will Continue Next Year-Year to be Completed: End of 2020
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Maria Ouellette</p> <p><b>Sponsoring Department:</b> PSES</p> <p><b>Project Team (internal):</b> Bob Reller (former employee), new fleet chemist (TBD), Alex Banicki</p> <p><b>Project Team (external):</b> NA</p> <p><b>Project Description:</b> Joined EPRI program 64 to allow Fleet Chemist and others access to EPRI guidelines for optimal cycle chemistry control to provide long term asset protection, reduce overall operating costs, increase steam turbine efficiency, minimize chemical cleanings and increase operator knowledge of cycle chemistry. Inclusion in this program will be very essential in helping to shape not only the fleet chemist role, as this is a new role for PGE, but it will help PGE a cycle chemistry program that is smart, efficient, effective and lasting which will lead to long term success of an important aspect of thermal plant operations.</p>	<p><b>PGE Budget/Actual:</b> FY18: \$33,044/\$33,044 FY19: \$33,727/\$33,727 FY20: \$34,406/\$0</p> <p><b>Cost Share Total:</b> (if applicable) <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b> Access to this EPRI program provides us access to valuable operating experience, research, and other documentation as it relates to cycle chemistry. This is an area in the power generation industry that lends itself well to user experience and knowledge sharing from plant to plant. In addition to that, our fleet chemist recently left PGE. Access to the P64 catalog will provide the new hire for this position access to excellent information to help get them up to speed on cycle chemistry concerns.</p>	<p><b>Strategic Alignment:</b> Perform – Delivering operational excellence</p>

**Value**

<p><b>PGE Participation:</b> We have utilized our access to EPRI programs to</p>	<p><b>Value Derived:</b> We have utilized the information accessible</p>
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## Research & Development EPRI Program Summary

investigate new technologies and areas such as pressure wave cleaning technology and traveled to the EPRI conference in 2019. We have flipbooks/field guides from EPRI to utilize during upcoming outage inspections.

through EPRI to inform our design and operations for the Carty Water Treatment Plant project. We also plan to utilize the information available to help with onboarding and development of the new fleet chemist planned to be hired on in 2020.



# Research & Development EPRI Program Summary

Date: 02/10/2020

## EPRI Program/Project Name: Educating Power Engineers for a Future Distribution Grid

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2021
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Jay Landstrom</p> <p><b>Sponsoring Department:</b> R&amp;D</p> <p><b>Project Team (internal):</b> Jay Landstrom</p> <p><b>Project Team (external):</b> EPRI Staff</p> <p><b>Project Description:</b>                  The GREAT with Data initiative will develop and deliver T&amp;E materials (both professional and university training) to address issues for merging Grid Operations Technology (OT) and Information Technology (IT). The central theme is to create necessary T&amp;E activities for the next generation power engineers and data scientists, so they can design and develop the grid architecture and infrastructure to enable the integration of distributed energy resources (DER).</p> <p>The project will train, educate, and recruit qualified personnel into the electric utility industry through enhanced industry coordination and workforce readiness initiatives. New and revised university curricula will prepare incoming engineers and computer scientists for the newly evolving grid architecture and infrastructure. Further, this project will develop credentials for the training and education needed in the electric industry workplace to transform the grid.</p>	<p><b>PGE Budget/Actual:</b>                  FY19: \$10,000/\$10,000                  FY20: \$10,000/\$0</p> <p><b>Cost Share Total:</b> (if applicable)</p> <p><b>Cost Share Percent:</b> 8.3%</p>
<p><b>Benefit to PGE:</b>                  The GREAT with Data initiative will address T&amp;E for workforce skills in five key technical areas:</p> <ol style="list-style-type: none"> <li>1. Power system fundamentals;</li> </ol>	<p><b>Strategic Alignment:</b>                  Decarbonize                  Electrify</p>



# Research & Development EPRI Program Summary

2. Data science, including descriptive, prescriptive, and predictive analytics, and machine learning;
3. Cyber security;
4. Information and communication technologies (ICT) including increased grid interoperability and standardization; and
5. Integration of solar photovoltaic (PV) and other synergistic distributed energy resources (DER) such as energy storage, electric vehicles, demand response (DR), etc.

Access to this training will help PGE up-level the skills of current and new employees to meet the challenges of the emerging grid.

**Customer Benefit:**

Customers benefit by PGE developing a smarter grid that will enable greater amounts of DER's.

## Value

**PGE Participation:**

Attending advisory meetings in the Spring and Fall. Named affiliate universities to participate, PSU and OSU.

**Value Derived:**

Affiliate universities gain access to all educational materials. PGE has access to all materials in addition to a limited number of free spots to attend training seminars on emerging smartgrid topics.



# Research & Development EPRI Program Summary

Date: 2/25/2020

## EPRI Program/Project Name: Power Quality

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Joey Baranski</p> <p><b>Sponsoring Department:</b> Distribution Operations Engineering</p> <p><b>Project Team (internal):</b> Ken Spencer is the lead and other engineers provide additional support as needed.</p> <p><b>Project Team (external):</b> EPRI staff, utility peers, and others</p> <p><b>Project Description:</b> Power Quality has evolved to become a critical enabler of operation and economic excellence for modern electric utilities. Electric utilities worldwide consistently report that power quality (PQ) is a fundamental component of three key utility business performance metrics: grid system performance, utility economic performance, and customer satisfaction. A resurgence of interest in electric power quality performance is being driven by the need to increase the economic performance of existing infrastructure, reduce the cost of grid operations and repairs, manage and respond to increasing grid complexity, and retain existing and attract new load with excellent PQ performance and related customer support. Key among these are R&amp;D imperatives to use PQ expertise and knowledge to improve utility performance and management, maximize the proactive value of PQ data, and address increasing PQ issues that are inevitable with increasing edge-of-grid complexity.</p>	<p><b>PGE Budget/Actual:</b> FY18: \$123,447/\$123,447 FY19: \$126,002/\$126,002 FY20: \$113,502/0</p> <p><b>Cost Share Total:</b> (if applicable) <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b> The Power Quality research program offers fundamental insights on electrical grid power quality and compatibility to improve the value of electricity service for society. It may also contribute to</p>	<p><b>Strategic Alignment:</b> This project aligns with all three strategic imperatives.</p>



# Research & Development EPRI Program Summary

the overall public benefit of reliably supporting and integrating increasing levels of DER.

**Customer Benefit:** The Power Quality research program offers fundamental insights on electrical grid power quality and compatibility to improve the value of electricity service for customers. It may also contribute to the overall customer benefit of reliably supporting and integrating increasing levels of DER.

## Value

**PGE Participation:** Provides access to PQ expertise.

**Value Derived:** Access to expert PQ knowledge



# Research & Development EPRI Program Summary

Date: 02/18/2020

**EPRI Program/Project Name: P94**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor: Darren Murtaugh</b></p> <p><b>Sponsoring Department: RC509</b></p> <p><b>Project Team (internal): Darren Murtaugh</b></p> <p><b>Project Team (external): Ben Kaun</b></p> <p><b>Project Description:</b>                  This program covers research related to energy storage and fueled distributed generation (DG) technologies. The scope covers energy storage connected to utility transmission system, distribution system, and customer premises. These technologies may provide a range of services and benefits to different stakeholders, including stacked services. It also covers fueled DG of less than 10 MW capacity, such as fuel cells or combined heat and power (CHP) connected to the utility distribution system or customer premise. The research covers and integrates multiple activities, including technology evaluation, economic and technical modeling to support grid planning and operations, and field demonstration, with a goal to support energy storage technology options and integration approaches which are safe, reliable, cost-effective, and environmentally responsible.</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$100,438/\$100,438</p> <p>FY19: \$104,456/\$104,456</p> <p>FY20: \$102,522/\$0</p> <p><b>Cost Share Total:</b> (if applicable)</p> <p><b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b>                  Program development for energy storage offerings, energy storage as a grid resource to support a more decarbonized resource portfolio, energy storage as a T&amp;D resource to support a more flexible and more reliable system including Microgrid support and expansion of Hosting Capacity</p> <p><b>Customer Benefit:</b>                  Program development for energy storage offerings, energy storage as a grid resource to support a more decarbonized resource portfolio, energy storage as a T&amp;D resource to support a more flexible and more</p>	<p><b>Strategic Alignment:</b></p> <p>Decarbonize</p>



# Research & Development EPRI Program Summary

reliable system including Microgrid support and expansion of Hosting Capacity	
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## Value

<p><b>PGE Participation:</b></p> <p>Webinars, twice-annual advisory meetings, and access to web portal</p>	<p><b>Value Derived:</b></p> <p>Reports on resiliency initiatives at other utilities, including examples of installations, cost/benefit and lessons learned. Examples of Non-wires Alternatives installations. Insights into technology development, as well as current fire safety practices and standards. Review of various use cases and operational trends for energy storage at other utilities.</p>
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# Research & Development EPRI Program Summary

Date: 03/06/2020

**EPRI Program/Project Name: EPRI 161**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: Ongoing
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor: David Worth</b></p> <p><b>Sponsoring Department:</b> RC712 DCIO Smart Grid</p> <p><b>Project Team (internal): David Worth, Joey Baranski, Kellie Cloud, Jess Borrevik, Dale Walker</b></p> <p><b>Project Team (external): Donald Von Dollen, Gerald Gray, Ed Beroset, Patricia Brown, Sean Crimmins</b></p> <p><b>Project Description:</b> (From proposal)</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$174,630/\$174,630 FY19: \$184,196/\$184,196 FY20: \$163,596/0</p> <p><b>Cost Share Total:</b> (if applicable) <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b> Research and Development cooperation between utilities in order to deliver grid modernization. Includes architectures, designs, and pilots that enable utilities to partner with vendors to deliver utility operations.</p> <p><b>Customer Benefit:</b> Shared research efforts and collaboration ensure that PGE is reviewing decisions and factors common across North American and international utilities for functionality, cost, reliability, and performance.</p>	<p><b>Strategic Alignment:</b></p> <p>This aligns to all three imperatives, Decarbonization through specific research into DER adoption and enablement, Electrification through the delivery of grid connected DERs like electric fleet and consumer vehicles and perform through shared information about costs and business cases for enablement at a good cost.</p>

**Value**

<p><b>PGE Participation:</b></p> <p>EPRI meetings and workshops</p>	<p><b>Value Derived:</b></p>
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## Research & Development EPRI Program Summary

Cyber Security Project Set Webcasts	Direct and provide feedback on EPRI research efforts, learn about the results of prior research efforts.
Interoperability webcasts	Low cost, no travel, receipt of research and intelligence on cyber protection and security as it relates to utility operations. This is interlinked between 161E (Enterprise Architecture and Integration) being the foremost, and 183 Cyber Security
Technology transfer webcasts	Define and drive open standard adoption to increase market choices and interoperability between systems, including the convergence of Operational Technology and Information Technology
	Receipt of specific learnings and materials from demonstration projects



# Research & Development EPRI Program Summary

Date: 01/31/2019

## EPRI Program/Project Name: P174 Integration of Distributed Energy Resources

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Harris</p> <p><b>Sponsoring Department:</b> 565</p> <p><b>Project Team (internal):</b> Derrick Harris, Amrit Rajagopal (DRIVE); Josh Davis (Distribution Interconnections)</p> <p><b>Project Team (external):</b> Matthew Rylander, Aminul Hague, Brian Seal, Nadav Enbar, Lindsey Rogers</p> <p><b>Project Description:</b> Participation in the EPRI Integration of DER research portfolio. Research covers tools and methods for planning and operating a more integrated distribution system in a changing landscape with increased penetration of Distributed Energy Resources (DER). Also included are valuation mechanisms for DERs and insights into utility interconnection practices and strategies related to future integration approaches.</p>	<p><b>PGE Budget/Actual:</b> FY18: \$71,258/\$71,258 FY19: \$74,593 /74,593 FY20: \$75,288/0</p> <p><b>Total Program Cost:</b> \$4.5m <b>Cost Share Percent:</b> 2%</p>
<p><b>Benefit to PGE:</b> Provides supporting documentation, workshops, and analytical tools regarding managing interconnection requests, grid control applications, and integration of DER.</p> <p><b>Customer Benefit:</b> Provide pathway for more transparent information to the customer regarding feeder DER, hosting capacity, etc. Will lead to a more visible and configurable system that will be analyzed through future ADMS. Provides groundwork for future initiatives aimed at increasing system reliability.</p>	<p><b>Strategic Alignment:</b> Addresses Hosting Capacity Initiative and related requirements. Addresses management of interconnection requests, and rules/regulations related to these requests. Inform content and requirements for assembling a Distribution Resource Plan.</p>



# Research & Development EPRI Program Summary

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## Value

<p><b>Synopsis:</b></p> <p>2019 Focus: Learning, utilizing DRIVE tool to perform feeder hosting capacity.</p> <p><b>PGE Participation:</b></p> <p>Continued participation in EPRI's DRIVE working group. Worked with EPRI and other utilities in further development of the tool. Enabled Planning Engineers to produce rudimentary hosting capacity maps for distribution feeders.</p> <p>Utilized EPRI DER Database tool, utilized research/reports to better understand DER modeling and inverter functions.</p> <p>Participated in webinars related to Energy Storage and Inverter standards.</p> <p>Advisory meeting representation.</p>	<p><b>Value Derived:</b></p> <p>Further development of the DRIVE tool will enable additional parameters for more informed accurate analysis. Tool will be further developed and utilized as basis of hosting capacity analysis in distribution planning studies.</p> <p>PGE DER interconnection standard final (ver 1) draft was produced via P174 reports as reference material.</p> <p>Research tools/materials were utilized to aid in research of interconnection rules related to new IEE 1547 standard.</p>
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# Research & Development EPRI Program Summary

Date: 02/07/2020

## EPRI Program/Project Name: P180 Distribution System Research

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: Multiyear commitment with EPRI due to emerging issues on distribution
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Jay Landstrom</p> <p><b>Sponsoring Department:</b> R&amp;D</p> <p><b>Project Team (internal):</b></p> <p><b>Project Team (external):</b></p> <p><b>Project Description:</b>                  Research addressing the asset life-cycle is designed to improve utilities' ability to acquire, operate, maintain, and dispose of distribution assets. This research can produce results impacting specifications, inspection tools, maintenance practices, fleet management, and other key aspects of distribution owners' responsibilities.                   Examples of assets addressed in this program include wood poles, transformers, reclosers, cable terminations, and overhead conductor. Examples of industry issues include use of reliability metrics, fleet management approaches, safety, and resiliency.</p>	<p><b>PGE Budget/Actual:</b>                  FY18: \$129,765/\$129,765                  FY20: \$130,020/\$0</p> <p><b>Cost Share Total:</b> \$5.25 million  <b>Cost Share Percent:</b> 2.5%</p>
<p><b>Benefit to PGE:</b></p> <ul style="list-style-type: none"> <li>• Enhance safety of utility workers and the public regarding distribution assets</li> <li>• Improve specifications for new assets</li> <li>• Develop maintenance practices based on a technical basis</li> <li>• Reduce maintenance costs</li> <li>• Proactively plan capital and maintenance budgets</li> <li>• Increase distribution system resiliency</li> <li>• Improve asset and system reliability</li> </ul>	<p><b>Strategic Alignment:</b>                  Perform                  Electrify</p>



# Research & Development EPRI Program Summary

<p><b>Customer Benefit:</b></p> <p>Improved and more efficient operations, increased reliability, and increased safety.</p> <p>Participation in this program allows PGE to leverage over \$5 million worth of research activities for a low cost.</p>	
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## Value

<p><b>PGE Participation:</b></p> <p>Participation in Advisory meetings to gain insight and influence research direction.</p> <p>Participation in supplemental research areas, such as new methods to inspect and detect failing wood poles and crossarms using hyperspectral imagery. PGE has sent examples of bad order crossarms for analysis.</p> <p>Participation in combining utility data to use with AI to gain better insights.</p>	<p><b>Value Derived:</b></p> <ul style="list-style-type: none"> <li>• Improve specifications, inspection and maintenance approaches, and workmanship practices associated with underground switches and cable accessories</li> <li>• acquire strategic intelligence on emerging technologies</li> <li>• increase engineering staff expertise in overhead distribution</li> <li>• improve the quality in overhead distribution system design</li> <li>• lower overhead distribution maintenance costs</li> <li>• gain more accurate and timely knowledge about asset condition and life expectancy</li> <li>• improve system reliability and safety and reduce environmental impacts</li> </ul>
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# Research & Development EPRI Program Summary

Date: 03/03/2020

## EPRI Program/Project Name: P-183 PDU Cyber Security

**Project Status:** Green

Complete

Will Continue Next Year

- Year to be Completed:

Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Christian Nolke  <b>Sponsoring Department:</b> 775  <b>Project Team (internal):</b> Lance Howard  <b>Project Team (external):</b> Galen Rasche  <b>Project Description:</b></p> <p>Cyber and physical security have become critical priorities for electric utilities. The evolving electricity sector is increasingly dependent on information technology and telecommunication infrastructure to ensure the reliability and security of the electric grid. Specifically, measures to ensure cyber security must be designed and implemented to protect the electric grid from both cyber and physical attacks by terrorists and hackers, and to strengthen grid resilience against natural disasters and inadvertent threats such as equipment failures and user errors.</p> <p>The Cyber Security Program of the Electric Power Research Institute (EPRI) focuses on addressing the emerging threats to an interconnected electric sector through multidisciplinary, collaborative research on cyber security technologies, standards, and business processes.</p>	<p><b>PGE Budget/Actual:</b>  FY18: \$91,691/\$91,691  FY19: \$95,642/\$95,642  FY20: \$95,913</p> <p><b>Cost Share Total:</b> (if applicable)  <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b></p> <p>EPRI's Cyber Security Program can provide the following benefits to members and the public:</p> <ul style="list-style-type: none"> <li>• A better awareness of industry and government collaborative efforts, where members can "plug in" to current activities;</li> </ul>	<p><b>Strategic Alignment:</b></p> <p>Electrify  Operational Efficiency</p>



# Research & Development EPRI Program Summary

- Guidance on developing cyber security strategies and requirements for selecting effective technologies;
- Guidance on security metrics;
- Techniques for assessing and monitoring risk;
- Practical approaches to mitigating the risk of operating legacy systems;
- Early identification of security gaps through laboratory assessments of security technologies; and
- Technologies which support the management of cyber incidents and increase the cyber security and resiliency of the grid.

**Customer Benefit:**

EPRI allows PGE to offset research costs associated with cyber security activities. PGE spends less than \$100,000 to gain knowledge through EPRI labs for testing security tools within a utility. It has also provided research on security tools and techniques are best with operational technologies. Customers benefit from these activities through reducing cyber security related events. They also benefit from the research as PGE continues to focus on securing the grid to ensure that is reliable and resilient.

## Value

**PGE Participation:**

The P-183 project allows multiple organizations within PGE to work together. Currently we have representatives from T&D, Generation, and IT that are actively engaged in many of these projects.

We have shared documentation with our grid operations organization for ADMS security practices that need to be part of the consideration of our implementation.

We are regularly engaged in meetings and are advisors on many of the projects that are associated with the projects under P-183. We attend technical meetings and advisory meetings that help shape the projects.

**Value Derived:**

**Information Assurance:** EPRI focuses on security challenges that affect multiple operations domains, such as designing security into products, creating security metrics for the electric sector, and developing technical solutions for meeting security compliance requirements. In 2017, EPRI:

- Built on the 2016 [Cyber Security Architecture Methodology report \(3002005942\)](#) to include attack surface analysis for microgrids.
- Built on the 2016 security metrics research to create the *Developing Security Metrics for the Electric Sector Technical Update (3002010426)*, which describes the details of





# Research & Development EPRI Program Summary

security metrics pilot projects and resulting metric formulae, along with guidelines, insights and new knowledge gained through this research.

- Updated the Security, Cyber, Risk Assessment Methodology (SCRAM) database (3002010421).

### Cyber Security Forensics

Members can apply the results of this forensics project to guide the development of their cyber security forensics program, which will serve as a key component of their incident management program.

Forensics next steps 2020: • Perform additional device use case studies • Draw conclusions across findings from multiple devices • Document abstracted common processes, best practices, and analysis approaches in general forensics guidebook

### Threat Management

Threat Automation Playbooks: Cyber Security. By using force multiplier threat automation tools can be used to automate tasks that security analysts might otherwise have to work through manually. Focus is on the considerations and requirements for ICS or OT threat automation including the following:  
•Threat automation for OT playbook recommendations •Threat automation for OT playbook examples

Identify and address challenges to applying Security Orchestration and Automation Response (SOAR) tools in a utility system. Security Orchestration and Automation Response (SOAR) Tool OT Gap Analysis report will evaluate the use of Security Orchestration and Automation Response (SOAR) tools in an OT environment. It will help articulate and plan how to address gaps in SOAR tools that are preventing OT integration.

### Asset and Configuration Management

Automating Asset and Configuration Management: Substation Devices. The typical ICS environment may use a wide range of devices that are managed through proprietary vendor configuration tools and device interfaces. These proprietary tools and legacy technologies combine to present utility engineers with several challenges for those attempting to effectively manage ICS infrastructure.

Leverage approaches for the exchange of information between passive monitoring systems (IDS) and active device management systems. Standardization through the development of an information model that describes relevant device



# Research & Development EPRI Program Summary

characteristics. An Integrated Solution for Monitoring and Managing Substation Devices (Technical Update) - This report will leverage past research focused on asset identification and management to evaluate potential integrated solutions for automating the substation device management process from commissioning through operations and maintenance. Additional plans for 2020 research include the following Securing Control Centers: • Cybersecurity Training for Grid Operators (Supplemental) • Distribution Operations Cybersecurity Drill (Collaboration-P200) • Emergency Control Center Network Isolation Technology and Processes • DNP Secure Authentication v6: Interoperability Plugfest (Supplemental) Securing Field Systems: • Remote IED Management for Field Systems (Collaboration-P180) • Field Management of Cyber and Physical Security for Distribution Automation (Collaboration-P180) • LTE Security Assessment (Supplemental-P161)

### Cyber Security Architecture

The objective of this project is to create a set of reference security architectures for the systems supporting the power grid. In 2019, the project focused on the network security architecture for DER integration. 3002016781 EPRI Security Architecture for the Distributed Energy Resources Integration Network: Risk Based Approach for Network Design - provides a practical set of cybersecurity requirements pertaining to the network components supporting distributed energy resources (DER) communications. Continuing the effort to create reference security architectures, the project will focus on security architecture for microgrid integration. The system components and characteristics specific to microgrid will be closely examined and security recommendations will be offered for both utility-owned and operated systems and systems in the customer site. Planned deliverable: Security Architecture for Microgrid Integration.

### Cyber Security for DER & Grid-Edge Systems

This project examines various topics related to the cyber security of DER and grid-edge systems. The topics may include • Security engineering topics (smart inverter security, secure communication, cryptography, etc.) • Security application areas (cyber security for PV integration, energy storage, EV, microgrid, etc.) In 2020, the project will focus on



## Research & Development EPRI Program Summary

	<p>communication protocol security. Through in-depth examination of IEEE 2030.5 (one of the three mandatory protocols for smart inverter communication according to IEEE1547-2018), the project will discuss the requirements, issues, and recommendations for secure DER communication. The analysis will not only suggest the path forward for enhancing the security of IEEE 2030.5, but also help the development of security options for other protocols widely used in DER integration. Planned deliverable: Security Assessment of IEEE 2030.5 for DER integration.</p>
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# Research & Development EPRI Program Summary

Date: 01/31/2020

## EPRI Program/Project Name: P200 Distribution Operations and Planning

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Harris</p> <p><b>Sponsoring Department:</b> 565</p> <p><b>Project Team (internal):</b> Derrick Harris, Justin Graff (Distribution Automation), Ricardo Garcia (Underground Networks)</p> <p><b>Project Team (external):</b> Jeff Smith</p> <p><b>Project Description:</b> Participation in the EPRI Distribution Operations &amp; Planning research portfolio. The mission of EPRI's Distribution Operations and Planning research program is to equip distribution planners and operators with the means necessary to meet the challenges of today and tomorrow. This includes the supporting and development of new planning processes and frameworks, models, tools, reliability assessment analytics, as well as incorporation of new automation, protection, and control technologies that will be required to transform the current distribution system into an active distribution system that integrates and uses new distributed technologies.</p>	<p><b>PGE Budget/Actual:</b> FY18: \$55,676/ \$55,676 FY19: \$60,124/ \$60,124 FY20: \$60,551/ \$0</p> <p><b>Total Program Cost:</b> \$2.5m</p> <p><b>Cost Share Percent:</b> 2%</p>
<p><b>Benefit to PGE:</b> Provides supporting documentation, workshops, analytical tools, and programs to enhance the distribution operation and planning process.  Approaches to P200 has informed PGE's future path regarding Distribution Resource Planning.</p> <p><b>Customer Benefit:</b> Project provides tools aimed at enhancing and modernizing the distribution system. Provides</p>	<p><b>Strategic Alignment:</b> Helps deliver a modernized grid platform for a clean energy future. Addresses PGE's Distribution Automation Initiative; will enhance the study process related to future installation of DA schemes.  Will continue to inform DRP and related processes moving forward.</p>



# Research & Development EPRI Program Summary

resources necessary to inform decision-making and enhance system reliability.

## Value

### Synopsis:

2019 Focus:  
Distribution System Modeling.  
Incorporating Distribution Automation into Planning Tools.  
Determine direction/next steps for implementing enhanced planning tools that will address DSP-related items.

### PGE Participation:

Further development and implementation of the DA Placement tool. Utilized this tool to study and scope DA integration for 24 feeders. Contributed to Paper “Optimal Distribution Automation Switch Placement” which will be presented at Chicago IEEE conference in 2020.

Participated in supplemental project “Modernizing Distribution Planning Using Automated Processes and Tools.” Project kicked off in Spring 2019. Group meeting occurred in June 2019. Project will introduce software solutions which will support scenario planning, sensitivity assessments, forecasting, and project evaluation.

Various Webinars, various research papers for education. Utilized the Underground Database Tool. Utilized the Protection Analysis tool.

### Value Derived:

DA tool has improved process/efficiencies in performing analyses. Moving forward, this tool will be utilized to determine the most optimal location(s) for automated switches.

Participation in future programs related to tool development will enhance planning processes and will allow PGE to continue to be a leading contributor during the product development phase.



# Research & Development EPRI Program Summary

Date: 2/25/2020

## EPRI Program/Project Name: PQ Knowledge Development & Transfer

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Joey Baranski</p> <p><b>Sponsoring Department:</b> Distribution Operations Engineering</p> <p><b>Project Team (internal):</b> Ken Spencer is the lead and other engineers provide additional support as needed.</p> <p><b>Project Team (external):</b> EPRI staff, utility peers, and others</p> <p><b>Project Description:</b> EPRI's core Power Quality (PQ) program "PQ Knowledge" provides the essential information and resource tools needed to help eliminate our customer's economic losses and allow PGE to remain at the forefront of PQ knowledge. This program will provide access to their Power Quality Hotline services that are considered the most knowledgeable team in the world on PQ issues. EPRI will provide newsletters, email updates, and Web access detailing their on-going R&amp;D programs and changes in electrical standards that will affect PGE and our customers. Discounts on training programs, PQ conferences, and ability to participate in Tailored Collaboration (TC) projects will be available</p>	<p><b>PGE Budget/Actual:</b> FY18: \$20,000/\$20,000 FY19: \$10,000/\$10,000 FY20: \$20,000/0</p> <p><b>Cost Share Total:</b> (if applicable) <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b> A power quality center of excellence is available to PGE engineers.</p> <p><b>Customer Benefit:</b> A power quality center of excellence is available to PGE engineers. PGE engineers use available resources to solve difficult customer power quality problems. The knowledge</p>	<p><b>Strategic Alignment:</b> This project aligns with all three strategic imperatives.</p>



# Research & Development EPRI Program Summary

base can also be used to inform design and standard changes.	
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## Value

<b>PGE Participation:</b> Provides access to PQ expertise.	<b>Value Derived:</b> Access to expert PQ knowledge
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# Research & Development Project Summary

Date: 12/15/2019

**Project Name: Voice of the Customer**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor: Hema Sundaram</b></p> <p><b>Sponsoring Department:</b> IT</p> <p><b>Project Team (internal):</b> IT, Market Insights, Corp Comm</p> <p><b>Project Team (external):</b> OSU Business Analytics Students</p> <p><b>Project Description:</b>                  PGE collects structured and unstructured data from Social Media (Sprinklr), Customer Surveys (Maritz), and other unstructured data from Maritz.                   We want the OSU students to correlate these datasets and model next action options to drive customer delight.</p>	<p><b>PGE Budget/Actual:</b>                  FY18: \$0/\$0                  FY19: \$15,000/\$15,000</p> <p><b>Cost Share Total:</b> (if applicable)  <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b></p> <ul style="list-style-type: none"> <li>• Active energy management</li> <li>• Making the right investments to improve customer satisfaction</li> <li>• Get an improved understanding of the customer needs and pains</li> </ul> <p><b>Customer Benefit:</b></p> <ul style="list-style-type: none"> <li>• Better customer experience. This was a one-time study done with the students and it was focused towards PGE understanding the customers' voices so that we can create a richer experience.</li> <li>• The study brought up a few key things that the team took action on. For e.g., Spanish site having a survey in English, too many surveys on each page etc. These are a few</li> </ul>	<p><b>Strategic Alignment:</b>                  Eliminating customer friction</p>





# Research & Development Project Summary

<p>examples of how it has helped us improve the customer experience</p> <ul style="list-style-type: none"> <li>Anything that stops us from delivering business benefit or value to our customers creates friction between us and them. Using the text analysis, the customer group was able to identify a few key pain points. They now have a roadmap to redesign bills, customer website, etc. based on the feedback.</li> </ul>	
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## Summary

<p><b>Synopsis of Project as Implemented:</b> The students completed the following</p> <ol style="list-style-type: none"> <li>1.1. Correlate the following structured and unstructured datasets using text analytics to obtain topics of interest (or pain) and their inter-relationships for PGE customers Social Media: Sprinklr Customer Surveys: Maritz Unstructured data: Maritz (VOC)</li> <li>1.2. Develop geo-tagging functions</li> <li>1.3. Correlate the geo-tagging functions and topics of interest to identify where the topics are emanating and whether there are similar topics coming from the same region</li> <li>1.4. Make recommendations on how to improve the customer satisfaction</li> <li>1.5. Make recommendations on how to utilize the geo-tagging function with voice (just like tweets)</li> </ol> <p><b>Performance Against Objectives/Deliverables:</b> OSU students delivered what we asked of them</p>	<p><b>Decisions to be Made:</b> None</p> <p><b>Next Steps:</b> Project has been closed</p>
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# Research & Development Project Summary

Date: 03/03/2020

**Project Name:** Biglow Wake Effects - PSU

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Jaisen Mody</p> <p><b>Sponsoring Department:</b> PSES</p> <p><b>Project Team (internal):</b> Alex Triplett</p> <p><b>Project Team (external):</b> Raúl Bayoán Cal</p> <p><b>Project Description:</b></p> <p>In the observation of wind turbine arrays, it is known that wake-to-wake interactions in a wind farm play a large role in the decrease of its efficiency and thus power extraction suffers from these non-linear interactions. The following hypothesis is posed: Derating upstream turbines enables further flow passage, allotting increased resources to turbines within the wind farm, and therefore, possibly increasing the overall performance of the farm. In the Biglow Canyon wind farm, specifically, Siemens 2.3MW turbines (or otherwise phase 3) could be improved by manipulating the Vestas V82 (1.65MW) turbines (phase 1). Wind tunnel experiments at Portland State University will be conducted to validate the conjecture as brought by the two posed questions in the Learning Objective. The experiments will have an installation of a single turbine as well as a 4x3 wind farm for which resistances (loads) will be varied for the upstream rows and voltages will be measured on the downstream turbine (Note: variable loads equate to the proposed derating). All will be scaled to be consistent with prior experiments. The voltages will be recorded at a sufficiently high frequency as well as its record length will be long enough to arrive at converged statistics for the differences due to derating. This is a continuation of a 2016 R&amp;D project</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$35,000/\$35,000</p> <p>FY19: \$35,000/\$35,000</p> <p><b>Cost Share Total:</b> NA</p> <p><b>Cost Share Percent:</b> NA</p>
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# Research & Development Project Summary

<p>– evaluating means of decreasing wake effects at Biglow Canyon.</p>	
<p><b>Benefit to PGE:</b> PGE has a better core understanding of how wind turbine wakes can affect adjacent turbine performance. PGE also has insight into opportunities to mitigate wake effects on wind turbines (pitch deflection, yaw deflection, and derating).</p> <p><b>Customer Benefit:</b> Optimizing wake impacts of Biglow phase 1 could increase Annual Energy Production of the site.</p>	<p><b>Strategic Alignment:</b> This project addressed the corporate imperatives of Decarbonize and Perform.</p>

## Summary

<p><b>Synopsis of Project as Implemented:</b> The team at PSU has taken this research effort as far as possible with theoretical/modelling approaches. The next step is to do field testing. Further hypothetical wake effect research is not required.</p> <p><b>Performance Against Objectives/Deliverables:</b> Project deliverables met the objective.</p>	<p><b>Decisions to be Made:</b> PGE is evaluating Biglow 1 SCADA upgrades that could include wake mitigation algorithms.</p> <p><b>Next Steps:</b> None</p>
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# Research & Development Project Summary

Date: 01/29/2020

## Project Name: Construction Safety Research Alliance (CSRA)

### Project Status:

- Complete
- Will Continue Next Year
  - Year to be Completed: 2023
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> William M. Messner</p> <p><b>Sponsoring Department:</b> Safety Security &amp; Resiliency</p> <p><b>Project Team (internal):</b> William Messner, Alden Streatly</p> <p><b>Project Team (external):</b></p> <p>There are currently 28 members; California Resources Corporation, Caterpillar, CenterPoint Energy, Cheniere, Chevron, ConocoPhillips, Consolidated Edison, Enable Midstream, Enbridge, Eversource, Exelon, Graham Construction, Honeywell, Laney Group, Marsh, Mastec, Otis Elevator Company, Price Gregory International, Quanta Services, Remote Medical International, Sabic IP, Southern Company, Southern California Edison, TC Energy, Technip FMC, Tennessee Valley Authority, Wolfcreek Group, Xcel Energy</p> <p><b>Project Description:</b></p> <p>The alliance of industry leaders (currently 29 members) and experienced scientists focuses on transformative construction safety research. The CSRA is a forum where: new safety ideas and innovations are tested; industry members actively participate in safety research; and new safety technologies are efficacies are explored. The two current projects are A. Quality-based safety leading indicators and, B. Predictive analytics. The research is field based and typically involve teams of 10 to 15 industry practitioners and 2 to 3 academics. The group meets three to four times per year to discuss ongoing CSRA research, identify data sources, conduct trials, interpret findings, create implementation resources, and present results. The</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$0/\$0 FY19: \$15,000/\$15,000</p> <p><b>Cost Share Total:</b></p> <p>PGE's 1-year leverage for the CSRA Alliance is 28:1. For every dollar PGE invests, we are leveraged by 28 other companies (\$15,000: \$420,000)</p> <p><b>Cost Share Percent:</b></p> <p>N/A</p>
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# Research & Development Project Summary

<p>research is led by Dr. Matthew Hallowell of the University of Colorado.</p>	
<p><b>Benefit to PGE:</b></p> <p>This research is safety based and will contribute to identifying new ways to improve PGE's safety performance. If an injury free work place is created and significant injuries and fatalities are avoided it will become a competitive advantage and result in avoided costs and a more productive workforce.</p> <p><b>Contacts</b></p> <p><b>Customer Benefit:</b></p> <p>The research should benefit operational efficiency by having an available workforce that can be productive for our customers, which will result in enhanced customer service, due to less injuries occurring to PGE employees. Furthermore, that information/research can improve the safety performance of our construction service providers as well, which should result in less expensive contracts.</p>	<p><b>Strategic Alignment:</b></p> <p>Participation in CSRA Alliance meets the company's strategies of delivering operational excellence and competitive financial returns.</p> <p>By our participation in this Alliance we leverage other companies best practices and gain insight how to operate more efficiently in safety. In addition, we are able to obtain tools to help us make better decisions. These improvements reduce injuries, increase work per manhour, and make us more reliable.</p>

## Summary

<p><b>Synopsis of Project as Implemented:</b></p> <ul style="list-style-type: none"> <li>A. The quality-based safety leading indicators tool is currently under review for the best safety attributes. Once finalized, the Alliance will use the Delphi method to arrive at a consensus for these indicators and then will begin validation and testing. The plan is to use this insight for PGE's tailboard, and safety auditing, into 2020.</li> <li>B. The CSRA Community of predictive analytics in energy-based recognition meetings have Alliance companies sharing how they incorporate their energy-based hazard recognition into their companies and lessons learned.</li> </ul> <p><b>Performance Against Objectives/Deliverables:</b></p> <p>We have met all objectives in 2019 and will continue</p>	<p><b>Decisions to be Made:</b></p> <ul style="list-style-type: none"> <li>A. The CSRA Alliance is still working on finalizing the quality-based safety leading indicator tools.</li> </ul> <p>Once the leading indicator tool is finalized, we will need to decide how to incorporate these into Safety Security, &amp; Resiliency, Operations and Utility Operation Support.</p> <ul style="list-style-type: none"> <li>B. We will continue to learn from the Predictive Tool Alliance companies sharing on how they incorporated energy-based hazard recognition and look for ways to incorporate.</li> </ul> <p><b>Next Steps:</b></p> <p>Attend CSRA Alliance meetings into 2020 and determine how best to incorporate these safety leading indicators into our existing efforts.</p>
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# Research & Development Project Summary

to attend in person and teleconference meetings.	
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# Research & Development Project Summary

Date: 02/06/2020

## Project Name: Microgrid Feasibility Study

### Project Status:

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor: Frederick Harris</b></p> <p><b>Sponsoring Department:</b>595</p> <p><b>Project Team (internal):</b> Frederick Harris, Brandon Prescott, Ricardo Garcia, Darren Murtaugh, Jill King</p> <p><b>Project Team (external): Power Engineers, OHSU</b></p> <p><b>Project Description:</b>                  This project evaluates the feasibility of utilizing existing customer-owned generating resources to form a microgrid within PGE’s service territory. Analyses were performed to determine equipment and infrastructure needs to allow selected areas on the OHSU Marquam Hill campus to form independent electrical islands. The ensuing study initially reviewed several potential islands on OHSU’s Marquam Hill campus and identified the capability and limitations of meeting energy requirements via existing onsite generation. The second phase of this study identified limitations of onsite generation and medium voltage assets for each island and reviewed the capabilities and benefits of adding energy storage devices. In order of priority, the initial islands identified were the OHSU South Campus (including Dornbecher’s Children’s Hospital), the OHSU Central Campus (including the Hatfield Research Center, South Hospital, and Kohler Pavilion), the OHSU East Campus (including the Casey Eye Institute), and the OHSU North Campus which consists primarily of research and administrative buildings.</p>	<p><b>PGE Budget/Actual:</b>                  FY18: \$0/\$0                  FY19: \$75,000/\$69,160.52</p> <p><b>Cost Share Total:</b> N/A  <b>Cost Share Percent:</b> N/A</p>



# Research & Development Project Summary

<p><b>Benefit to PGE:</b></p> <p>Research results will provide PGE with the necessary information to implement a Microgrid at a customer's location. Results provide the physical requirements (distribution upgrades and generation addition) to prepare for a related project.</p> <p><b>Customer Benefit:</b></p> <p>Informs the customer on what will be needed to procure a self-sufficient grid system that has capability to fully island itself. Allows the customer to better align its future plans to consider the development of area microgrids in the future.</p>	<p><b>Strategic Alignment:</b></p> <p>Deliver exceptional Customer Service Build and operate a smarter, more resilient grid</p>
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## Summary

<p><b>Synopsis of Project as Implemented:</b></p> <p>In this project, contractors worked with OHSU staff to collect localized metering data and re-establish islands (or areas of isolation) within the Marquam Hill campus. Future/proposed projects on the OHSU campus were considered when making this assessment. Studies were performed in CYME to identify circuit limitations and help determine mitigation strategies regarding distribution system upgrades and additional resource needs. The final (expected) deliverable was a report describing the process and making determinations regarding the feasibility of the project.</p> <p><b>Performance Against Objectives/Deliverables:</b></p> <p>Timelines were extended from Q3 2019 to Q4 2019 due to some initial trouble in gathering meter data from all OHSU facilities. Objectives and deliverables were met.</p>	<p><b>Decisions to be Made:</b></p> <p>Results were presented to OHSU in November, 2019. To move forward, OHSU will need to continue to construct buildings with proposed generation as planned. PGE and OHSU will need to determine where a Microgrid Project will fit into the future scheme.</p> <p><b>Next Steps:</b></p> <p>Focused meeting with OHSU SMEs to determine best fit (proposed islanding) and potential timelines to implement a Microgrid. Commitments will be needed from both parties to begin a next phase of detailed study and design.</p>
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# Research & Development Project Summary

Date: 02/14/2020

**Project Name: NEEA End-use reasearch**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2022

Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Andy Eiden</p> <p><b>Sponsoring Department:</b> Smart Cities &amp; Grid Products (formerly Consumer Energy Solutions)</p> <p><b>Project Team (internal):</b></p> <ul style="list-style-type: none"> <li>• Andy Eiden, Steering Committee Member</li> <li>• Ashleigh Keene, Working Group Member</li> </ul> <p><b>Project Team (external):</b></p> <ul style="list-style-type: none"> <li>• David Clement, NEEA, Project Manager</li> <li>• Residential vendor, Evergreen Economics</li> <li>• Commercial vendor, DNV-GL</li> <li>• Steering Committee, various participants</li> <li>• Working Group, various participants</li> </ul> <p><b>Project Description:</b></p> <p>This project involves participating in the End Use Load Research (EULR) Project being managed by NEEA. The purpose of the EULR project is to obtain a representative sample of electric end use load shapes, as this data has not been collected since the 1980s. This data will be collected continuously over a five-year period and will be accessible through an online database to participating parties. Detailed end use data has several important uses for PGE, including informing our deep decarbonization planning, demand response planning, bottom-up forecasting, and rate design.</p>	<p><b>PGE Budget/Actual:</b></p> <p>2018: \$130,000/ \$130,000                  2019: \$130,000/\$130,000                  2020: \$130,000/\$0                  2021: \$130,000                  2022: \$130,000  <b>Total: \$650,000</b></p> <p><b>Cost Share Total:</b></p> <p>The total 5-year budget for the project is \$12.7 million, of which PGE is contributing \$650k. The remaining budget will be covered by the other member utilities as well as regional stakeholders such as the Energy Trust and BPA, and the US Department of Energy.</p> <p><b>Cost Share Percent:</b></p> <p>PGE's share of the total 5-year project budget is 5%.</p>
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# Research & Development Project Summary

<p><b>Benefit to PGE:</b></p> <p>The data collected as part of this study will be a critical input as we take on a more distributed view of planning and resource deployment. The end use load data will inform the deployment, forecasting, and analysis of deep decarbonization measures on our grid. It will also improve our ability to conduct granular, bottom-up load forecasting to inform distribution resource planning efforts.</p> <p><b>Customer Benefit:</b></p> <p>Research from this project will help PGE better plan and develop programs that fit customer lifestyles and meet their desire for clean, reliable energy.</p>	<p><b>Strategic Alignment:</b></p> <p>This research project is an example of PGE’s commitment to investing in a reliable and clean energy future, and building and operating a smarter, more resilient grid. Underlying both strategic initiatives is a detailed, empirical understanding of how our customers use electricity so that we can develop accurate forecasts and effective demand response programming.</p> <p>Collaborating with regional partners to improve shared data sources and increase our understanding of behind-the-meter consumption patterns is also evidence of PGE’s drive to pursue excellence in our work.</p>
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## Summary

<p><b>Synopsis of Project as Implemented:</b></p> <p>The EULR Project consists of separately implemented yet coordinated residential and commercial studies. The targeted end uses for both studies are specific HVAC systems (e.g. ductless heat pumps, central AC, roof-top units) and, secondarily, individually circuited loads that can be easily metered.</p> <p>The Home Energy Metering Study (HEMS) kicked-off in early 2018 and is being implemented by Evergreen Economics, with subcontractors kW Engineering and Michaels Energy. HEMS targets 400 single-family homes throughout the Northwest over the life of the study (2018-2022).</p> <p>The Commercial Energy Metering Study (CEMS) is being implemented by DNV-GL, with subcontractors Cadmus and McKinstry, and started recruitment in the fall of 2019. The focus of this study is retail and office buildings with square footage greater than 2,500 sq ft, with a goal of 100 buildings throughout the region over the 5-year study (2019-2023).</p>	<p><b>Performance Against Objectives/Deliverables:</b></p> <p>Site installations for HEMS surpassed the halfway mark at the end of Year 2 but were slightly lower than the target (211 actual versus 225 targeted). There have been zero complaints to/from participating utilities and zero accidents or injuries to date.</p> <p>Two ongoing challenges that Evergreen Economics are managing are recruiting homes with heat pump water heaters (only 19% of the 5-year target have been recruited thus far) and responding to issues with the technical equipment (ie, loose current transducer connections and inconsistent temperature sensor communication).</p> <p>The CEMS launch was delayed by a few months due to a longer planning and trial phase, and recruitment challenges. At the end of 2019, metering equipment had been installed in only 5 buildings. DNV-GL is reevaluating the attrition rate, incentives, customer release agreement, and recruitment design to find opportunities for improvements.</p> <p>A notable change that arose in 2019 was that one of the subcontractors (McKinstry) will no longer do live-panel metering installations following a fatality the company experienced on a different project. This required a re-design and testing of metering methods, resulting in process changes that increase project</p>
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## Research & Development Project Summary

costs by about \$195,000 (split between the project, 36%, and DNV-GL, 64%).

### Decisions to be Made:

There are no high-level decisions to be made in the near term.

### Next Steps:

The first order of business in 2020 is to update funder contracts to reflect the following changes:

- Contracts based on a percentage of the total project budget (now expressed as dollar values)—**PGE's funding commitment is unchanged**
- Updates the term of the study to account for the Working Group decision for CEMS to lag HEMS by one year
- Updates for the priority end uses selected by the Working Group for both HEMS and CEMS
- Updates the confidentiality language to allow public disclosure of 15-minute and longer data intervals, as requested by DOE and NREL



# Research & Development Project Summary

Date: 12/10/2019

**Project Name: Plant Monitoring Technology Pilot**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Brandon Humble</p> <p><b>Sponsoring Department:</b> PSES</p> <p><b>Project Team (internal):</b> Alex Triplett, Brandon Humble, Mitch Simantel, Jeremy Morris, Josh Reeve</p> <p><b>Project Team (external):</b> Matt Laux (Curtiss Wright)</p> <p><b>Project Description:</b> This project installed a wireless sensor system at the Carty plant. The sensors will enable condition-based maintenance of critical equipment and use of the cycle isolation software. The system is designed to wirelessly monitor downstream tailpipe temperatures of 16 valves. Additionally, the inlet and outlet temperatures of the seal water heat exchangers have been measured. In total, 20 temperature sensors were installed in the plant.</p>	<p><b>PGE Budget/Actual:</b> FY19: \$59,310/\$58,244</p> <p><b>Cost Share Total:</b> NA</p> <p><b>Cost Share Percent:</b> NA</p>
<p><b>Benefit to PGE:</b> Monitoring valve tailpipe temperatures will enable condition-based maintenance of critical valves. Instrumenting heat exchangers will alert PGE to any fouling or suboptimal performance. Wireless sensors have the potential to be more cost effective than hardwired sensors. Once the network is established, it can be easy to deploy additional sensors in the field with a wireless system.</p>	<p><b>Strategic Alignment:</b> Perform</p>



## Research & Development Project Summary

### **Customer Benefit:**

This technology has potential to improve operational efficiency and performance of generation assets. Condition based maintenance can minimize unnecessary maintenance. Implementing cost-effective sensors can monitor reliability of a system, triggering maintenance only when necessary. Wireless technology has the potential to be a valuable tool in optimizing generation fleet performance.



# Research & Development Project Summary

## Summary

### Synopsis of Project as Implemented:

1. Online monitoring of identified valves and exchangers in place. Several transmitters are sending incorrect temperatures. This is being troubleshot with PGE and Curtiss Wright.
2. Installation and commissioning in 2019.
3. Project costs within budget.

### Performance Against Objectives/Deliverables:

1. Limited value/cost savings for non-temperature data. Curtiss Wright transmitters cannot power pressure transducers, which output a 4-20mA signal. This requires pressure transmitters to get power. If electricians need to install sensor power, it is not much additional effort to hardwire data cable.
2. Outdoor instrumented piping has heat trace installed. This will affect readings of downstream tailpipe temperatures. Unknown how this will affect being able to detect valve leakage.
3. Outdoor transmitters, receivers, and repeaters need to be weather-proof. All should be in NEMA enclosures. There should be conduit between transmitters and thermocouples. There is no way to terminate conduit at each transmitter, receiver, and repeater.
4. Battery life of wireless hardware depends on sampling rate and type of sensor. Recommend making condition-based PM to change batteries.

### Decisions to be Made:

Emerson's Wireless HART technology seems to be most applicable to power plant applications. Recommend evaluating that technology for future wireless instrumentation projects.

### Next Steps:

1. Troubleshoot transmitters sending incorrect temperatures.
2. Project closeout meeting with project stakeholders.
3. Disseminate Lessons Learned with site management.



# Research & Development Project Summary

Date: 1/14/2020

## Project Name: Program 60: Electromagnetic Fields and Radio-Frequency Health Assessment and Safety

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2021
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> William Messner</p> <p><b>Sponsoring Department:</b> Safety &amp; Resiliency</p> <p><b>Project Team (internal):</b> William Messner &amp; Rob Roloson</p> <p><b>Project Team (external):</b> Ximena Vergara (EPRI Senior Technical Leader and Program 60 Lead) and Mike Silva (Research Engineer and President of Entertech Consultants)</p> <p><b>Project Description:</b> The Program conducts and supports research addressing key environmental health and safety issues related to public and worker exposure to EMF environments associated with electric power system infrastructure. The program is the largest and most comprehensive EMF/RF research program in the United States. It provides a balanced research approach that addresses health &amp; safety issues with regard to both the community and workers. In 2019 the focus will remain on experimental and epidemiologic research to help address issues such as childhood leukemia, neurodegenerative diseases, pregnancy outcomes, and EMF interference with implanted medical devices. EPRI's EMF research and expertise can augment and build in-house EMF issue management capabilities-gained from EPRI meetings, technical updates, webcasts and reports. In addition, EPRI held a Knowledge Transfer workshop at PGE that was attended by Engineers, Project Managers, Corporate Communication, and other professionals to help us understand the latest science, mitigation techniques, and how to establish a procedure for customer concerns related to EMF.</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$144,588/\$144,588</p> <p>FY19: \$97,472/\$97,472</p> <p>FY20: \$101,371/\$101,371</p> <p><b>Cost Share Total:</b> PGE's 1-year leverage for P60 is 26:1. For every dollar that PGE invests, it is being leveraged by \$26 from other utilities</p> <p><b>Cost Share Percent:</b> NA</p>
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# Research & Development Project Summary

**Benefit to PGE:** PGE will be able to provide proactive risk management strategies to address high priority issues concerning potential health effects related to EMF and RF exposures by contributing to the body of scientific knowledge, contributing to accurate health risk evaluations, and informing exposure guideline development. PGE will maintain expertise in the field through access to scientific experts and be able to share the expertise with other areas of the organization through the EPRI Knowledge Transfer Initiative. PGE will be able to provide scientific information to ratepayers that address issues raised by local constituencies with respect to new construction or upgrades of transmission lines or substations.

**Customer Benefit:**

Both EMF and RF have been classified by the International Agency for Research on Cancer as possible human carcinogens. As our infrastructure ages, the grid expands to address electric vehicles, renewable integration, and new technologies (T&D construction, smart meters); we need to understand the latest in EMF research. PGE’s support of P60 demonstrates our leadership and proactive approach to addressing potential community and regulatory concerns. Without this participation, PGE would be unable to access experts and the benefits of EMF and RF research geared toward the electric utility industry. Ultimately, the EPRI EMF/RF Program provides research, analyses, and expertise to better inform public dialogue and regulatory oversight on EMF and RF health and safety issues that is based on sound science.

**Strategic Alignment:** Participation in EPRI’s Programs fully meets the company strategies of: Delivering an exceptional customer experience (See Customer Benefits below)

- 1) Investing in a reliable and clean energy future by supporting plans to build infrastructure where we anticipate EMF/RF being issues and can work to proactively mitigate them.
- 2) Building a smarter, more resilient grid by developing and implementing design criteria to support EMF reduction in new construction.
- 3) Pursuing excellence in our work by having access to world class research, information, and tools needed to support external shareholder engagement.

## Summary

**Synopsis of Project as Implemented:**

Participation in Program 60 has improved internal/external communication on EMF/RF issues and supported plans to build infrastructure where we anticipate EMF/RF being issues. PGE has hosted an EPRI Knowledge Transfer Initiative that was attended by 45 employees and has helped to develop design criteria to support EMF reduction in new construction.

**Decisions to be Made:** How T&D engineering will incorporate EMF reduction into the design of new construction of transmission lines and substations.

**Next Steps:** Attend EPRI Advisory meetings and schedule the first PGE EMF/RF Working Group meeting of 2020. Host Bob Olsen (WSU) for





## Research & Development Project Summary

PGE has implemented an EMF/RF Working Group and Program document that helps guide the EMF/RF customer concern process and management of EMF/RF Safety. Learnings from EPRI Program 60 participation and attending EPRI advisory council meetings have been shared across the company and to management in Bi-annual EMF/RF Working Group meetings.

**Performance Against Objectives/Deliverables:**

Met all objectives/deliverables on time, including: Bi-annual EMF/RF Working Group meetings, participating in EPRI Program Advisory Meetings, partnered with EPRI to provide EMF Knowledge Transfer Initiative training to 45 PGE employees, receiving EMF Gateway emails and sharing learnings across the company. Another Knowledge Transfer meeting is scheduled in February 2020 to discuss the 5G network and associated risks to workers.

Knowledge Transfer discussing the 5G network and safety of workers.



# Research & Development Project Summary

Date: 2/24/2020

## Project Name: Smart Streetlight Technology Pilots

### Project Status:

- Complete
- Will Continue Next Year
  - Year to be Completed: 2020
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Andy Macklin</p> <p><b>Sponsoring Department:</b> T&amp;D/Smart City Initiatives</p> <p><b>Project Team (internal):</b></p> <ul style="list-style-type: none"> <li>• Andy Macklin, Project Sponsor</li> <li>• Kevin Muck, Key Resource/OLS Subject Matter Expert</li> <li>• Erik Cederberg, Key Resource/NDO Subject Matter Expert</li> <li>• Joe Barra, Consultant/Subject Matter Expert</li> <li>• Theresa Haskins, Customer Insights/Market support</li> <li>• Coreen Henry, Product Development support</li> <li>• Colin Wright, Rates &amp; Regulatory support</li> <li>• Kari Nordquist, Project Manager</li> </ul> <p><b>Project Team (external):</b></p> <ul style="list-style-type: none"> <li>• Curtis Johnson, Itron/SSN support</li> <li>• Dave Urda, Sensus support</li> <li>• Peter Passarelli, City of Milwaukie</li> <li>• Delora Kerber, City of Wilsonville</li> </ul> <p><b>Project Description:</b> Streetlights are seen as critical infrastructure in the 'Smart City' landscape. Technology vendors have developed networks and smart devices that monitor vehicular and pedestrian traffic, air quality and environmental conditions. Streetlight fixtures are often ideal locations to deploy these systems, along with lighting controls that allow cities and municipalities the option to remotely control lighting level to suit specific conditions (e.g. traffic</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$0/\$0 FY19: \$80,000/\$64,500</p> <p><b>Cost Share:</b> Sensus will provide a preferred partner discount to PGE in the amount of \$6,000 (this has been subtracted from the total requested for 2019). There are no additional leveraged or matching funds available for this Smart Streetlight technology pilot.</p>
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# Research & Development Project Summary

levels, special events, emergencies). To stay relevant, bring thought leadership to customers and to understand feasibility of providing these products and services, PGE is exploring this area in more detail. There are several vendors who are working to bring Smart City Enablement platforms to the market and understanding as much as possible about these vendors and what they can provide is key to defining a solution for PGE and their customers. Although there are several vendors entering this market, there is currently one strong market leader. Itron Network stands out in both mesh networking in general and streetlight management in particular. PGE is also looking to expand exploration of this technology with their current AMI provider, Sensus, and believes both pilot projects are needed to fully understand existing capabilities of the offerings and to do an ‘apples to apples’ comparison between the two. This pilot will also provide PGE the opportunity to work very closely with a different vendor in this space and compare from a technical and business perspective to determine if they can work well with PGE and their customers (especially considering that Itron is a newly merged company). This will also help spur competition with Sensus as they will see PGE looking out into the market for what other options are available if they cannot meet PGE’s needs. The Itron pilot project will deploy the vendor’s ‘pilot package’ of ~130 streetlights in the City of Milwaukie’s downtown area and potential other locations. The expanded Sensus portion of the pilot will deploy 50 smart streetlights in the City of Wilsonville. Both of these pilots are being implemented to test the following high level areas: Install smart streetlight controllers on maximum of 250 streetlights, including upgrading to 7 pin LEDs; Verify lighting control strategies (scheduling, dimming, trimming, etc...); Third party access/shared data and control; Outage and other maintenance information availability and usefulness; Ability to integrate use of sensors and data to provide additional city services; Establish baseline data and assess accuracy of usage data collected.

**Benefit to PGE:**

This Smart Streetlight technology pilot identifies most closely with two of PGE’s strategic pillars:

- Deliver exceptional customer experiences – our streetlight customers want better equipment capabilities and services. This offering is designed to simplify the customer’s experience doing business with PGE (e.g. billing, outage response), remove barriers to new technology adoption, and support smart

**Strategic Alignment:**

**Alignment with corporate strategy:**

- Deliver exceptional customer experience
- Invest in a reliable and clean energy future
- Build and operate a smarter, more resilient grid



# Research & Development Project Summary

<p>streetlighting options for all municipal customers.</p> <ul style="list-style-type: none"> <li>• Build a smarter, more resilient grid – this offering supports the development of a network of smart, connected devices (controls and/or sensors) to meet municipal customer data needs, as well as providing a base for additional smart city technologies and capabilities.</li> </ul> <p><b>Customer Benefit:</b></p> <p>Customer benefits associated with Smart Streetlight technology:</p> <ul style="list-style-type: none"> <li>• Show customers that PGE is interested in addressing their streetlight needs.</li> <li>• Reduce barriers to implementation of Smart LEDs and communication technology for streetlights.</li> <li>• Make the process easy for customers to monitor and control their streetlights.</li> <li>• Support customers with their smart city goals by enabling them with the needed infrastructure.</li> <li>• Provide customers with solutions that support their key initiatives (safety, resiliency, environmental, etc.) in the context of smart city capabilities.</li> <li>• Show customers that PGE is emerging as a thought leader in this area and can be a resource for them as they continue to evolve.</li> <li>• Save energy through smart LED upgrades and features such as dimming and trimming of the lights.</li> <li>• Enhance outage response by leveraging automated outage reporting.</li> <li>• Improve granularity and timeliness of streetlight energy consumption via actual usage data.</li> </ul>	<p><input type="checkbox"/> Pursue excellence in our work</p>
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## Summary

<p><b>Synopsis of Project as Implemented:</b></p> <p>The project team was able to successfully implement ~130 Itron smart streetlights in the City of Milwaukie as well as 50 Sensus Smart Streetlights in the City of Wilsonville.</p> <p>All planned tests were successfully performed with Itron and the City received training on the software and access to use it to test ease of use and assess whether or not they would be interested in this type of functionality going forward.</p>	<p><b>Decisions to be Made/Next Steps:</b></p> <p>These smart streetlight pilots are providing useful information from a technology, vendor and city perspective, but they are only focused on smart streetlighting and the benefits of a mesh network (which the addition of streetlights and other devices will strengthen). The financial case for a smart streetlight network across PGE service territory does not pencil out at this time. It needs benefits associated with DER/DR and other potential uses of</p>
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## Research & Development Project Summary

Sensus tests are still outstanding due to issues with the environment set up. All of the lights and modules were installed; however, we still have tests that we need to complete. We have requested R&D funds in 2020 to complete this work since it was not able to be finished in 2019. If funds become available, we will plan to continue these final tests with the City of Wilsonville. The city is very interested to test these lighting features to determine if this system has functionality that they would want to use for their outdoor lighting longer term.

### Performance Against Objectives/Deliverables:

The project team was able to test all of the areas of our test plan with the Itron Smart Streetlight pilot in the City of Milwaukie. The following areas were tested successfully:

- Ability to communicate with modules/view in the software
- Remotely control lights: on/off, brighten, dim, flash
- Ability to support multiple secure user roles, which would allow municipalities access to specific features they need/want
- Scheduling: specific date ranges, times
- Ability to export interval data/usage, alarm data/information
- Establish baseline data and assess accuracy of usage data collected
- Ease of implementation of pilot software/hardware
- Service level of technology vendor
- Secure cloud capabilities
- Automatic asset tracking

the network in the future, so we are recommending more field testing be done to prove out the technical feasibility of these other uses of a 'network' before making any further decision on how to proceed.

The team has been in touch with the Test Bed project and an interested vendor to test their mesh network communication with water heaters and possibly other devices in the home. Knowing that this type of communication can be successful with these other devices (as well as streetlights), will significantly help build the case for this type of network at PGE. We have also been in touch with Itron to explore connecting other devices through the existing pilot network that is set up for streetlighting to gather additional data points.

We do not have to deploy a service territory-wide mesh network in order to meet the needs of a specific customer who may be requesting smart streetlighting, smart city applications or other functionality that could communicate over a NAN. For these customers, before PGE has made an official decision on the long-term network strategy, we could leverage Sensus or deploy a "pop-up NAN" similar to the small-scale pilot network that we are currently using in Milwaukie. The functionality provided by Sensus for smart streetlighting is very similar to other vendors in this space and we already have the network deployed (lowest cost option) and a team at PGE highly skilled at using and maintaining the system.

Sensus does not appear to be the best choice, per the information receive in our recent RFI, if we move past streetlighting into other smart city applications or DERs. However, we have shown that implementation of a small network that controls a certain area of streetlights and other devices could be deployed if/as necessary to meet customer needs.



# Research & Development Project Summary

Date: 02/10/2020

**Project Name: Solar PV Monitoring Laboratory – U of O**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: TBD, Ongoing support to gather solar radiation metrics
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Jay Landstrom  <b>Sponsoring Department:</b> R&amp;D  <b>Project Team (internal):</b> Jay Landstrom  <b>Project Team (external):</b> Dr. Frank Vignola, UofO  <b>Project Description:</b>                  The University of Oregon collects data from a network of 30 Pacific NW monitoring stations. They submit this data to the National Renewable Energy Lab (NREL) and post this data on a Public website. The U of O maintains this network of solar PV monitoring stations.</p>	<p><b>PGE Budget/Actual:</b>                  FY19: \$10,000/\$10,000                  FY20: \$10,000/\$0  <b>Cost Share Total:</b> \$160,000  <b>Cost Share Percent:</b> 6.25%</p>
<p><b>Benefit to PGE:</b>                  Access to solar data that will help with analysis of future solar generation facilities  <b>Customer Benefit:</b>                  Helps move PGE to a more renewable and carbon free generation mix.</p>	<p><b>Strategic Alignment:</b></p>

**Summary**

<p><b>Synopsis of Project as Implemented:</b>                  Upgraded solar stations in Portland, Salem, and Hermiston  <b>Performance Against Objectives/Deliverables:</b>                  Existing stations were enhanced</p>	<p><b>Decisions to be Made:</b>                  None  <b>Next Steps:</b>                  Provide access to solar data across PGE business units</p>
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# Research & Development EPRI Program Summary

Date: 12/20/2019

## EPRI Program/Project Name: Testing Grounding and Personnel- Protection on Overhead Distribution

**Project Status:**

- Complete
- Will Continue Next Year

- Year to be Completed: 2020 – Update 12/19 - Final Draft report and video production in final stages

Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> William Messner /Tom Yost</p> <p><b>Sponsoring Department:</b> PGE Safety &amp; Resiliency and Utility Operations – Distribution Line Operations</p> <p><b>Project Team (internal):</b> Bill Messner, Tom Yost , Thom Van Hoon , Joel Wallace, Ryan Hagel</p> <p><b>Project Team (external):</b> EPRI Staff , CMS Energy , Exelon Utilities , CenterPoint Energy, First Energy</p> <p><b>Project Description:</b> This proposed research with EPRI will verify and expand on testing and modeling already done within the industry. The research aims to expand knowledge around a number of research questions: What is the difference between bracket grounding and EPZ arrangements for touch potentials for a worker on a pole? Does the grounding approach affect step potentials at ground level? What is the benefit of a pole band? What happens if there is no connection to the earth (only at the pole top)? Does it matter which side a “master ground” is on relative to the worker? What is the voltage gradient along the pole? Is a pole band more effective if it somehow penetrates the wood (like the depth of a gaff)? Are there scenarios where the impedance is too high to trip upstream protection? The answers to these questions will be used to help educate our workforce and increase their safety when using EPZ grounding techniques.</p>	<p><b>PGE Budget/Actual:</b> \$94K FY18: \$0/\$0 FY19: \$30,000/\$30,000</p> <p><b>Cost Share Total:</b> (30K)</p> <p><b>Cost Share Percent:</b> (if applicable)</p> <p>EPRI and PGE successfully sought funding from other companies to supplement the \$94,000 estimated budget for this research, reducing PGE’s share to \$30,000.</p>
<p><b>Benefit to PGE:</b> This effort will reinforce a very important tool in worker safety protection --- EPZ</p>	<p><b>Strategic Alignment:</b></p>



# Research & Development EPRI Program Summary

<p>grounding. Currently our workforce, and many in industry don't fully understand the science behind EPZ grounding which is resulting in questioning the technique and may be encourage others to use other grounding techniques that may not be as protective of the worker</p> <p><b>Customer Benefit:</b> By avoiding injuries, our customers benefit from avoided costs (e.g. workers comp, medical expenses, and loss protection).</p>	<p>Pursue excellence in our work Safety</p>
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## Value

<p><b>PGE Participation:</b></p> <p>PGE personnel will be participating in the actual testing scenarios at EPRI's lab in Lenox Massachusetts.</p>	<p><b>Value Derived:</b></p> <ul style="list-style-type: none"> <li>• Line workers often have misconceptions about protective grounding. The goal of this research is to demonstrate the best approaches to personal protective grounding in various scenarios.</li> <li>• The result of this research may improve safety for line workers.</li> <li>• The result of this research will produce training materials that will be repeatable and sustainable.</li> </ul>
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# Research & Development Project Summary

Date: 12/20/2019

**Project Name:**

**Ultra-Capacitors for use as Emergency Backup Generator Starting Power.**

**Project Status:**

Complete

<p><b>Project Sponsor:</b> Bruce Barney</p> <p><b>Sponsoring Department:</b> Customer Specialized Programs</p> <p><b>Project Team (internal):</b> Brent Olsen</p> <p><b>Project Team (external):</b> Tesla, Tice Electric, Maxwell, World Trade Center Facilities, Stored Energy Systems, UCLA</p> <p><b>Project Description:</b> (From proposal) This project will explore a solution to the number one cause of backup reciprocating generator failures, the starting battery system. This common point of failure contributes to 70% of generator failures to start. Advancements in capacitor technology offer several benefits over the traditional lead acid starting batteries including reliability, lifespan, cranking amps, wider operating condition tolerances and the cost savings related to each. This project will explore the technology, determine the best solution, procure the equipment and modify the starting power system of a single backup emergency generator to utilize ultra-Capacitors in place of lead-acid batteries. Afterwards the system will be operated as normal, in conjunction with other DSG generators, to observe its operation and verify the benefits for the possible retrofit of future starting systems.</p>	<p><b>PGE Budget/Actual:</b> FY18: \$0/\$0 FY19: \$40,000/\$15,110</p> <p><b>Cost Share Total:</b> (if applicable) <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b> Industry wide, failure of starting batteries contributes to 70% of generator 'fail to start' problems. Compared to the traditional lead-acid starting batteries, ultra-capacitors offer 6 times the lifespan, 3 times the cranking amps and are less susceptible to temperature fluctuations. ultra-capacitors are also more energy efficient as they use less energy to float charge and have faster recharge between cranking attempts. DSG regularly and prescriptively changes existing lead acid batteries for DSG generators. If the project is successful, we could start the changeover to ultra-</p>	<p><b>Strategic Alignment:</b> Deliver exceptional customer experience Invest in a reliable and clean energy future Build and operate a smarter, more resilient grid</p>



# Research & Development Project Summary

capacitors from lead-acid technology. PGE will gain knowledge of ultra-capacitor systems versus lead-acid systems. This could include energy savings, cost savings, and performance increases. PGE will be a leader in identifying solutions to the leading cause of generator 'fail to start' incidents. The generators participating in the DSG program will be more reliable which in turn will make the grid more resilient, reliable and energy efficient.

**Customer Benefit:**

The Dispatchable Standby Generation group works with 86 customer owned emergency generators at 58 sites. We work closely with 38 different customers to provide a key service for critical backup emergency systems. The failure of any of these systems to start significantly impacts customer operations and consequently their perception of the DSG program. Reduced O&M costs would benefit all PGE customers.

## Summary

**Synopsis of Project as Implemented:**

This project explored the technology, researched vendors, compared costs, designed a system, procured equipment and retrofitted the starting power system of a single backup emergency generator who's lead acid batteries were at the end of life and replaced them with an ultra-capacitor system.

**Performance Against Objectives/Deliverables:**

Commissioning of the system was performed to verify its operations. Further testing was done to learn how many times the system can start on a single charge of the Ultra capacitors if power to the charger was lost and the generators were called on for emergency backup power. The conclusion was that the Ultra-capacitors can power the starting motor for 15 seconds three times for a total of 45 seconds. At the end of the 3rd crank the voltage had dropped from 24VAC to 19VAC which is below the required voltage to operate. This verified that the system complied with NFPA standards.

**Decisions to be Made:**

The system will be operated as normal, in conjunction with other DSG generators, to observe its operation and verify the benefits for the possible retrofit of future starting systems.

**Next Steps:**

The system will be operated as normal, in conjunction with 3 other DSG generators using lead acid batteries, to observe/compare its operation and verify the benefits. The outcome of this project will be an input into the decision to retrofit future starting systems with Ultra-Capacitors.



# Research & Development Project Summary

Date: 02/10/2020

## Project Name: OSU Wave Energy Research

### Project Status:

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Jay Landstrom  <b>Sponsoring Department:</b> R&amp;D  <b>Project Team (internal):</b> Jay Landstrom  <b>Project Team (external):</b> Dr. Ted Brekken OSU  <b>Project Description:</b>                  The R&amp;D funding will be used to advance Wave Energy and Modeling Research at OSU. This project would provide support for the continued expansion of wave energy research &amp; modeling, prototype linear test-bed testing, and resource evaluations being used to assess renewable energy potential in the Pacific Northwest.</p>	<p><b>PGE Budget/Actual:</b>                  FY19: \$25,000/\$25,000   <b>Cost Share Total:</b>  <b>Cost Share Percent:</b> The DOE provides a matching funding up to \$40 million.</p>
<p><b>Benefit to PGE:</b>                  Marine hydrokinetic energy is reliable and clean. Locating marine renewable energy off the Oregon coast will improve over-all Grid reliability in the Pacific NW.   <b>Customer Benefit:</b>                  Additional clean renewable resources will enhance the generation portfolio and overall quality of life in the Pacific NW.</p>	<p><b>Strategic Alignment:</b>                  Decarbonize</p>

## Summary

<p><b>Synopsis of Project as Implemented:</b>                   OSU continued the research and is pivoting to providing an offshore testing area for generator manufacturers.</p>	<p><b>Decisions to be Made:</b>                   N/A   <b>Next Steps:</b></p>
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## Research & Development Project Summary

<b>Performance Against Objectives/Deliverables:</b>	N/A
Year-end report summarizing research conducted in wave energy during 2019.	



# Research & Development Project Summary

Date: 2/11/20

**Project Name:**

Emobility Research Analytics (includes EPRI XFC, I-5 Study, Pole Charging/Sub-metering)

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2020 (though EPRI work will extend beyond)
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Aaron Milano</p> <p><b>Sponsoring Department:</b> Grid Products &amp; Integration</p> <p><b>Project Team (internal):</b> Andy Eiden</p> <p><b>Project Team (external):</b> SCE, EPRI</p> <p><b>Project Description:</b>                  By 2025, we expect 10x growth in EV adoption with charging rates for passenger vehicles exceeding 200 kW and heavy-duty vehicles at 1-2 MW. In order to ensure that PGE can support the adoption of this new load and to plan for how PGE will use these vehicles/chargers as resources, we must better understand load profiles of high powered charging equipment, utilization/diversity of factors of different types of charging deployments, integrity of vehicle to grid energy flows, quality of on-charger and on-vehicle metering equipment, and the ability to integrate charging with power operations. This project includes:</p> <ul style="list-style-type: none"> <li>- Enrollment in EPRI’s Electric Transportation Research Group (P18)</li> <li>- Enrollment in EPRI’s Extreme Fast Charging Working Group</li> <li>- Interstate study on long-haul electrification needs for the i-5 corridor</li> <li>- Pole charging submetering demonstration</li> <li>- Load research for high powered quick chargers: interval metering of high powered charging equipment (50 kW or more)</li> </ul>	<p><b>PGE Budget/Actual:</b></p> <ul style="list-style-type: none"> <li>- EPRI XFC: FY19:\$20,000.00/\$20,000</li> <li>- FY20:\$40,000/0</li> </ul> <p><b>Cost Share Total:</b> (if applicable)</p> <ul style="list-style-type: none"> <li>- EPRI partners are expected to invest a total of \$5 million in P18, leveraging PGE’s contribution of \$67,500 by a ratio of 74 : 1. EPRI’s XFC agreement leverages approximately \$100,000. I-5 study cost share is approximately \$400,000. I-5 Long Haul Electrification: \$25,320.56</li> <li>- Load Research: \$30,000</li> </ul> <p><b>Cost Share Percent:</b> (if applicable)</p>
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# Research & Development Project Summary

<p><b>Benefit to PGE:</b> Better position PGE to serve evolving EV customers' needs by understanding load shapes, reducing costs to serve, and learning from industry best practices.</p> <p><b>Customer Benefit:</b> The research will support PGE's ability to support low-cost decarbonization efforts:</p> <ul style="list-style-type: none"> <li>• Better understanding charger impacts will allow us to improve interconnection processes and develop programs that add customer value.</li> <li>• This research will support our ability to evaluate future investments that support EV adoption, which will support our customers' decarbonization goals.</li> <li>• This research could inform tactics that reduce the operation costs (e.g. sub-metered EV charging).</li> </ul>	<p><b>Strategic Alignment:</b></p> <ul style="list-style-type: none"> <li>• <i>Exceptional Customer Experience:</i> better understanding charger impacts will allow us to improve interconnection processes and develop programs that add customer value.</li> <li>• <i>Invest in Clean Energy Future:</i> The transportation sector accounts for about 40% of Oregon's GHG emission. This research will support our ability to evaluate future investments that support EV adoption.</li> <li>• <i>Build a Smarter, More Resilient Grid:</i> better understanding charger dynamics and capabilities will help inform how PGE will support a network of connected, flexible load resources to support grid operations and customer needs. This research will ensure our standards are appropriate for the future of charging.</li> <li>• <i>Pursue Excellence in our work:</i> this research could inform tactics that reduce the operation costs (e.g. sub-metered EV charging).</li> </ul>
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## Summary

<p><b>Synopsis of Project as Implemented:</b></p> <ul style="list-style-type: none"> <li>- Enrollment in EPRI's Electric Transportation Research Group (P18) and XFC groups takes effect in 2020, so results will be in 2020</li> <li>- The Interstate study on long-haul electrification needs for the i-5 corridor is substantially complete and will be released in Q1 2020</li> <li>- Pole charging submetering demonstration: chargers have been installed and tariff filed for OPUC approval.</li> <li>- Load research for high powered quick chargers: interval metering of high powered charging equipment (50 kW or more)—data collection plan and lit review complete, and metering/data analysis work has been assigned to be completed in 2020.</li> </ul>	<p><b>Decisions to be Made:</b> n/a</p> <p><b>Next Steps:</b></p> <ul style="list-style-type: none"> <li>- Attend EPRI engagements and leverage data from their reports.</li> <li>- Finalize and publish findings from I-5 study</li> <li>- Secure OPUC approval for pole charging pilot, then turn chargers on, and document learnings.</li> <li>- Finalize chargers/customer sites for deployment of metering equipment, collect field data, integrate with Python and SQL database to analyze charging patterns and power quality data.</li> </ul>
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## Research & Development Project Summary

**Performance Against  
Objectives/Deliverables:**

Work is moving forward according to plan, however some work shifted into 2020 due to project constraints and employee work loads.



# Research & Development EPRI Program Summary

Date: 12/20/2019

## EPRI Program/Project Name: Testing Grounding and Personnel- Protection on Overhead Distribution

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2020 – Update 12/19 - Final Draft report and video production in final stages
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> William Messner /Tom Yost</p> <p><b>Sponsoring Department:</b> PGE Safety &amp; Resiliency and Utility Operations – Distribution Line Operations</p> <p><b>Project Team (internal):</b> Bill Messner, Tom Yost, Thom Van Hoon, Joel Wallace, Ryan Hagel</p> <p><b>Project Team (external):</b> EPRI Staff, CMS Energy, Exelon Utilities, CenterPoint Energy, First Energy</p> <p><b>Project Description:</b> The proposed research with EPRI will verify and expand on testing and modeling already done within the industry. The research aims to expand knowledge around a number of research questions: What is the difference between bracket grounding and EPZ arrangements for touch potentials for a worker on a pole? Does the grounding approach affect step potentials at ground level? What is the benefit of a pole band? What happens if there is no connection to the earth (only at the pole top)? Does it matter which side a “master ground” is on relative to the worker? What is the voltage gradient along the pole? Is a pole band more effective if it somehow penetrates the wood (like the depth of a gaff)? Are there scenarios where the impedance is too high to trip upstream protection? The answers to these questions will be used to help educate our workforce and increase their safety when using EPZ grounding techniques.</p>	<p><b>PGE Budget/Actual:</b> \$30,000 FY18: \$0/\$0 FY19: \$30,000/\$30,00</p> <p><b>Cost Share Total:</b> (30K)</p> <p><b>Cost Share Percent:</b> (if applicable)</p> <p>EPRI and PGE successfully sought funding from other companies to supplement the \$94,000 estimated budget for this research, reducing PGE’s share to \$30,000.</p>
<p><b>Benefit to PGE:</b> This effort will reinforce a very important tool in worker safety protection --- EPZ grounding. Currently our workforce, and many in</p>	<p><b>Strategic Alignment:</b> Pursue excellence in our work</p>





## Research & Development EPRI Program Summary

<p>industry don't fully understand the science behind EPZ grounding which is resulting in questioning the technique and may be encourage others to use other grounding techniques that may not be as protective of the worker</p> <p><b>Customer Benefit:</b> By avoiding injuries, our customers benefit from avoided costs (e.g., workers comp, medical expenses, and loss protection).</p>	<p>Safety</p>
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### Value

<p><b>PGE Participation:</b></p> <p>PGE personnel will be participating in the actual testing scenarios at EPRI's lab in Lenox Massachusetts.</p>	<p><b>Value Derived:</b></p> <ul style="list-style-type: none"><li>• Line workers often have misconceptions about protective grounding. The goal of this research is to demonstrate the best approaches to personal protective grounding in various scenarios.</li><li>• The result of this research may improve safety for line workers.</li><li>• The result of this research will produce training materials that will be repeatable and sustainable.</li></ul>
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# Research & Development EPRI Program Summary

Date: 03/09/2020

## EPRI Program/Project Name: P18 Electric Transportation

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Darren Murtaugh</p> <p><b>Sponsoring Department:</b> RC509 – Grid Edge Solutions</p> <p><b>Project Team (internal):</b> Aaron Milano, Transportation Electrification Strategy Lead; Elizabeth Turnbull, Product Developer, Roch Naleway, Residential Portfolio Manager, Brian Patterson, Senior Product Developer, Coreen Henry, Senior Product Developer, Luke Whittemore, Grid Edge Solutions Engineer, and Joe Colett, Grid Edge Solutions Engineer</p> <p><b>Project Team (external):</b> Daniel Bowermaster, EPRI Program Master</p> <p><b>Project Description:</b> EPRI’s P18 Electric Transportation research area includes strategic intelligence and fundamental research through market modeling, surveys, technical analyses, projections, and other activities. Work products include zip-code level EV sales, EV charging load forecasts, technology assessments, stakeholder collaborations, and other activities.</p>	<p><b>PGE Budget/Actual:</b> FY20: \$67,500/\$67,500 (paid for in 2019) FY21: \$70,200/\$0 FY22: \$73,008/\$0</p> <p><b>Cost Share Total: \$210,708 (3 year)</b> <b>Cost Share Percent: 1.35% (year 1 only)</b></p>
<p><b>Benefit to PGE:</b> The strategic insights, analyses, and other activities included in EPRI’s Transportation Electrification focus areas will benefit PGE by providing insight into the latest trends in electric vehicle development and adoption. The latest vehicle adoption forecasts and technical analyses play a key role in the development of PGE’s new products and services, providing direct inputs into program design documents and regulatory filings.</p>	<p><b>Strategic Alignment:</b> The transportation sector is the largest source of greenhouse gas emissions in Oregon. Facilitating the use of electricity as a transportation fuel is key to decreasing greenhouse gas emissions and, by displacing liquid fossil fuels, increasing total electricity use in Oregon.</p>



# Research & Development EPRI Program Summary

<p><b>Customer Benefit:</b> PGE's participation in this focus area will also enhance customer service by allowing us to design better informed products and services. Vehicle sales projections and foresight into the latest technical trends ensure our programs will meet customer needs.</p>	
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## Value

<p><b>PGE Participation:</b></p> <p>PGE should gain access to research products like EPRI's EV and PHEV Market Overview, Overview of Electric Transit Bus Pilots in the U.S., Electric Bus Depot and On-Route Charging Report, Electric Vehicle Adoption Simulation Tool v1.1 and other research reports and tools.</p> <p>Participation in Q1 2020 included:</p> <ul style="list-style-type: none"> <li>• February 27<sup>th</sup> on-site meeting with EPRI Program Manager Daniel Bowermaster</li> <li>• Monthly market insights newsletter distribution and review by PGE team</li> </ul> <p>Planned future participation may include the use of EPRI tools and resources for a transformer overloading impact study and charging-related data collection and analysis.</p>	<p><b>Value Derived:</b></p> <p>PGE staff benefited from market insights and incorporation of EPRI data and tools into research planning activities.</p>
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# Research & Development Project Summary

Date: 03/31/2020

## Project Name: FlowTech Water Systems

### Project Status:

- Complete
- Will Continue Next Year

- 2020:

Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor: Mark White</b></p> <p><b>Sponsoring Department:</b></p> <p><b>Project Team (internal):</b></p> <ul style="list-style-type: none"> <li>• Mark White – Plant &amp; Operations Manager, Port Westward</li> <li>• Phil White – Operations Manager, Beaver</li> <li>• Austin Curtis – Maintenance Manager, Port Westward</li> </ul> <p><b>Project Team (external):</b></p> <ul style="list-style-type: none"> <li>• Gary Post – Sales Engineer, FlowTech</li> </ul> <p><b>Project Description:</b></p> <p>FlowTech Water Systems has a chemical free water treatment system that reduces hardness scale, corrosion and inhibits bacteriological growth. The system uses low bandwidth AM radio waves to alter water chemistry and force hardness minerals out of solution and into a soft sludge that collects in the cooling tower basin. The radio waves also damage cell walls in bacteria which cause cells to spend time repairing themselves instead of reproducing thus preventing biological slime growth. FlowTech is willing to a trial at the Port Westward Generating Station on the cooling tower. PGE would set the parameters of what a successful trial would look like. FlowTech would require PGE to purchase the equipment upon the successful completion of the trial. If the trial is successful, we could then use this technology at other power plants. By far, the largest chemical spend at any plant is for cooling tower chemicals and in 2017 it ranged from about \$112,000 to \$177,00. A non-chemical treatment would show a very large reduction in chemical spend.</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY19: \$146,00/\$0 project postponed to 2020 FY20: \$157,000 / \$0</p> <p><b>Cost Share Total: N/A</b></p> <p><b>Cost Share Percent: N/A</b></p>
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# Research & Development Project Summary

<p><b>Benefit to PGE:</b></p> <p>Could potentially remove water tower treatment chemicals from generations sites, saving \$250,000 - \$300,000 per year in chemical costs and minimizes possibility of violating NPDES permits and allows for non-chemical treatment to extend the life expectancy of valuable PGE assets.</p> <p><b>Customer Benefit:</b></p> <p>PGE's customers would see PGE using a greener technology to maintain valuable plant assets and a reduction in operating costs.</p>	<p><b>Strategic Alignment:</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Deliver exceptional customer experience</li> <li><input checked="" type="checkbox"/> Invest in a reliable and clean energy future</li> <li><input type="checkbox"/> Build and operate a smarter, more resilient grid</li> <li><input checked="" type="checkbox"/> Pursue excellence in our work</li> </ul>
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## Summary

<p><b>Synopsis of Project as Implemented:</b> See attached document: 'Flowtech Trial Plan'</p> <p><b>Performance Against Objectives/Deliverables:</b></p> <ol style="list-style-type: none"> <li>1. Determine if this technology can reduce scale formation and minimize corrosion.</li> <li>2. Determine if this technology can control microbial activity in cooling systems.</li> <li>3. Determine if this technology is a good fit for all generation cooling towers.</li> </ol>	<p><b>Decisions to be Made:</b> Whether it makes sense to utilize this process at Port Westward 2, Beaver, Coyote Springs, and Carty</p> <p><b>Next Steps:</b> Install &amp; evaluate at Port Westward 1.</p>
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# Research & Development Project Summary

Date: 03/12/2020

**Project Name:**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2022
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Dan Peterson</p> <p><b>Sponsoring Department:</b> PSES</p> <p><b>Project Team (internal):</b> Ivan Auer, Dan Peterson</p> <p><b>Project Team (external):</b> N/A</p> <p><b>Project Description:</b>                  EPRI Program 79 provides resources to address all aspects of the life management of conventional and advanced gas turbines, and addresses aspects of combined cycle plant-wide integration. This program researches areas such as operations and maintenance of gas turbines, repair techniques, performance monitoring, and future trends and technology. Program 79 also collaborates and coordinates technical activities with the Steam Turbine program (P65) and Heat Recovery Steam Generator program (P88). PGE has 4 combined cycle power plants with newer gas turbines (Mitsubishi 501Gs, GE 7FA) to vintage units (GE 7B).</p>	<p><b>PGE Budget/Actual:</b>                  FY20: \$107,093/\$107,093 (paid for in 2019)                  FY21: \$109,771/\$0                  FY22: \$112,515/\$0</p> <p><b>Cost Share Total:</b> (if applicable)  <b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b> Access to Program 79 provides access to research and data on programs, technology, and equipment that directly relates to our generating fleet. Access to this information will improve our programs and engineering design for related projects.</p> <p><b>Customer Benefit:</b> Involvement in this program is just starting but PGE plans to provide customer benefit by utilizing past research and study to better utilize our capital and O&amp;M resources. As the PGE turbine fleet ages PGE can better address maintenance aspects and capital upgrades, learning</p>	<p><b>Strategic Alignment:</b>                  Perform – Delivering operational excellence</p>



# Research & Development Project Summary

from technical experts and other utilities that are part of the program.

## Summary

**Synopsis of Project as Implemented:** PGE is currently evaluating the future of our Beaver plant, with specific attention on the aging gas turbines. Our involvement in P79 will provide access to technical information regarding gas turbines in combined cycle plants and a greater pool of industry peers to leverage. Furthermore, our involvement in P79 will provide PGE the opportunity to more quickly and efficiently develop subject matter expertise in this area as retirements and turnover continue within our engineering departments.

**Performance Against Objectives/Deliverables:** With our involvement in this program just starting we cannot provide any performance metrics or measurements at this time.

**Decisions to be Made:**

No immediate decisions to be made

**Next Steps:**

We will review the following reports in detail in addition to researching other reports and software tool available through the program. We will also reach out to EPRI program owners and participate in annual program sponsor meetings.

- 3002013575 – Vintage Gas Turbine Best Practices Guideline for High Reliability
- 1022094 – Operational Flexibility Guidelines for Gas Turbine Low NOx Combustion Systems
- 1015788 – Best Maintenance Practices for Gas Turbine Low-NOx Combustion Systems



# Research & Development EPRI Program Summary

Date: 02/27/2020

**EPRI Program/Project Name:**

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed: 2020
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor: Darren Murtaugh</b></p> <p><b>Sponsoring Department:</b> RC509</p> <p><b>Project Team (internal): Darren Murtaugh</b></p> <p><b>Project Team (external): Nicolas Tumilowicz</b></p> <p><b>Project Description:</b></p> <p>As new products for customer-sited energy storage systems emerge, many organizations are testing equipment individually, with varying degrees of coordination and consistency of method making it difficult to draw meaningful conclusions from comparative data sets and results in several unresolved questions. This project seeks to understand functional and performance characteristics of customer-sited energy storage products. It aims to test a series of customer-sited energy storage products in parallel at a single test site with the same methodology and conditions. Additionally, the project seeks to understand key differences between available systems, including functionality and topology. New learning is expected in characterization of technical readiness, performance, and uptime of customer-sited, particularly residential, battery storage products (uptime quantifies percentage of time the product is functioning and responding as intended).</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$0/\$0</p> <p>FY19: \$10,000/\$10,000</p> <p>FY20: \$40,000/\$0</p> <p><b>Cost Share Total:</b> (if applicable)</p> <p><b>Cost Share Percent:</b> (if applicable)</p>
<p><b>Benefit to PGE:</b></p> <p>A residential energy storage offering provides customers with improved reliability and resiliency, and PGE could leverage the resources to meet operational needs.</p>	<p><b>Strategic Alignment:</b></p> <p>A robust energy storage offering helps PGE to integrate more renewable energy resources into the system in a reliable manner to help <u>reduce GHG emissions by more than 80% by 2050</u>. This project supports the initiative by delivering lessons learned on customer-sited storage solutions.</p>





# Research & Development EPRI Program Summary

**Customer Benefit:**

Energy storage allows customers to ride through outages and enhance their renewables integration.

**Value**

**PGE Participation:**

Attended update webcasts, EPRI has procured and begun installing the energy storage systems from multiple vendors. Testing to follow when installations are complete.

**Value Derived:**

None yet, value to come when EPRI has started testing.



# Research & Development Project Summary

Date: 2/7/2020

## Project Name: Regenerative Grid Simulator at PSU

**Project Status:**

- Complete
- Will Continue Next Year
  - Year to be Completed:
- Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Jay Landstrom  <b>Sponsoring Department:</b> R&amp;D  <b>Project Team (internal):</b> Jay Landstrom  <b>Project Team (external):</b> Bob Bass (PSU)  <b>Project Description:</b>                  A Regenerative Grid Simulator (GS) is a four-quadrant AC source that provides a user-defined electrical service. For example, a user can program the GS to produce a steady-state over voltage or under frequency, or transient events such as sudden frequency deviations or loss of voltage.                  Having a GS in the PSU Power Lab will provide opportunities for expanded research and teaching.</p>	<p><b>PGE Budget/Actual:</b>                  FY19: \$26,300/\$26,300  <b>Cost Share Total:</b> (if applicable) NA  <b>Cost Share Percent:</b> (if applicable) NA</p>
<p><b>Benefit to PGE:</b>  <u>Frequency Response Algorithm Testing</u>                  PSU and PGE are interested in developing algorithms for detecting frequency events and dispatching battery-inverter systems (BIS) to provide primary frequency response to those events. These algorithms will reside within a real-time automation controller connected to a phasor measurement unit, which can be deploy alongside any BIS PGE may have within its BA.    <u>BIS Volt/VAr Support</u>                  A GS would also be useful for developing Volt/VAr functionality for BIS systems. Volt/VAr support can help maintain acceptable voltage levels across a</p>	<p><b>Strategic Alignment:</b>  <b>Decarbonize</b>  <b>Electrify</b></p>



## Research & Development Project Summary

distribution feeder that is experiencing heavy loading (decreased voltage) or high PV production (increased voltage). Algorithms for autonomous control of reactive power production/consumption could be tested against feeder profiles provided by PGE.

### DER Dispatchability

PSU would like to see how the resource availability of a residential BIS changes as a function of grid conditions. A BIS that is autonomously providing frequency response or voltage regulation will experience changes to its power availability and energy storage as a function of time. This in turn affects its dispatchability for other ancillary services, such as peak demand mitigation or TOU.

### Inverter Compliance Testing

A GS could be used for inverter compliance testing. UL 1741 and IEEE 1547 both specify inverter behaviors in response to grid events, specifically +/- frequency deviation, +/- voltage deviation, and fault ride-through. The PSU GS could be used to test inverter compliance with the specifications. QualityLogic, Inc., has expressed interest in doing such testing in the PSU lab, and PGE may be interested in testing inverters that it admits into its residential BIS programs.

### Protection and RA testing

A GS could be used to test protection equipment settings, and remedial action schema in response that are triggered by grid events. RA initiate actions in order to prevent power systems protection tripping. Frequency Response can be considered an RA.

### **Customer Benefit:**

Having advanced testing capability at the PSU power lab, PGE can quickly determine if new control and protection strategies will help advance our smartgrid initiatives. Customers benefit by having a grid that is more DER capable.

## Summary



## Research & Development Project Summary

### **Synopsis of Project as Implemented:**

The Grid Simulator is currently in service at the PSU power lab and will be used to do research with PGE as outlined above.

### **Performance Against Objectives/Deliverables:**

Grid Simulator was procured and installed.

### **Decisions to be Made:**

Determine which use cases and research are to be evaluated in 2020.

### **Next Steps:**

Ongoing collaboration with the PSU Power lab.



# Research & Development Project Summary

Date: 11/20/2019

**Project Name: Energy Systems Innovation Center (ESIC)**

**Project Status:**

Complete

Will Continue Next Year

- Year to be Completed:

Discontinued (reason) \_\_\_\_\_

<p><b>Project Sponsor:</b> Rich Goddard</p> <p><b>Sponsoring Department:</b> 576</p> <p><b>Project Team (internal):</b></p> <ul style="list-style-type: none"> <li>• Larry Bekkedahl – ESIC Board Member (primary)</li> <li>• Rich Goddard – ESIC Board Representative (backup)</li> <li>• Jay Landstrom – PGE R&amp;D Committee Chair</li> <li>• Joe Barra – PGE R&amp;D Committee Representative</li> </ul> <p><b>Project Team (external):</b></p> <p>Mani Venkatasubramanian, Director, ESIC</p> <p><b>Project Description:</b></p> <p>The Energy Systems Innovation Center (ESIC) at Washington State University is a leading center of excellence, both nationally and internationally, for research, education, technological innovation, and technology transfer in energy systems, including smart grids. With an exceptional team of faculty in power, energy, and computer science, and more than 20 faculty in allied fields (including economics, public policy, and sociology), ESIC provides a strong synergistic environment for conducting major multi-disciplinary studies on electric energy and its social and economic impacts, facilitating the development of public policy at the state and national levels.</p>	<p><b>PGE Budget/Actual:</b></p> <p>FY18: \$15,000/\$15,000 FY19: \$15,000/\$15,000 FY20:\$15,000/0</p> <p><b>Cost Share Total:</b> (if applicable) <b>Cost Share Percent:</b> (if applicable)</p> <p>There were 13 ESIC members in 2018 including Puget Sound Energy, Seattle City Light, Snohomish PUC, Pacific Northwest National Lab, and BPA. Current ESIC funding from DOE totals approximately \$13M.</p>
<p><b>Benefit to PGE:</b></p> <p>ESIC collaborates with governments and industries at local, state, regional, national, and international levels on research and development, education, workforce training, and economic development. ESIC is also</p>	<p><b>Strategic Alignment:</b></p> <p>Decarbonize/Electrify</p>



# Research & Development Project Summary

establishing strong linkages with leading educational institutions around the world to promote collaborative research and educational programs as well as faculty and student exchanges.

**Customer Benefit:**

Participation in ESIC provides PGE an opportunity to leverage our research funding through partnerships with other NW utilities, WSU, and PNNL. Outcomes will provide PGE additional tools to develop and manage the grid of the future and will provide a forum to help shape state and federal energy policy.

## Summary

**Synopsis of Project as Implemented:**

PGE participated in semi-annual ESIC Board meetings to review project progress, guide future focus areas, and prioritize funding. Meeting synopsis were distributed internally to key partners. The team identified areas of opportunity to partner/collaborate with ESIC on research projects including microgrid resiliency, infrastructure security, cyber security, smart grid analytics, and ADMS. Opportunities were also identified for supporting student engagement (e.g. hosting PGE tours/internships) and leveraging PGE research dollars.

**Performance Against Objectives/Deliverables:**

Objectives for 2019 were met.

**Decisions to be Made:**

1. Does PGE want to participate in any of the current ESIC research projects?

**Next Steps:**

1. Review current research projects and provide feedback to ESIC on projects of interest to PGE
2. Fund 2020 ESIC membership