
EE 491 Week 6 Report - sddec18-03

Design of a More Reliable Power Grid for Puerto Rico

2/26/18 - 3/5/18

Faculty Advisor: Vikram Dalal

Team Members

Logan Lillis - *Communications and Reports Lead*

Ricardo Rodriguez-Menas - *Webmaster and Project Plan Lead*

Heiqal Zamri - *Test Engineer Lead*

Weekly Summary

On Monday, February 26th, we had our weekly meeting. At the meeting, we discussed the specific research findings we had come upon over the last week's studying. We also continued to delegate researching topics. Lastly, we discussed the design document and completing the required sections which we assigned throughout the group.

Past Week Accomplishments

- ❖ Upload Documents to Website: Ricardo
 - Weekly Reports
- ❖ Work on Design Document
 - Section 1: Introduction - Ricardo
 - Section 2: Design Proposal and Analysis - Logan
 - Section 3: Testing - Heiqal
- ❖ Discussed logging study hours - alleviated this week!
 - Add specific examples
 - Share with Logan BEFORE the end of the next weekly report period
- ❖ Delegate specific research category roles
 - Gas Turbines
 - Energy Storage
 - Renewables
 - Generation
 - Interconnectivity
 - Economics

Pending Issues

- ❖ Lack of research on costs associated with implementing and building
 - Will continue to look into
- ❖ Need to decide energy storage options

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Logan Lillis	<ul style="list-style-type: none"> ● Completed section 2 of design document: Proposed Design and Design Analysis ● Researched Renewable Energy <ul style="list-style-type: none"> ○ Over 7 renewable farms in place. ○ Wind: Santa Isabel, largest wind farm in caribbean, generated half of Puerto Rico's renewable energy in 2016. ● Researched Energy Storage <ul style="list-style-type: none"> ○ AES has begun donating 6MW batteries post-Maria to aid renewable farms ○ AES has proposed 2.5GW of 10-hour battery storage will be enough to make renewable energy a viable central generation option <ul style="list-style-type: none"> ■ Many price concerns with implementing this amount of storage ● Researched natural gas <ul style="list-style-type: none"> ○ No reserves in Puerto Rico ○ Imports 55 billion cubic feet, mainly from Trinidad and Tobago. <ul style="list-style-type: none"> ■ Imported as LNG through Peñuelas terminal and regasification facility at Guayanilla Bay on the southwestern coast ○ Discussions of a pipeline, but discontinued due to mountains and habitat. 	9	27

	<ul style="list-style-type: none"> ○ Discussions and proposal in place for a floating natural gas deliquification plant near Peñuelas <ul style="list-style-type: none"> ■ Further talk of plant on north coast, but no proposal or plan generated yet. ● Researched Interconnectivity and Blackouts <ul style="list-style-type: none"> ○ Puerto Ricans experience 4-5x more blackouts than the average American ○ Many problems with blackouts even before Maria. <ul style="list-style-type: none"> ■ 3-day country wide blackout after a fire ■ Many power lines down pre-maria causing blackouts and safety concerns. ■ Maintenance and Upkeep is a big component of these blackout issues, as well as lack of interconnectivity between microgrids. ● Researched economics <ul style="list-style-type: none"> ○ Puerto Rico’s utility rates are around \$0.24/kilowatt-hour, nearly \$0.10/kilowatt-hour below the Caribbean average, with residential rates at \$0.20/kWh and industrial sector rates at \$0.18/kWh. 		
<p>Ricardo Rodriguez-Menas</p>	<ul style="list-style-type: none"> ● Research in Interconnectivity ● Since 2007 Puerto Rico and Authorities in the Island adopted Interconnection Standards based on the Federal Policy Act of 2005. In case we desire to implement simple “inverter-based systems” the new policies for the process are : <ul style="list-style-type: none"> -25 kW for single-phase. -No more than 200 kW for three-phase systems ● Generators for these systems will be required to generate a capacity greater than 500 kW and less than 1MW 	<p>7</p>	<p>23</p>

	<ul style="list-style-type: none"> ● These regulations are subject to changes every 180 days ● In the latest regulations the significant change was that an expedited plug-and-play interconnection process for systems with a generation capacity of 10kW or less installed in residences and businesses. PREPA has also established new regulations for interconnections using Wind and Solar generation <p>https://www.nrel.gov/docs/fy14osti/57089.pdf</p> <ul style="list-style-type: none"> ● Research in Storage ● Previous Company supplying the island was ABB. Now the majority of Energy Storage components is supplied by AES <ul style="list-style-type: none"> ○ AES is going to donate 6MW batteries to Island and suggest the installation of solar panels and Microgrids in the Island is the answer ○ Other Companies working in Puerto Rico (Tesla, Sonnen and Tabushi America) ○ 300 million awarded in a contract to the Company Whitefish Energy. ● Capacity Firming ● Load leveling ● Spinning reserve ● Peak shaving ● Power quality ● Frequency regulation 		
Heiqal Zamri	<ul style="list-style-type: none"> ● Research on Gas Turbines <ul style="list-style-type: none"> ○ Most notable gas turbine company is Siemens that has implemented many gas turbines throughout the world ○ There are three main gas turbines that are being manufactured by Siemens: <ul style="list-style-type: none"> ■ Heavy-Duty: 	4	18

	<ul style="list-style-type: none"> ● Used to implement as a co-generator which most likely will be the one that we will focus on for this project. ● Also used for large or simple combined cycle power plants ■ Industrial <ul style="list-style-type: none"> ● Used for industrial power generator and mechanical drive application ■ Aeroderivative <ul style="list-style-type: none"> ● Used for power generation and mechanical drive in the oil and gas industry. ● Originally used for aviation ● Cost of Siemens turbines <ul style="list-style-type: none"> ○ Cost around between 2-3 million dollars per turbine ● Researched current power source of Puerto Rico <ul style="list-style-type: none"> ○ Currently focus on mostly petroleum 	
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Plan for Upcoming Week

- ❖ Work on Design Document (due end of week 8)
 - Section 1: Introduction - Ricardo
 - Section 2: Design Proposal and Analysis - Logan
 - Section 3: Testing - Heiqal
- ❖ Research for Professor Dalal:
 - Gas Turbines - Cal
 - Renewable Energy Implementation - Ricardo
 - Generation and Interconnectivity - Logan
- ❖ Begin looking into economics
- ❖ Start narrowing down energy storages
- ❖ Dig deeper into Natural Gas plant - Logan

