EE 492 Bi-Weekly Report 7 - sddec18-03

Design of a More Reliable Power Grid for Puerto Rico

11/29/2018 - 12/3/2018

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*
Pinjia Zhang - *Design Lead*

Weekly Summary

This biweekly period was spend completing our final documents. The team poster was created and edited by Logan with information from each section. The written document was created by Logan, with sections by Ricardo (Energy Storage and Microgrids), Heiqal (Microgrids and Backup Generation), and Pinjia (Renewable Energy) and Logan (Generation, Transmission, Natural Gas)

Past Week Accomplishments

Logan

- Gathering group information for IRP poster
- Creation of Poster
  - Formatting, contacting group members for needed information, etc.
- Creation of Proposal Document
  - Commuting deadlines with group
- Authoring of Proposal Document
  - Generation, Transmission, Natural Gas
  - Introduction, Conclusion
  - Economics and Policies
  - Assist with renewable energy, energy storage, and test plan sections
- Creation of Final Presentation
  - Introduction, Generation, Transmission, Economics and Policies
  - Assisting with Energy Storage Investment and Renewable Energy

Ricardo:

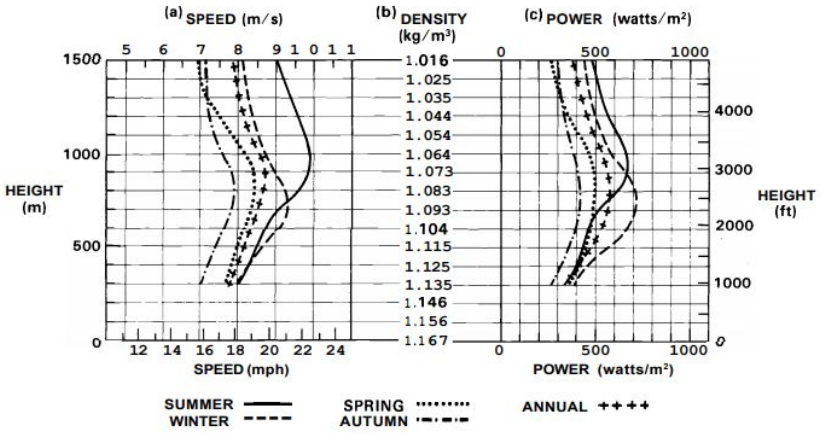
- Contacted NREL to gather information on energy storage and renewable resources
- Researched and learned how to use NREL tools for calculations
- Compute population and consumption calculations
- Research initial energy storage investment options

Heiqal:

- Found the energy required for a single microgrid and also the population that the microgrid can supply continuous power to. It is seen that the microgrid should be able to provide for an average of 15,000 people. Places like San Juan with 355,000 people will have 24 microgrids whereas Mantini has 1 microgrid for their population of 16,000 people.
- The annual power consumption is about 18.88 billion kW for the whole island that the microgrids must help supply continuous power for the whole island which we can see that the energy storage for each microgrid which we will need around 848,622 energy storage batteries.
- Looked into the many different software programs that can help with designing the microgrids. We look into 4 different softwares:
  - OpenDSS: Help implement the design and its flow and processes however requires proper training to be able to use this program.
  - Distributed Energy Resources - Customer Adoption Model (DER-CAM): Implemented by Berkeley Lab to find the optimal way to design the microgrid and find which resources are most suitable for our situation. It has been implemented all over the world. For example, in New York University the microgrid using natural gas helped protect a power outage from Hurricane Sandy.
  - Microgrid Design Toolkit (MDT) : A software that can help create the whole design and its utilities to be able to see if the design is feasible or applicable.
  - Gridlab-D: A program that can help have a better understanding of how much power the utilities we have will output and how much will it generate for our designed power grid.
- Worked on finishing up the presentation slides for final presentation and worked a bit on the final report of the senior design class.
- Sources:
  - https://www.gridlabd.org/
  - https://building-microgrid.lbl.gov/projects/der-cam
  - https://www.energy.gov/sites/prod/files/2018/06/f53/DOE%20Report_Energy%20Resilience%20Solutions%20for%20the%20PR%20Grid%20Final%20June%202018.pdf
  - https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/PRERWG_Report_PR_Grid_Resiliency_Report.pdf
  - http://smartgrid.epri.com/SimulationTool.aspx
  - https://energy.sandia.gov/download-sandias-microgrid-design-toolkit-mdt/

Pinjia:

- Research about the wind distribution around the crest region, list out the average wind velocity 22 mph on the side of crest region. The duration time for maximum wind that can drive turbine is between **winter and summer.** During other time the turbine can still operate but it is not running at its maximum capacity.



- Find out the offshore wind turbine near the New Jersey and compare to the case in Puerto Rico. The cost of New Jersey wind project is **$3030/kw**(in 2011 dollars), according to EIA the base price for the wind cost delivered to the grid is about **$23.5cents/kwh** without the of state tax credit for resident and about **12 cents/kwh** for commercial consumers. Since New Jersey is the only offshore wind projects in US we can conclude that Puerto rico should be the same as the New Jersey program.
- Sources:
  - 1. *The Cost and Economic Impact of New Jersey Offshore Wind Initiative* June 2011 http://www.beaconhill.org/BHIStudies/NJ-Wind-2011/NJWindReport2011-06.pdf
  - 2.*Cost Assessment for Offshore wind energy in Puerto Rico* http://www.laccei.org/LACCEI2015-SantoDomingo/RefereedPapers/RP186.pdf
  - 3.*Wind Energy Technology for Puerto Rico 2008* http://vbn.aau.dk/files/16414900/Wind_Energy_Technology_for_Puerto_Rico.pdf

Individual Contributions

Team Member	Contribution	Bi-Weekly Hours	Total Hours
Logan Lillis	• Write Weekly Report • Create and Format Poster • Create and Format Proposal Document • Author Proposal Document • Create and Format Final Presentation • Author Final Presentation	30	79.5
Ricardo Rodriguez-Menas	• Contact and find data and literacy of NREL organization on energy storage and renewable resources. • Learn how to use NREL tools for calculation • Find and calculate data about population and total consume of Puerto Rico. • Debate and determine our decision for the initial investment on energy storage	6	55.5
Heiqal Zamri	• Research on microgrid consumer size • Research on island-wide consumption ○ Microgrid Distribution • Research on testing softwares	19	48
Pinjia Zhang	• Research on wind distribution • Research wind projects in the US	5	32.5

Plan for Upcoming Week

- ❖ Present at the IRP presentation on December 8th.