sdmay19-46: Impact of High Photovoltaic Penetration on Distribution Systems

Advisor: Dr. Ajjarapu
Week 1 Report
August 29 - September 12

Team Members

Daniel Tott - Team Leader
Nathan McGlaughlin - Webmaster
Jasleen Grover - Key Concept Holder 1
Minsung Jang - Key Concept Holder 2

Summary of Progress this Report

We studied duck curves, solar generation, components of a distribution system. We also reviewed the previous teams' report and solar prices. We started working on the IEEE 4 bus system by hand. We all did the same research as the topics were all assigned to members equally.

Past Week Accomplishments

Everyone:

- Researched Duck Curves
    - Researched the California duck curve, and how it is indicative of too much solar power being supplied to a distribution system around midday, and not enough around dusk.
    - Gained an understanding of how this would need to be accounted for with the voltage problems that it can create throughout the day.
- Researched Solar Generation
    - Studied the basics of solar power generation, and how it ties into a distribution system.
    - Found high PV penetration is a common problem with distribution systems that incorporate solar power.
- Studied Components of a Distribution System
    - Studied the basic components of a distribution system such as generators, loads, transmission lines, and transformers, and how to deal with them in distribution systems.
- Reviewed Previous Team’ Report
    - Looked at the report from the previous team who did the same project.
    - Got an outline of what we’ll be doing for the project starting with the IEEE 4 node bus system by hand, moving onto solving the IEEE 34 node system using software, and then working on a real Alliant Energy distribution system and trying to integrate solar power into it.
- Began Working on IEEE 4 Bus System by Hand
    - Attempted to solve the power flow for the IEEE 4 bus system by hand.
    - Calculated values for the node voltages and line currents by hand, and then repeated the same solutions in MATLAB until we got the voltages to converge. The voltages that we got were incorrect when compared to IEEE’s solution.

Pending Issues

Everyone:

- IEEE 4 Bus - Solve for Currents Correctly
    - In our first attempt at solving the IEEE 4 bus system, the answers were incorrect due to the currents being set at a constant value.
    - Need to solve for the second line current using the power load and impedance of the second line, and the first line current by using the turns ratio.

Plans for Upcoming Reporting Period

Everyone:

- Solve the IEEE 4 Bus System by Hand
    - We will work together on solving the IEEE 4 bus system by hand, and use the proper way to solve for the line currents to accomplish this.
    - Need to find the line currents simply by using the turns ratio of the transformer, and don't need to include anything with the node voltages.
    - Will make changes to our MATLAB code to change the formula for computing the line currents.
    - Possibly make changes to our steps for the power flow according to how the line current changes affects the rest of the formulas.
- Further research distribution systems
    - Reading chapter 4 of the textbook "Distribution System Modeling and Analysis" by William Kersting to gain a deeper understanding of overhead and underground distribution lines.

Individual Contributions

Team Member	Contributions	Weekly Hours	Total Hours
Daniel Tott	First week I studied up on the California Duck Curve, components of solar distribution systems, and solar prices. Also looked at the previous group's final report for their project (same as ours). In the second week we were assigned to work separately on the IEEE 4 bus feeder power flow problem, and I worked on a solution which turned out to be wrong.	15	15
Nathan McGlaughlin	I studied the duck curve, solar generation, components of a distribution system. I reviewed the previous groups' report and solar prices. I started working on the IEEE 4 bus system by hand.	12	12

Jasleen Grover	Solving the problem given by the advisor. Researching on the topic in depth and went through the previous year report.	11	11
Minsung Jang	I studied the duck curve, solar generation, components of a distribution system. I reviewed the previous groups' report and solar prices. I started working on the IEEE 4 bus system by hand.	5	5

Gitlab Activity Summary

Gitlab Report

- Nothing to report.