

Impact of High Penetration Photo-Voltaic on Distribution Systems

PROJECT PLAN

may1728

Client - Alliant Energy

Dr. Ajjarapu

Nathaniel Summitt - Team Leader

Wyatt Lauer - Communications Leader

Samuel Searls - Webmaster

Mark Szkodyn - Key Concepts Holder

Abdul Waasay Mirza - Key Concepts Holder

may1728@iastate.edu

<http://may1728.sd.ece.iastate.edu>

Revised: October 16, 2016/Version 1

Contents

1	Introduction	2
1.1	Project statement.....	2
1.2	purpose	2
1.3	Goals	2
2	Deliverables	2
3	Design	2
3.1	Previous work/literature.....	3
3.2	Proposed System Block Diagram.....	3
3.3	Assessment of Proposed methods	3
3.4	Validation	3
4	Project Requirements/Specifications	4
4.1	functional	4
4.2	Non-functional	4
5	Challenges	4
6	Timeline.....	5
6.1	First Semester.....	5
6.2	Second Semester	5
7	Conclusions	6
8	References	6
9	Appendices	7

1 Introduction

1.1 PROJECT STATEMENT

The amount of solar generation is increasing rapidly in Iowa, and the current systems are having problems (over-voltage, opposite direction power flow, the possibility of islanding, etc.) keeping up with all of the additions. In this project, we are trying to assess the impact of high penetration solar power generation on distribution feeders and its effects on the power quality delivered to the consumer.

1.2 PURPOSE

The purpose of this project is to use computer modelling systems to analyze the impacts of solar generation in the utility's distribution systems. It will be beneficial to the society because we will be able to find the adverse effects of high penetration solar generation before the implementation of the generation so the customers never see the problems. Also, this project will allow for more solar power on distribution systems while limiting the problems seen.

1.3 GOALS

We have several goals that we would like to achieve. Our goals are shown below.

- Run simulations on an Alliant-owned distribution feeder to calculate the allowable PV generation that the feeder can handle before operating outside regulated parameters.
- Compare community PV generation and residential PV generation
- Find solutions that will prevent future problems relating to solar PV generation on the Alliant Energy Systems

2 Deliverables

The deliverables necessary in this project are listed below.

- Voltage profiles from simulations
- Comparison of residential and community solar PV generation
- Cost Estimations

3 Design

Include any possible methods and solutions for approaching the project at hand. You may want to include diagrams such as flowcharts to, block diagrams, or other types to visualise these concepts.

We are using OpenDSS which is a program used to analyze distribution systems. It can return many different points of information: graphs, time series, voltage profiles, the magnitude and phase

of voltages and currents at any given bus, and more. We will be running the files provided for us and then collecting different

3.1 PREVIOUS WORK/LITERATURE

We have been using the OpenDSS user manual that can be found at <http://smartgrid.epri.com/SimulationTool.aspx>. It is an open source program.

We are also using the book Distribution System Modeling and Analysis to help us better understand how the data we get from the computer is computed by hand so that we know whether or not our data makes sense.

Kersting, William H. Distribution System Modeling and Analysis. Boca Raton: Taylor & Francis, 2012. Print.

3.2 PROPOSED SYSTEM BLOCK DIAGRAM

Everything we do will be done with the OpenDss software. Our project goals will be to first get a better understanding of OpenDss by running different IEEE test cases, getting data, and analyzing that data. Once we can understand everything that is being outputted by the simulation, then we will move into modifying the simulations.

When modifying the simulations, we will be adding community and residential solar to see how that addition will affect the stability of the distribution system we are testing.

After we are experienced with all of the test systems, we will be provided a system from Alliant Energy that we will test in multiple different scenarios to see how solar will impact their current distribution system, and see if any changes need to be made to make sure that the system can handle the solar penetration.

3.3 ASSESSMENT OF PROPOSED METHODS

We do not currently have the flexibility of other options. We must stick to our plan as we need to report specific information to our adviser each week.

3.4 VALIDATION

In the short term, our results will be confirmed in our weekly meetings with our professor and graduate assistant. We will go through and discuss everything that we did the past week.

In the long run, we will be providing possible solutions to Alliant, and giving them the technical data that we calculated. We will want to review this with our professor before we send it off to make sure he agrees with the data.

4 Project Requirements/Specifications

4.1 FUNCTIONAL

- Analyze IEEE distribution systems.
 - Load profiles
 - Voltage magnitudes and angles
 - Voltage violations at busses
- Add Solar PV to the distribution models
 - Compare the load profiles to those from the base case
 - Compare the power flows to the base case
- Analyze the Alliant Energy bus system provided
 - Load profiles
 - Compare those when solar is added
- Determine what modifications need to be made to the current Alliant system for it to be feasible to add solar

4.2 NON-FUNCTIONAL

List and explain the non-functional requirements of the project. This is where you would enlist non-technical requirements. This may still be a fundamental deliverable that your client needs at the end of the semester.

- Can the current Alliant system support high solar penetration as it exists now?
- How much would modifications cost to the current system?

5 Challenges

The organization and representation of simulation data present the need for outside code to acquire, format, and display data from OpenDSS in another program such as Excel. Learning how to write code to communicate between the programs is useful for when we have to export large amounts of data to be combined and organized to present to our adviser.

Almost every member of our group has not used the OpenDSS software before starting this senior design project. This puts the team in the position to have to learn the software at a swift pace to perform the assignments that are given to us by our advisor on a weekly basis.

6 Timeline

You may want to include a Gantt chart/something similar to help visualise your timeline to complete the project.

6.1 FIRST SEMESTER

Assign different roles to group members and learn how to operate OpenDSS software.

Write out hand calculation for the IEEE 4-bus system and also run OpenDSS simulation and compare results.

Simulate 34-bus system in OpenDSS and provide plots of the voltage profile at certain busses in the system. We also need to change the load to a different value to show the effects on the system.

Travel to Washington, IA to visit the Alliant Energy Solar Farm.

Analyze voltage profiles and be able to distinguish why the voltage at certain points in the system is out of bounds and how to fix that issue.

Research voltage regulators and find out a cost of installation at certain points in the distribution system.

The research was adding community and residential solar PV into the system to see the effects it has on the entire system.

....

End of Semester – Finalize simulation of IEEE 8500 node system and figure out if we will use a new distribution system for the project or if we will continue to use Alliant Energy system. Give the presentation of our work thus far on the project.

6.2 SECOND SEMESTER

Continue our work on the 8500 node system and solution to any issues with the Alliant Energy system integration with the solar PV.

....

Finish project and submit our work to Alliant Energy once our advisor approves. Give a final presentation of our project during the dead week.

7 Conclusions

Work with OpenDSS software to simulate different scenarios on the IEEE 8500 node system as well as the Alliant Energy system.

Figure out what the best solution would be with regards to installing voltage regulators at certain points in the system.

Analyze data from both systems to figure out what solution would work the best with regards to the compensating any issues with solar PV penetration in the system.

8 References

List all the sources you used in understanding your project statement, defining your goals and your system design. This report will help you collect all the useful sources together so you can go back and use them when you need them.

9 Appendices

If you have any large graphs, tables, or similar that does not directly pertain to the problem but helps support it, include that here. You may also include your Gantt chart over here.