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Accelerating Cost-Effective Deployment of Solar Generation on the Distribution Grid

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SYSTEMS INTEGRATION

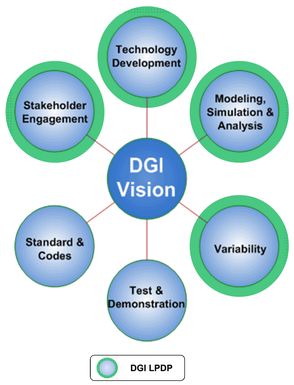
BACKGROUND

The interconnection process needs to be improved in order to increase the rate of PV deployment on the distribution grid. The purpose of this R&D program is to develop analysis procedures, tools, and data that can be used to expedite the interconnection study process and lower the cost of interconnecting to the grid in order to accelerate solar deployment on the distribution grid.

An important measure of success for the SunShot initiative will be the amount of solar generation that can be cost-effectively and reliably installed on the grid by 2020. A critical challenge to grid integration is the inability of current interconnection screens to adapt to the proliferation of high PV deployment scenarios and differentiate high risk interconnections from those not needing interconnection studies. Sandia's research program addresses these gaps. The work is conducted in collaboration with key stakeholders.

OBJECTIVES

- Expedite the PV interconnection process by revising and simplifying the screening process in California, utilizing data-driven and validated approaches to determine feeder PV capacity limits.
- Determine the technical feasibility of high PV deployment scenarios and their impacts on the electric distribution system in the U.S and improve the cost effective mitigation of the impacts.



- Develop PV modeling tools and methods to systematically generate representative high-frequency solar output variability data to enhance the accuracy of distribution integration studies.
- Engage stakeholders on grid interconnection results to encourage the adoption of new Small Generator Interconnection Procedure (SGIP) screening processes and best practices guidelines for cost-effective mitigation of system impacts

KEY PARTNERS

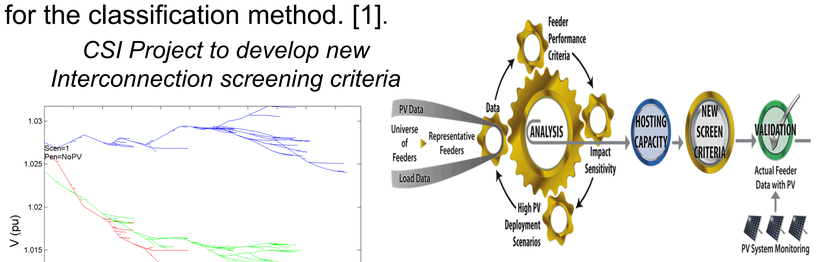
EPRI, NREL, Georgia Institute of Technology, IREC, UVIG, CPU and NARUC.

RESULTS

Expedite the PV Interconnection Process

Sandia developed a method to classify the feeders in a utility service territory and determine the sensitivity of particular groups of distribution feeders to the impacts of high PV deployment levels.
This innovative clustering method classifies a large number of feeder types into clusters, from which representative feeders can be selected and analyzed for PV hosting capacity. The project involved the analysis of 8,163 utility feeders from the three largest investor owned utilities in California. This effort determined 21 representative feeders for analysis and resulted in a user guideline for the classification method. [1].

CSI Project to develop new Interconnection screening criteria

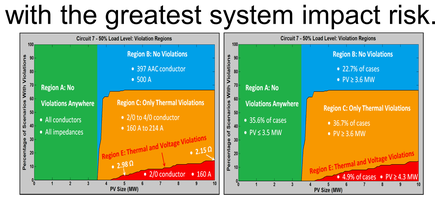


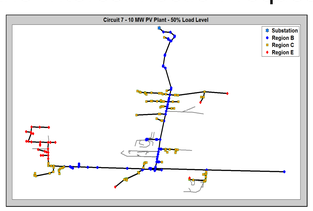
Analysis of representative feeders using 300 scenarios for various PV deployment levels and locations

Determine the Technical Feasibility of HPV Scenarios

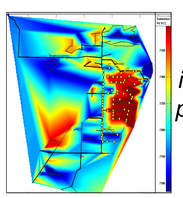
Sandia National Laboratories is developing a Feeder Impact Risk Score Technique (FIRST) to assess the impacts of high PV deployment on the distribution system and investigating new ways to streamline the interconnection analysis process.

Sandia is expanding the understanding of the impacts of high PV deployment scenarios in order to mitigate interconnection costs and focusing time and resources on the interconnection requests with the greatest system impact risk.





A matrix of snapshot power flow scenarios on a feeder model, Variables: 1) All possible PV interconnection points on the feeder, 2) Feeder load levels from 20%-100% of annual feeder peak and 3)PV system size from 0-10 MW in increments of 100 kW (adjustable)

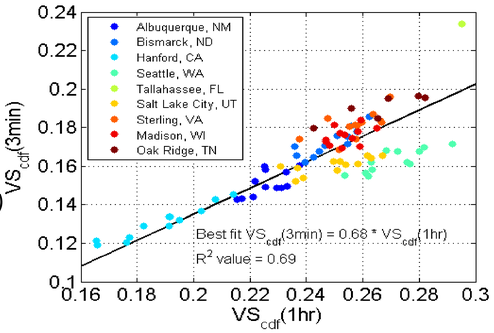


The results show the impact of high pen PV on the distribution system

Variability Modeling

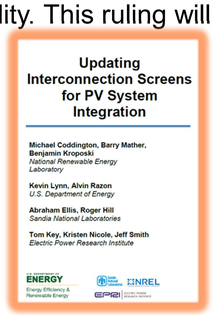
Sandia is developing new methods to produce appropriate, high-frequency solar inputs for distribution studies. Our approach is different from other works as we have assembled a large library of 1-second irradiance measurements (11 different locations collected, with more being pursued) to ensure that we have representative measured high-frequency data in different regions. We use 1-hour satellite data to define variability zones with similar 1-hour variability. We will then use 1-second data measured anywhere within a variability zone to be representative of all locations within that same zone. In this way, a representative solar input will be produced based on measured high-frequency data while still accounting for local climates. [2].

Validation of low and high frequency variability zones: Demonstrating significant correlation between 1-hour (x-axis) and 3-minute (y-axis) variability for ISIS data



Stakeholder Engagement

Sandia, in partnership with the Interstate Renewable Energy Council, proposed to FERC a new SGIP screening criteria based on voltage class, proximity to the stiff voltage source of the substation, and the connection to a large conductor backbone on the feeder as the criteria for fast-track eligibility. This ruling will affect all the procedures for getting distributed PV systems connected in the U.S.
Sandia co-authored a technical paper that formed the basis for a Notice of Proposed Rulemaking (NOPR) in Docket No. RM13-2-000, proposing modifications to the Federal Energy Regulatory Commission's SGIP.


Updating Interconnection Screens for PV System Integration

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REFERENCES AND RESOURCES

[1] R. Broderick, J. Williams, K. Ramos, "Clustering Method and Representative Feeder Selection for the California Solar Initiative". SAND 2014-1443, 2014
[2] M. Lave, R. Broderick, "Characterizing Local High-frequency Solar Variability for use in Distribution Studies" SAND 2014-1126A.

SunShot U.S. Department of Energy

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