Bring Energy to Life

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MA-TSRG National Grid Advanced PV Facilities Update

Samer Arafa

06.13.2019

The Problem of Solar

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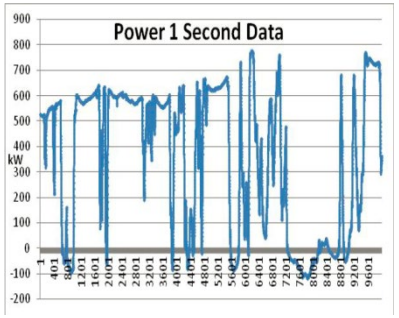

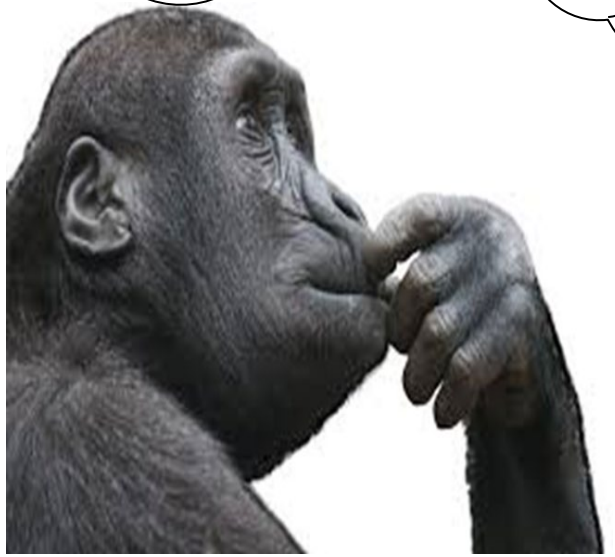

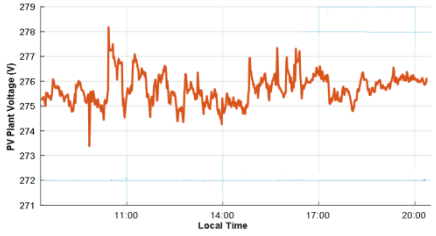

Are Doing Enough Today?

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Goal: *Reduce customer interconnection cost and time. Move from interconnecting DER to integrating it.*

Promising Technologies We are Exploring

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Key Areas of Research in the program	Partner	Share updates
Increasing Hosting Capacity-Interim Report	EPRI	Offered Q2, 2018
DC Arc flash study	EPRI	Offered Q3, 2018
Increasing Hosting Capacity-Smart Inverters	EPRI	Q2, 2019
Azimuth Shifting	EIG	Q3, 2019
Distribution Resource Open Management Optimization System (DROMOS)	Sandia	Q4, 2019
PV +Storage+ Load Management systems	Fraunhofer	Q1, 2020
Cost/Benefit Analysis of Smart Inverters	EPRI	Q2, 2020
Risk of Islanding of Smart Inverters	NPPT	Q3, 2020
Grid Edge DTT	Grid Edge	Q4, 2020

Why Advanced Inverters?

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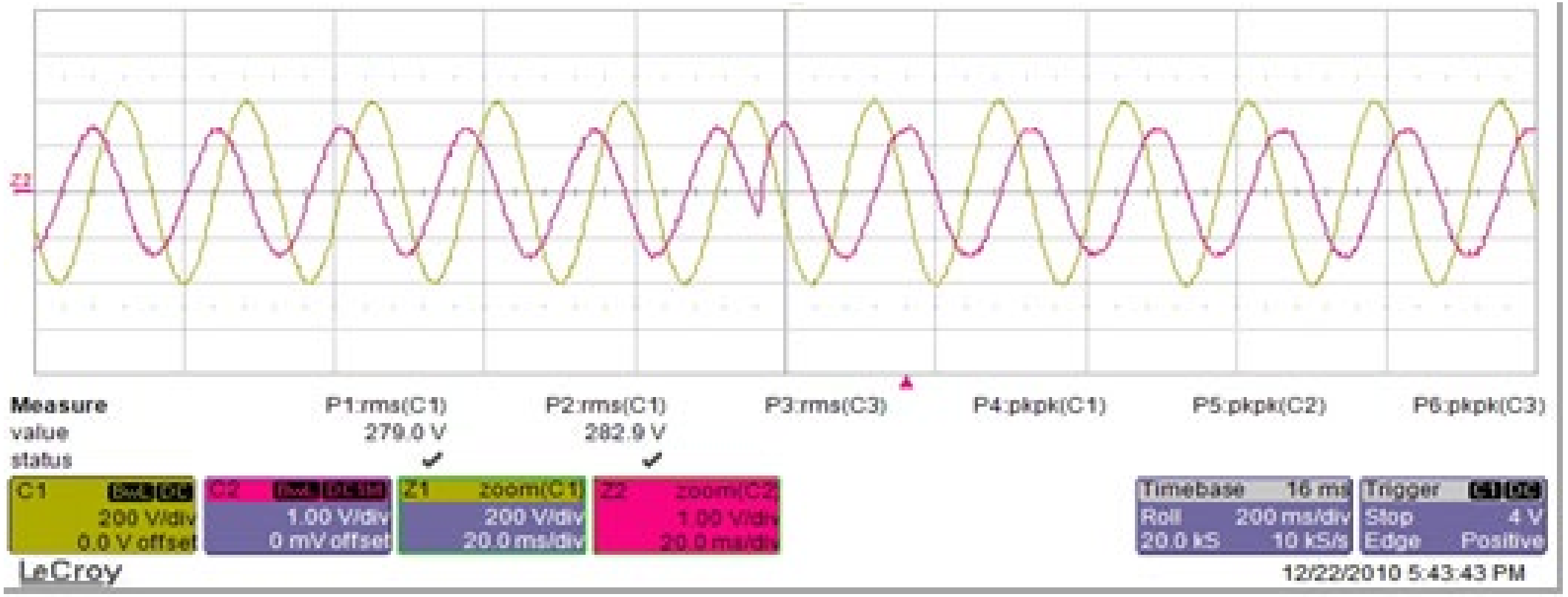
- Inverters can change the run angle of their Current, within one cycle ➔ Inverters can generate or absorb VARs when needed ➔ Inverters can be used to regulate voltage.



Smart Grid Ready PV Inverters with Utility Communication: Results from Field Demonstrations, EPRI 2016
http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000003002008557

Let's Talk to Them!

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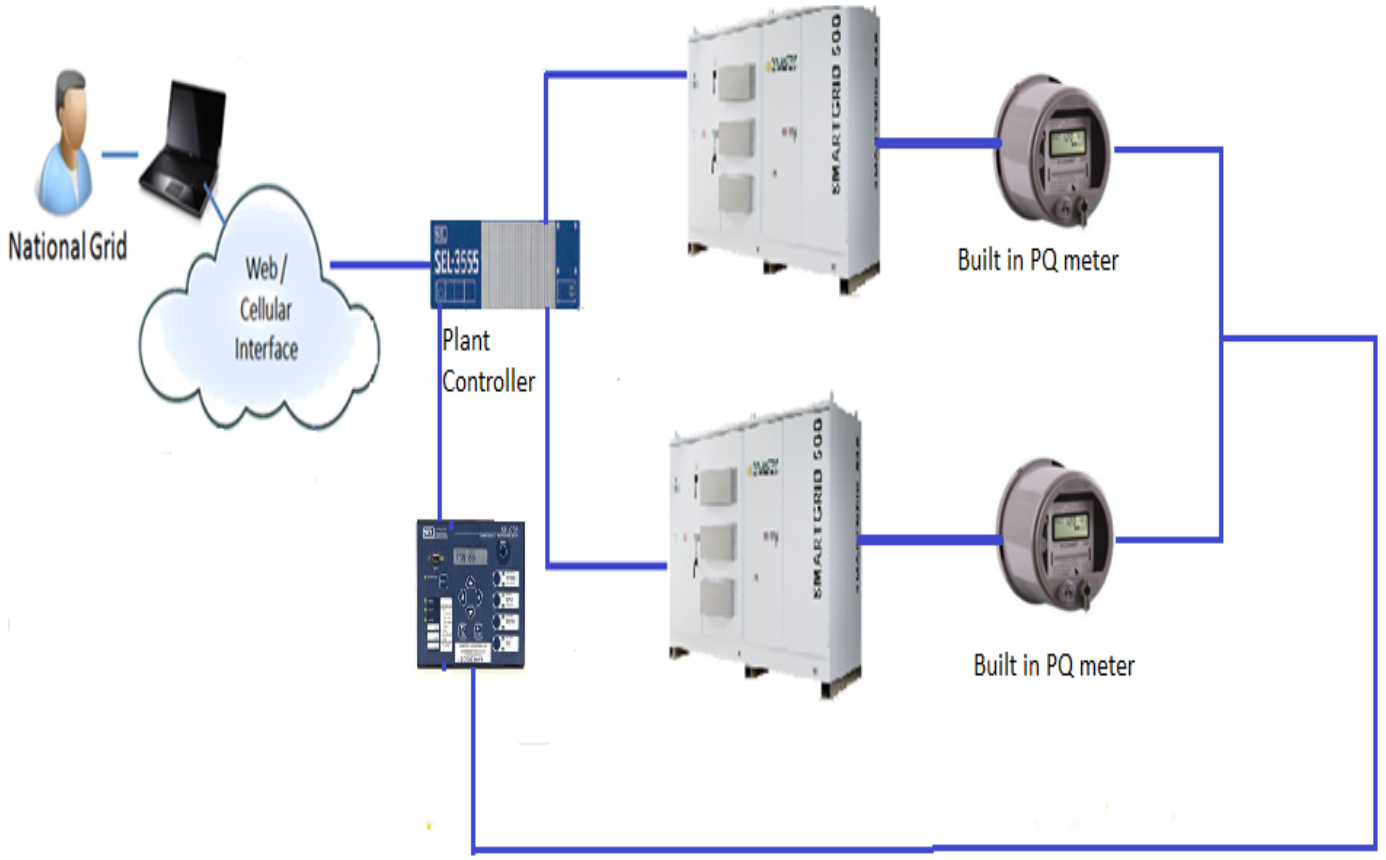
- Plant Controllers/ Management systems will continuously measure System PQ conditions and translate them into commands.

- Plant Controllers will continuously update commands based on real time challenges and inverters actual response.



2MW Kelly Rd PV Site

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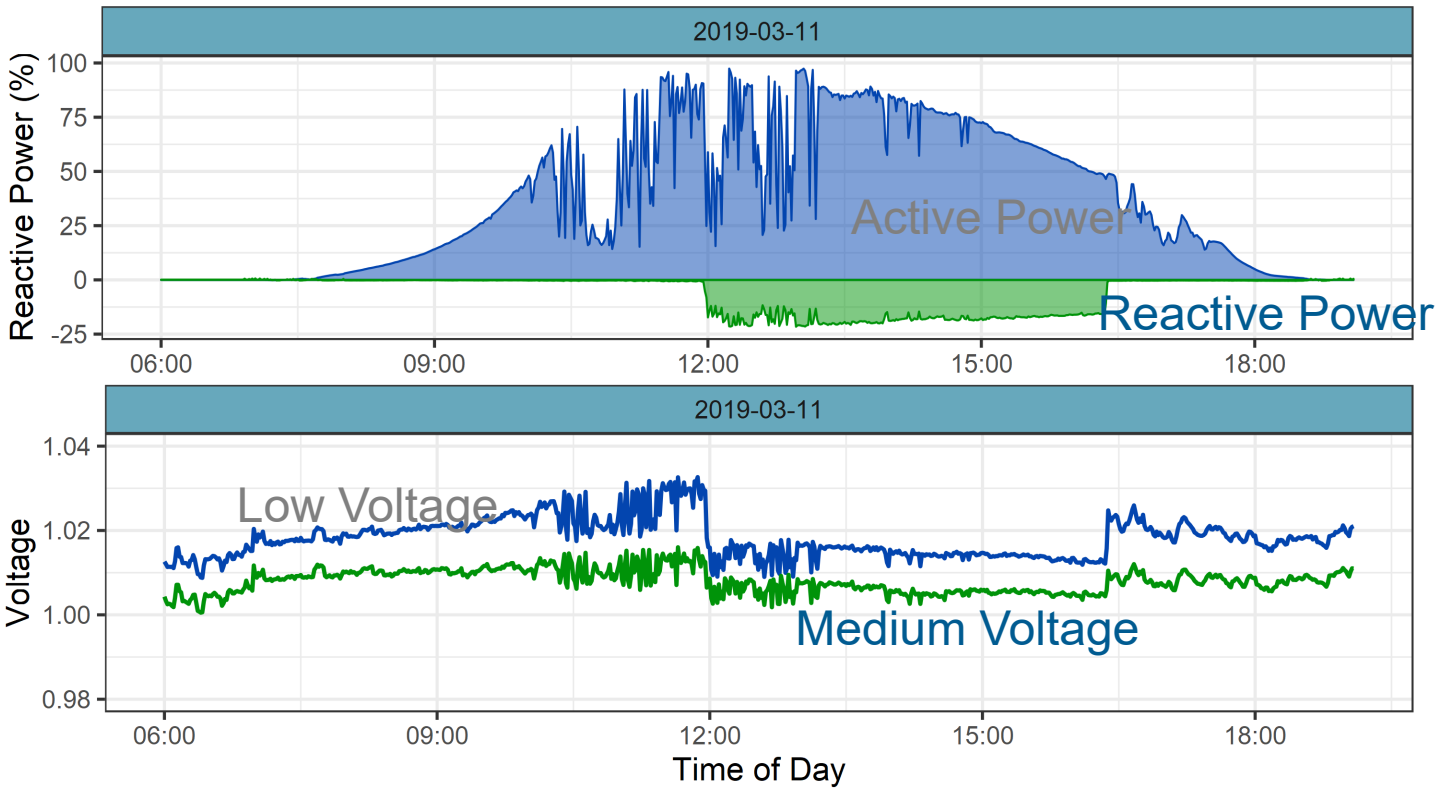
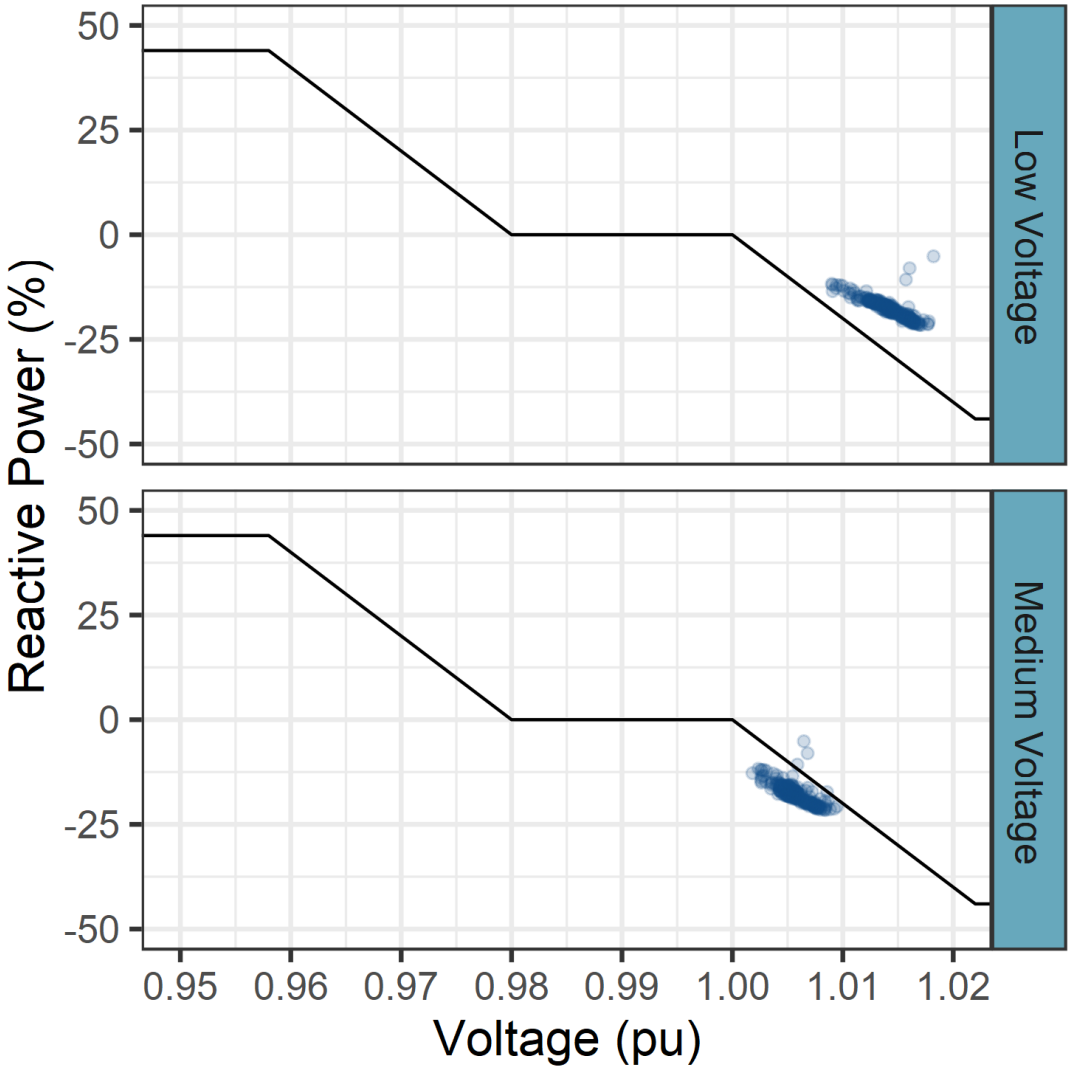
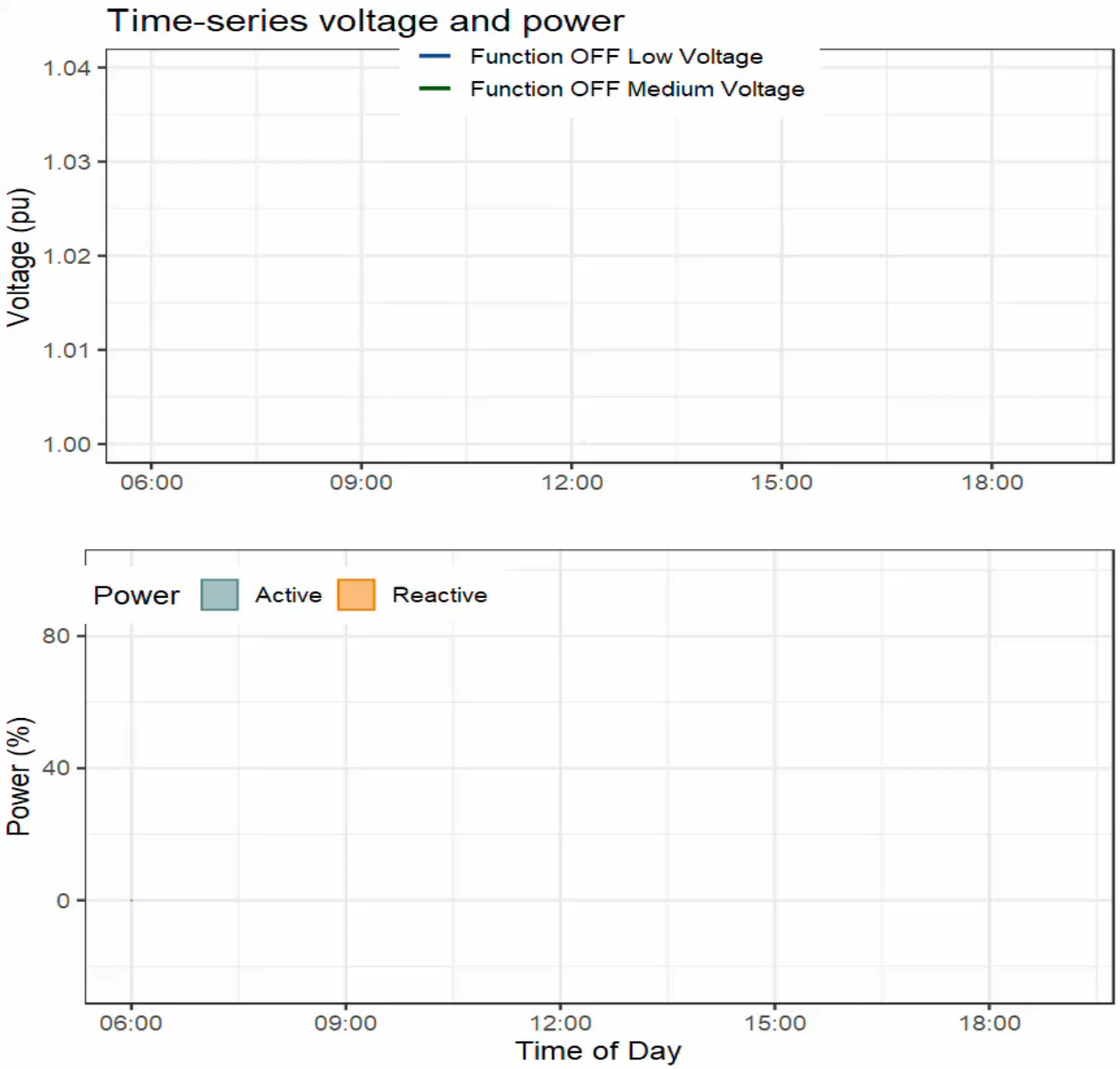
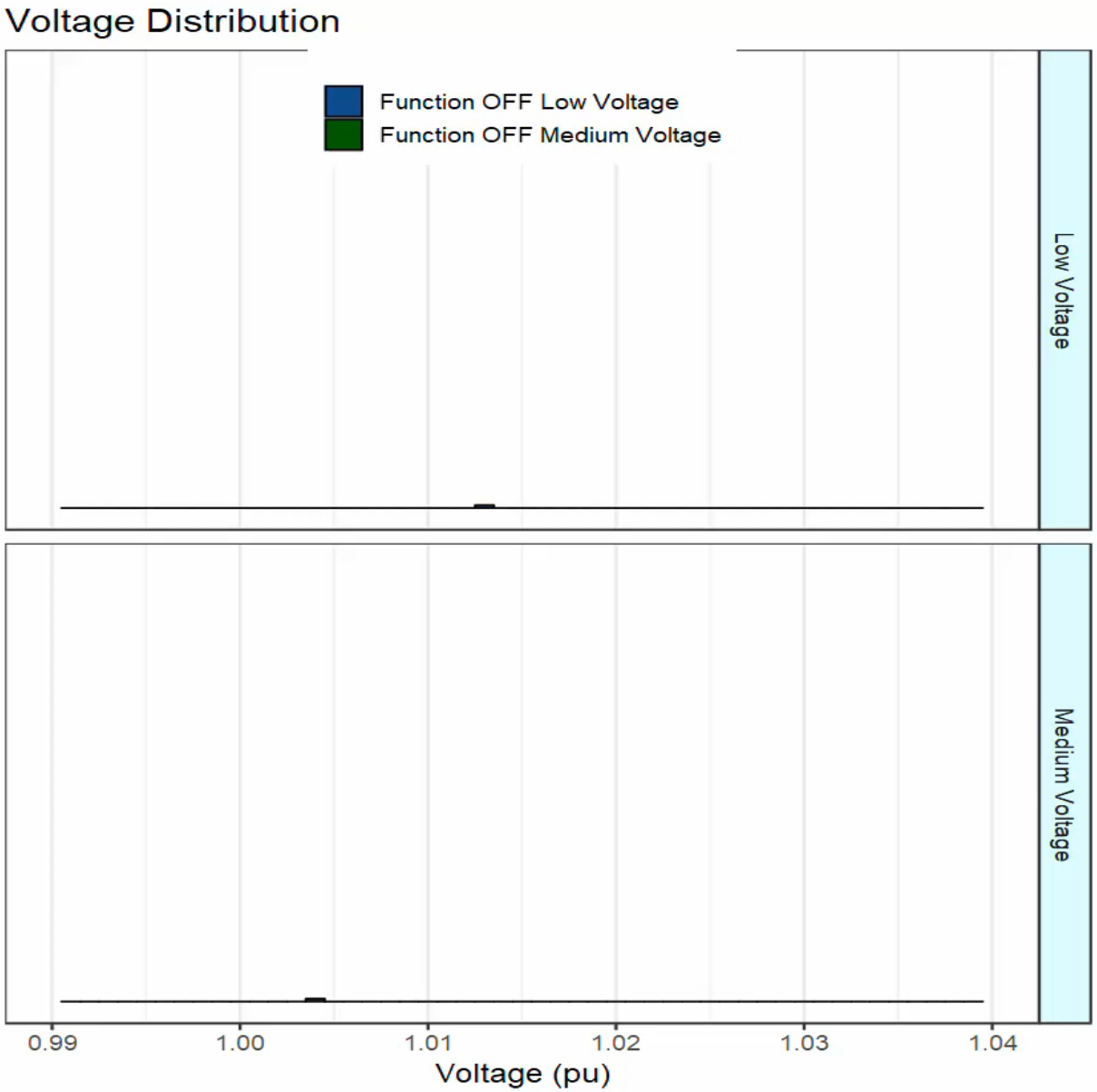
- VAR Support reduces voltage and reduces voltage variability









Data Analysis courtesy of EPRI

1MW Groton Rd site

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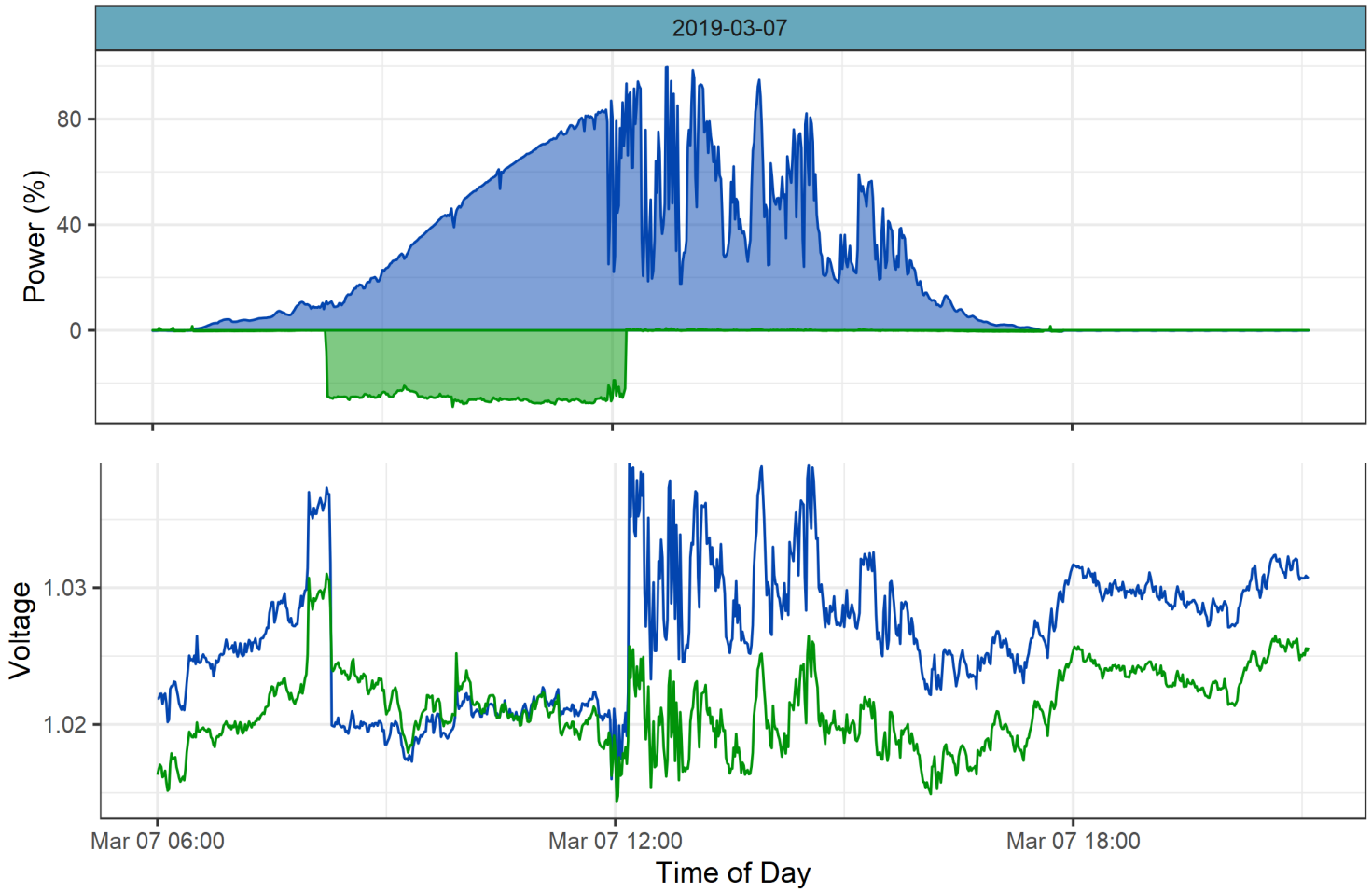
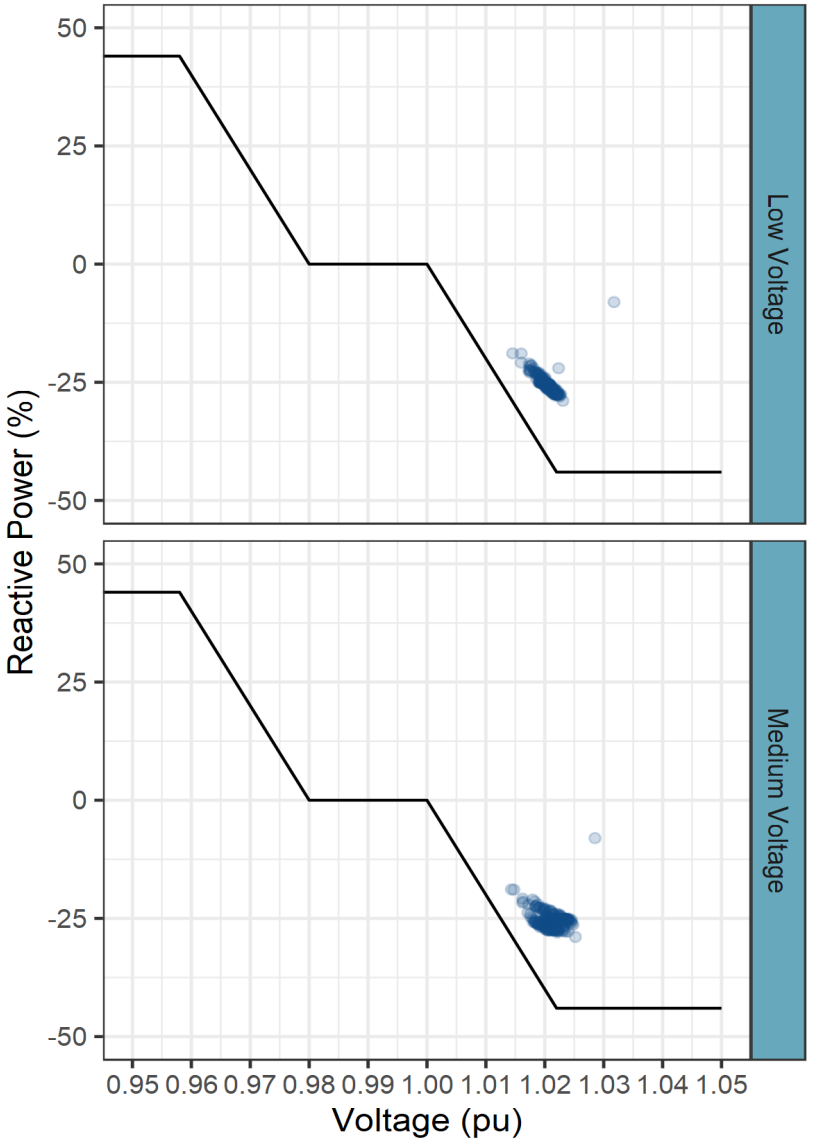
- Var support reduces voltage and reduces voltage variability





Setting the Feeder to Fixed PF- Blossom Rd 2MW

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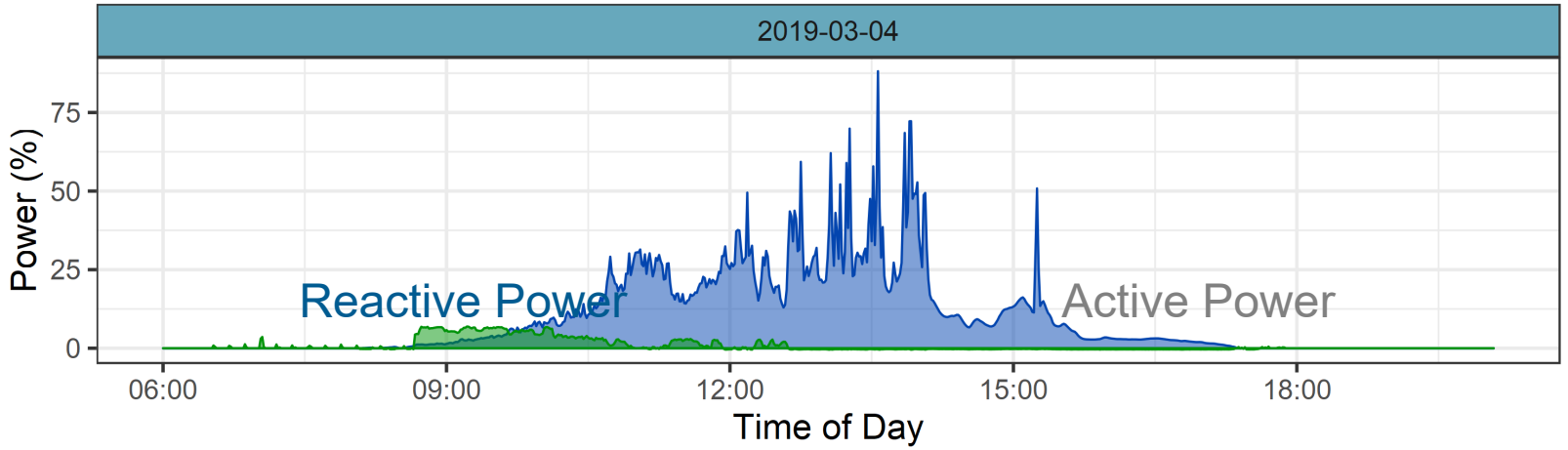
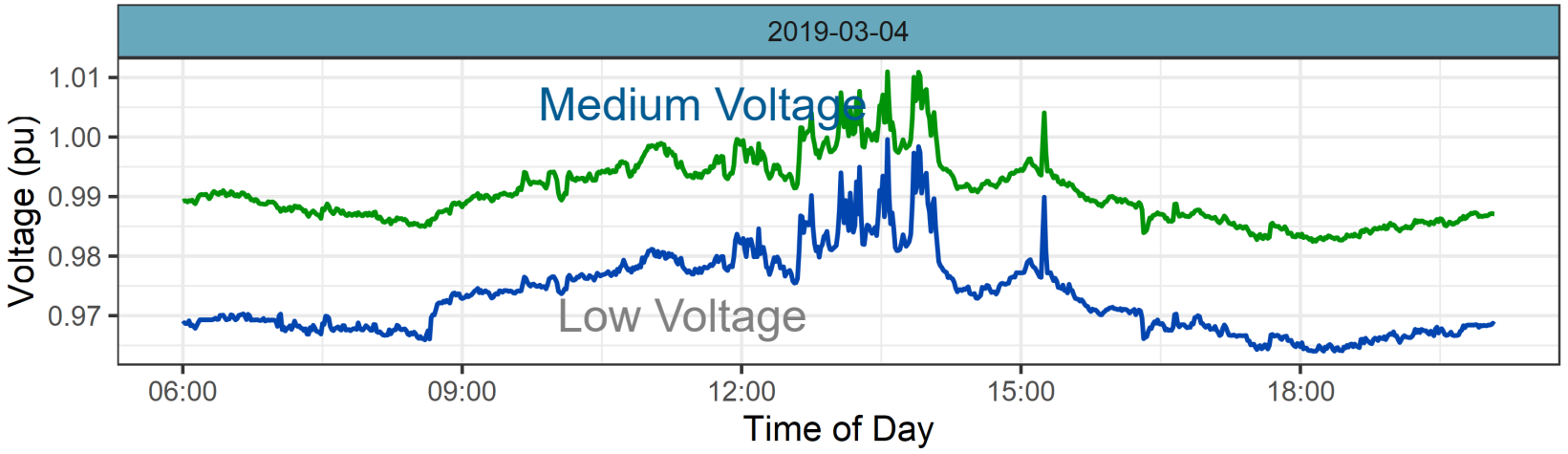
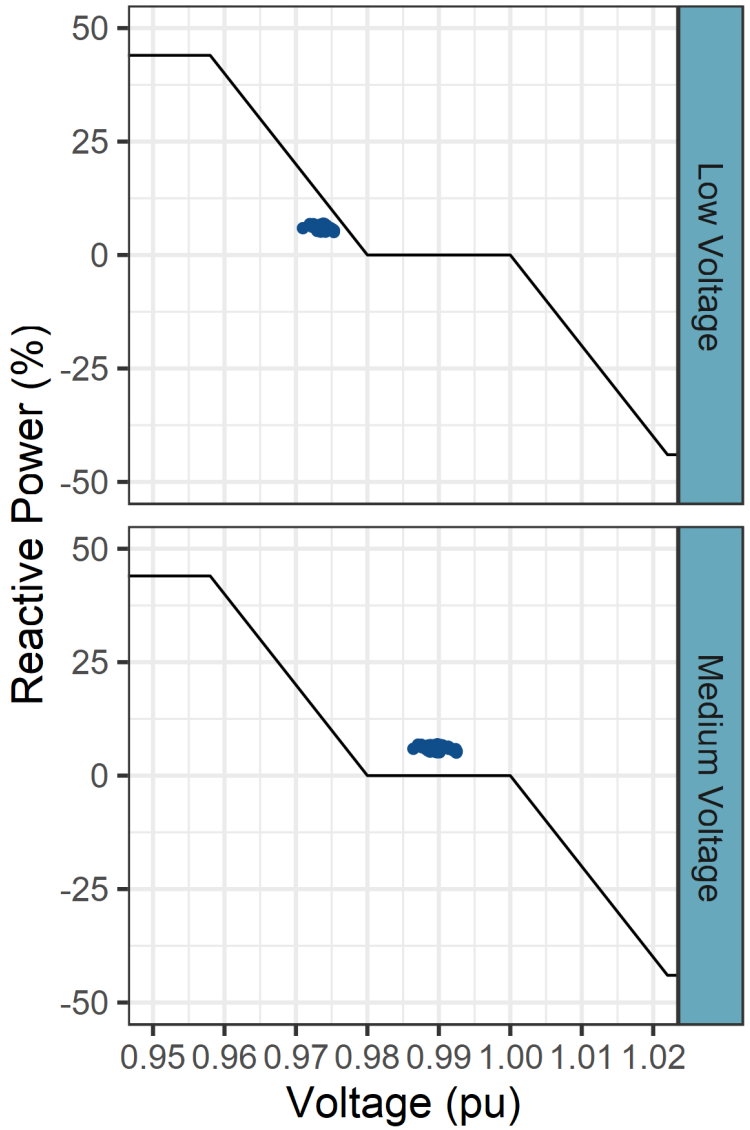
- Neighboring sites are operating in a fixed PF absorbing PF 0.97
- This results in voltage that is sub-optimal.







So, Let's Turn Them On?

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Wide adoption of Smart Inverters largest challenge is the lack of available models that allow system planners to predict Inverters fault and islanding behaviors.

Smart Inverters are only part of the solution, a more complete solution requires addressing the following:

- System needs change overtime, grid support settings that work for winter seasons may not work the following spring.
- Communications maybe needed to solve system Thermal issues.
- Storage and Load Management are also part of the solution.
- Inverters internal PQ metering may not be sufficient.

When Things Go wrong- Voltage Oscillations Challenges

Data Analysis courtesy of EPRI

Voltage Oscillation Challenge

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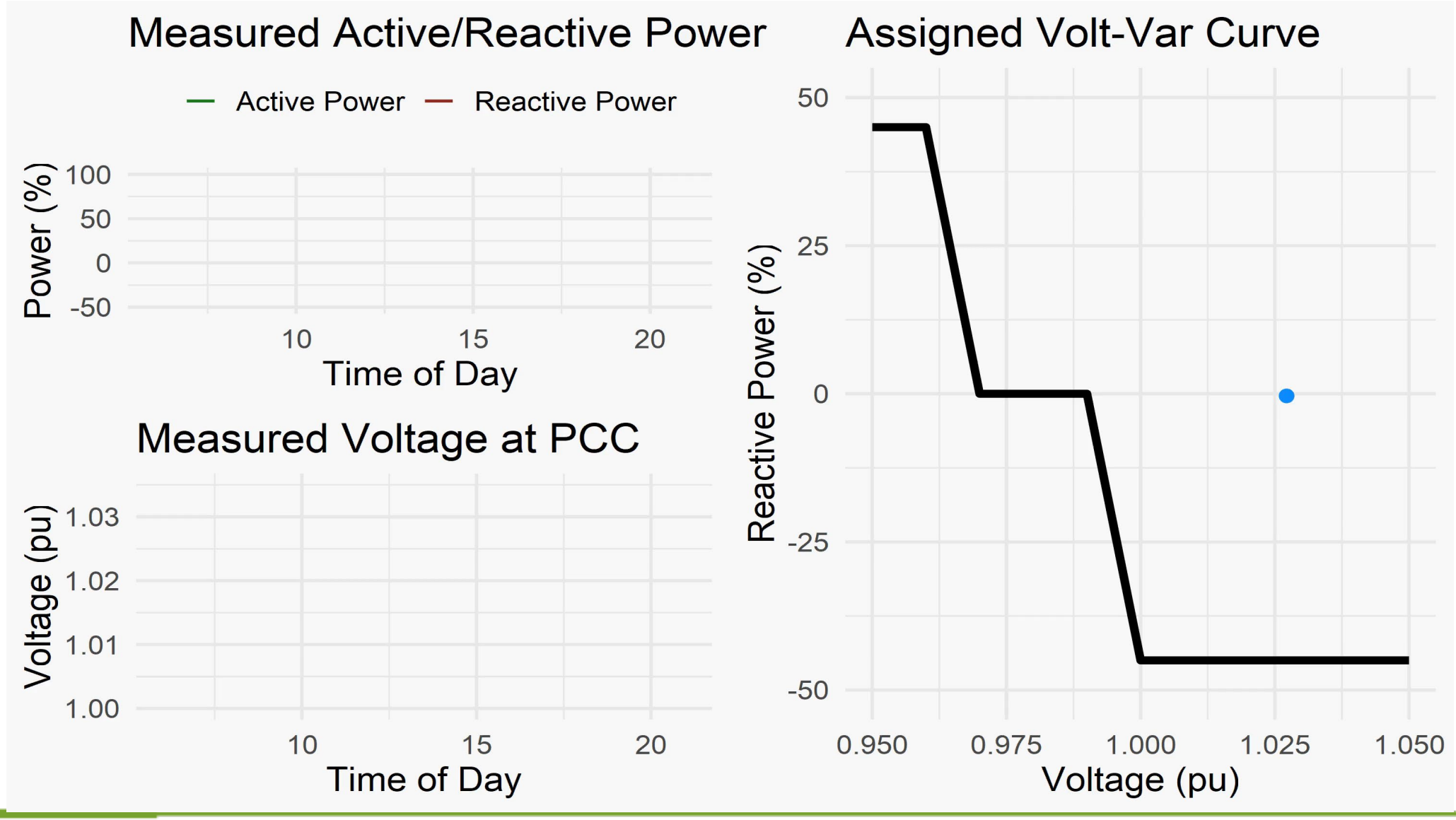

High-resolution Data Reveals Plant Control Induced Oscillations

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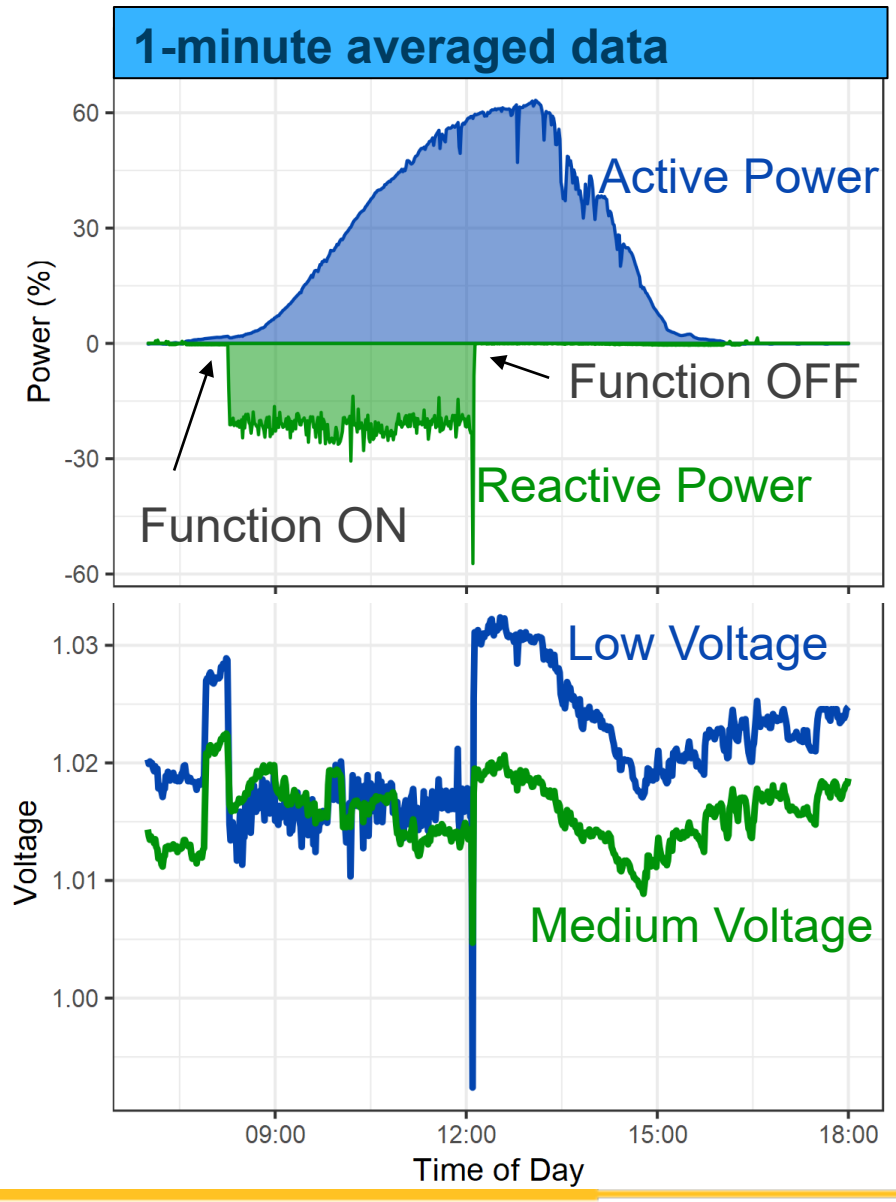

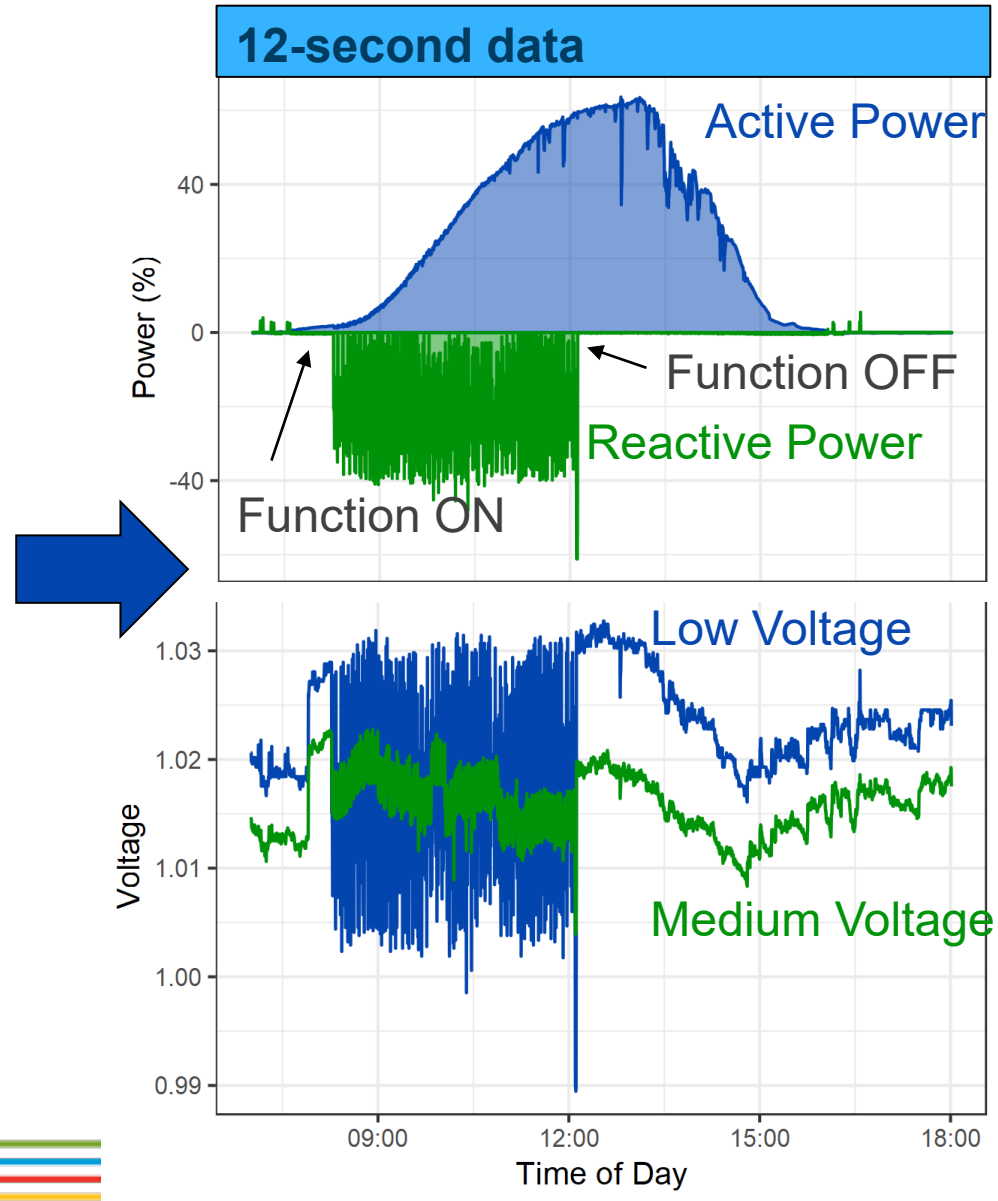

Large oscillations in reactive power result in voltage oscillations

Low voltage oscillations: 3%

Medium voltage oscillations: 0.5%

Comparison of Volt-Var Slope Impact on Oscillations

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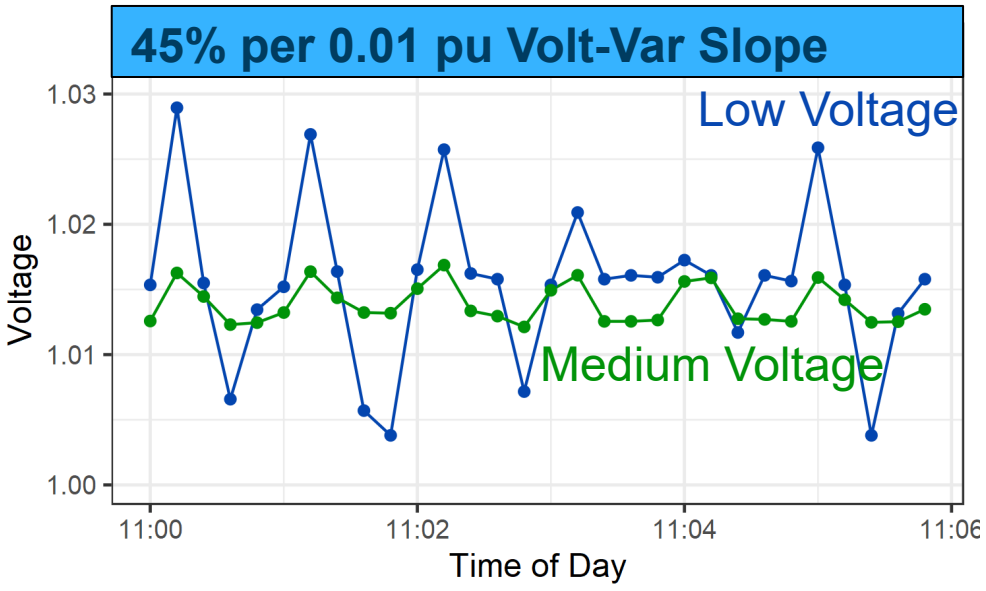
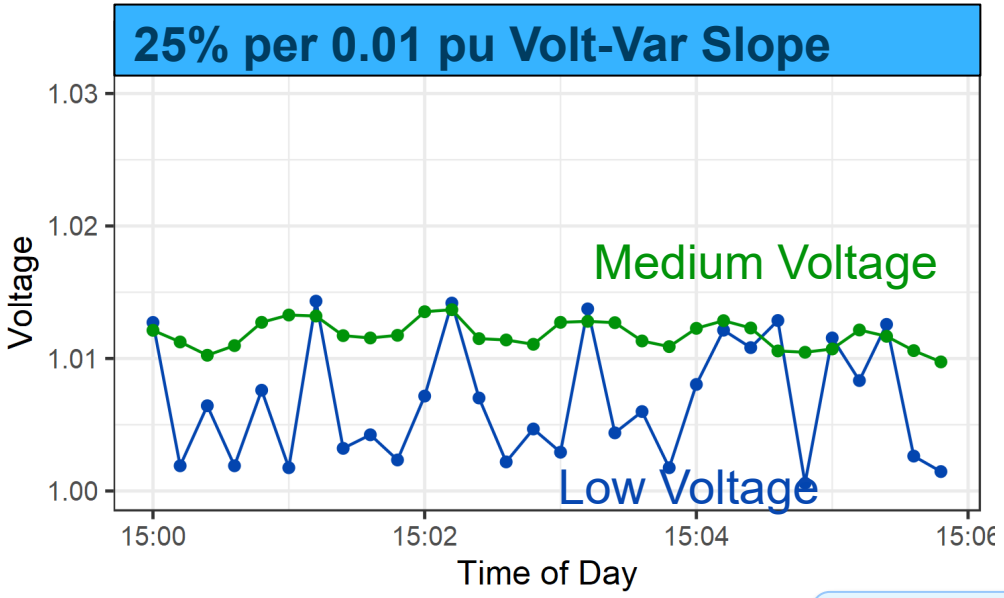
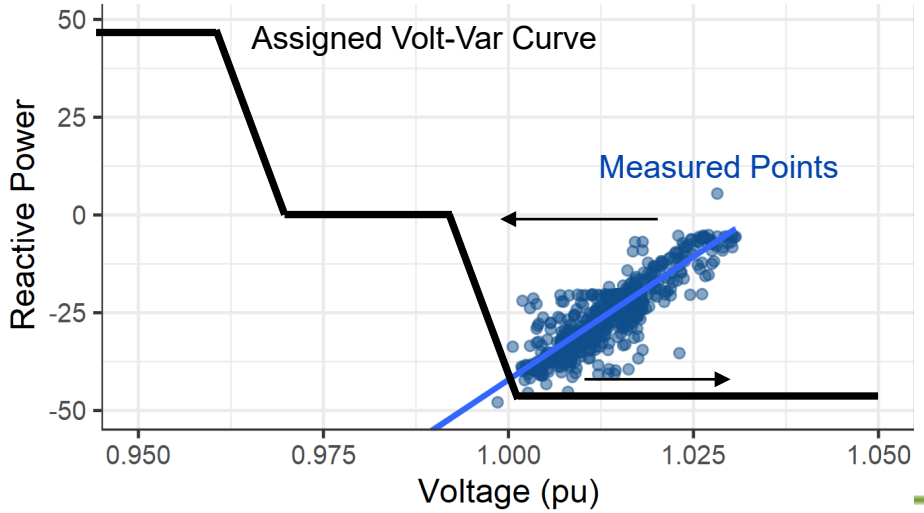
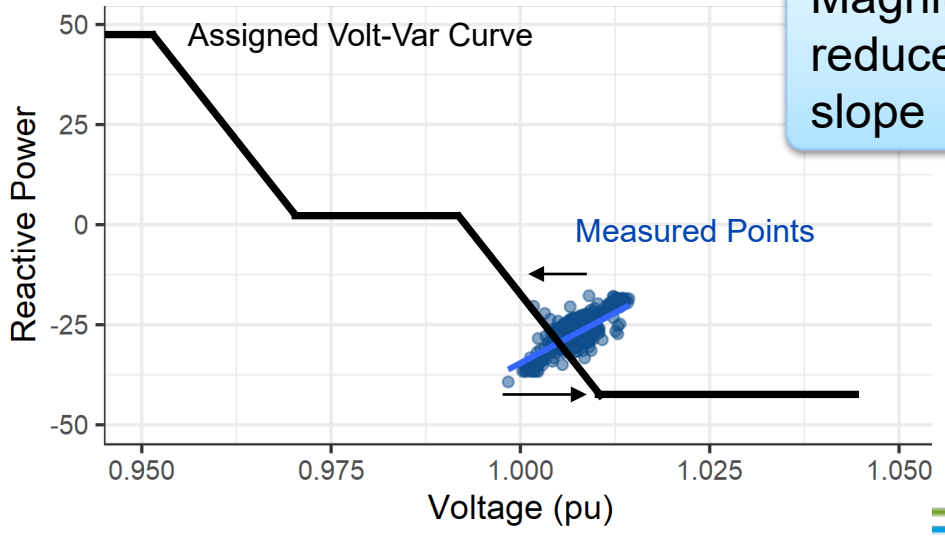


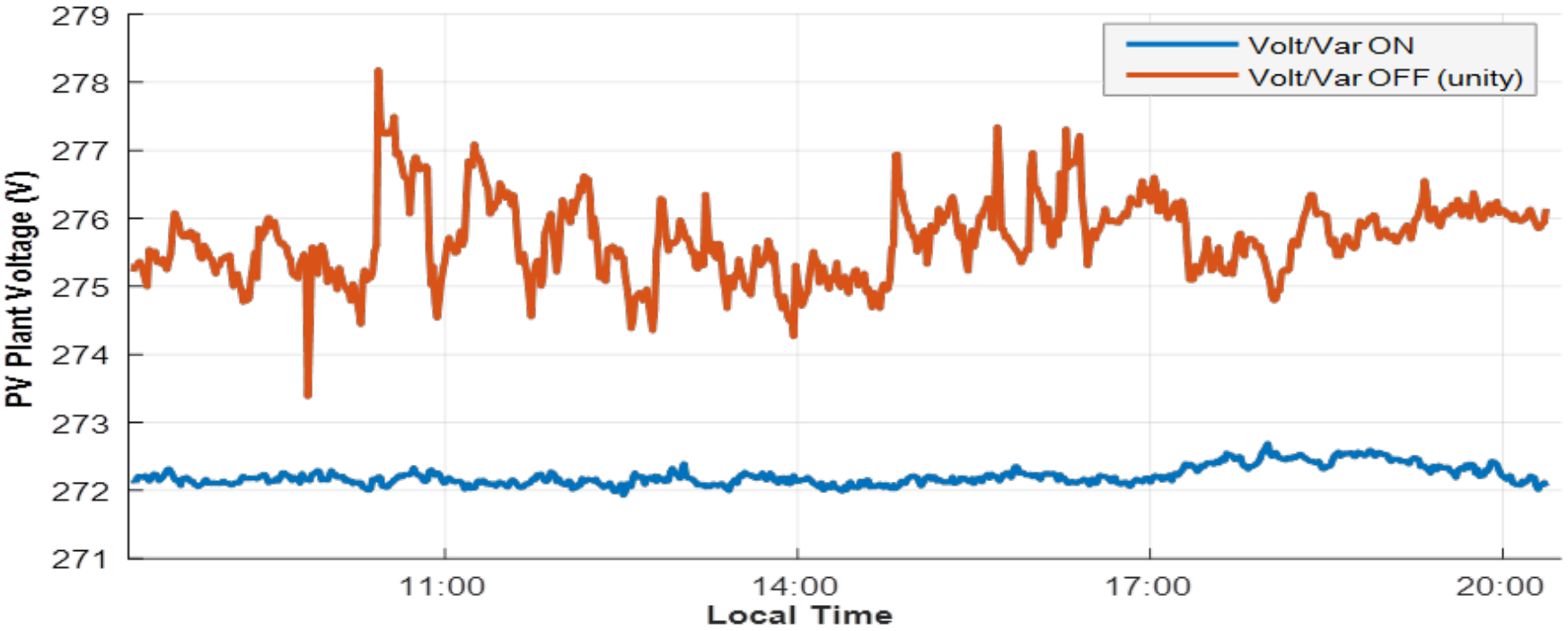






Magnitude of oscillations is reduced with a shallow slope

National Grid received an EPRI Technology Transfer Award for the potential this research may have into increasing the adoption of renewable energy and reducing customer interconnection cost and time.



References

- Recommended Smart Inverter Settings for Grid Support and Test Plan: Interim Report

https://www.epri.com/#/pages/product/3002012594/?lang=en

- Smart Grid Ready PV Inverters with Utility Communication

https://www.epri.com/#/pages/product/000000003002008557/?lang=en

- *Links may need to be copy and pasted into Chrome

Questions?

Discussions/ Ideas

Samer Arafa (Ms.ECE, PMP,CSM)
Lead Engineer – Grid Modernization & Telecom
National Grid
samer.arafa@nationalgrid.com