Open Source Modeling of Advanced Inverter Functions for Solar Photovoltaic Installations

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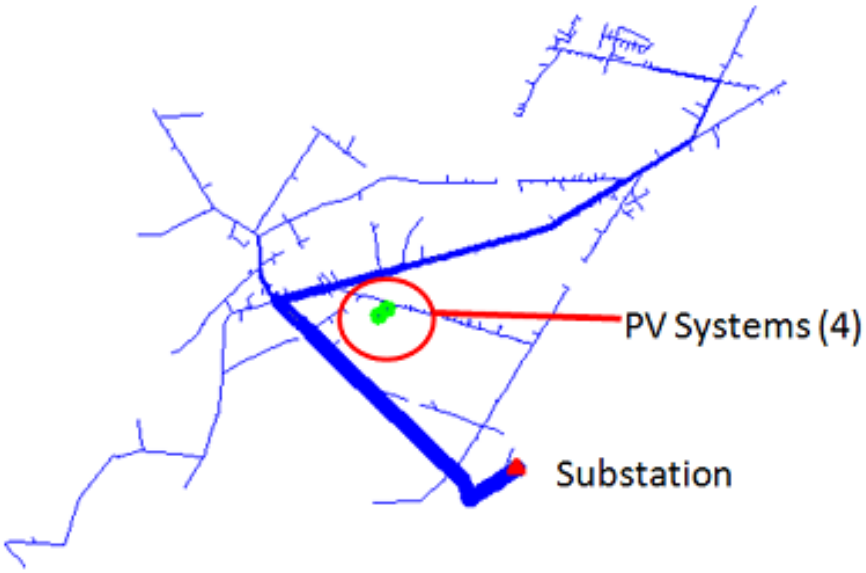
Introduction

- Increasing penetration of solar photovoltaic (PV) installations on distribution system
- Increasing possibility of interactions between PV and power system
- Developed Inverter Control (InvControl) in the OpenDSS to enable investigation of Advanced Inverter Control Functionality by students, engineers, and researchers
- OpenDSS: http://sourceforge.net/projects/electricdss/

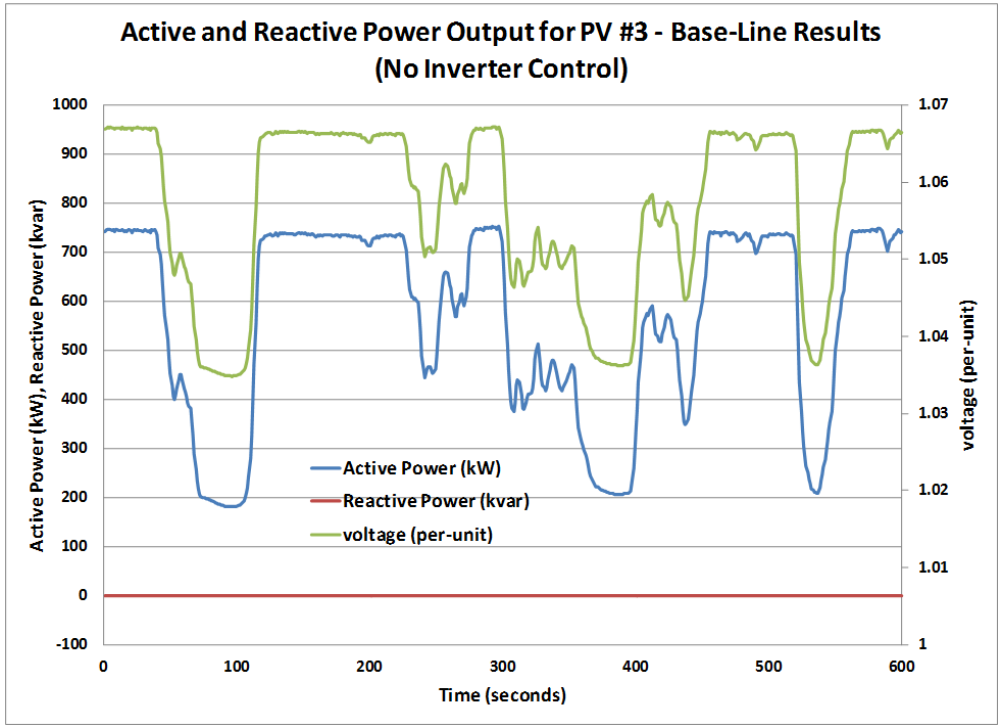
Demonstration of InvControl

- Used an actual feeder provided by utility funder to illustrate InvControl
- Four large-scale PV installations

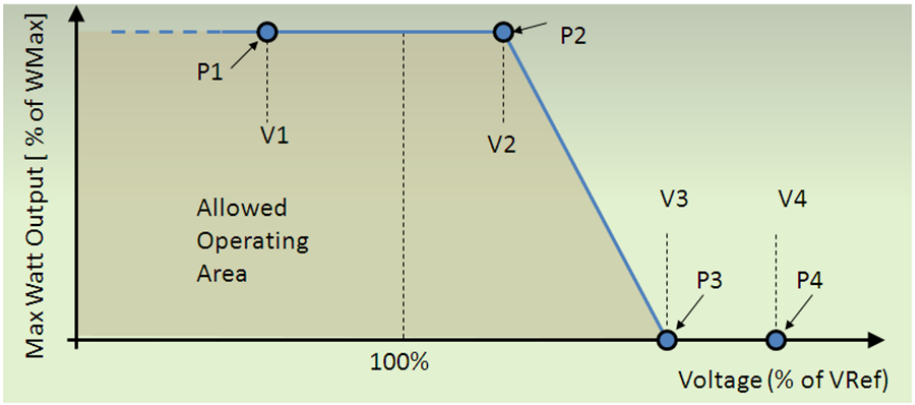


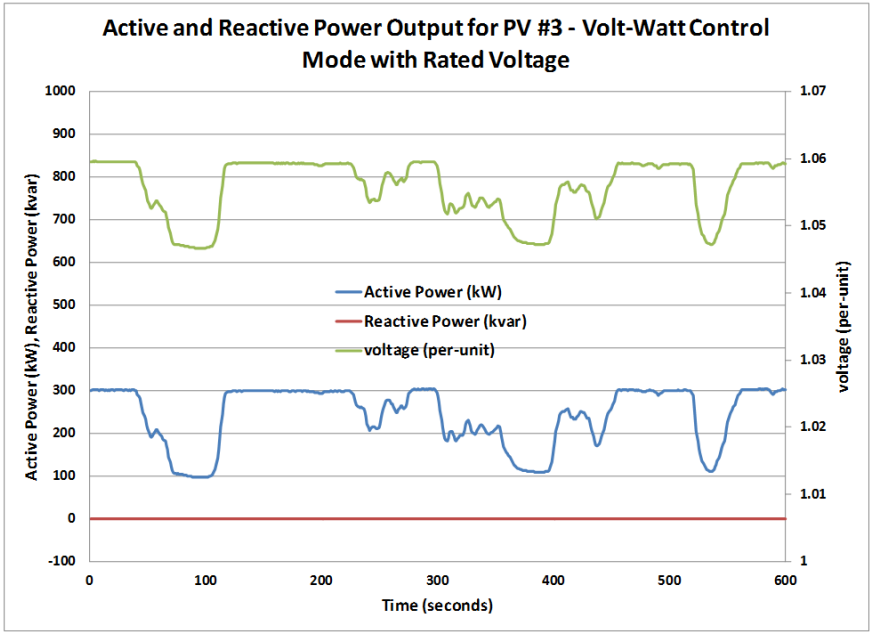
Base-Line Results

- Using a PVSystem model, determined base-line results for one of the PV (PV #3)



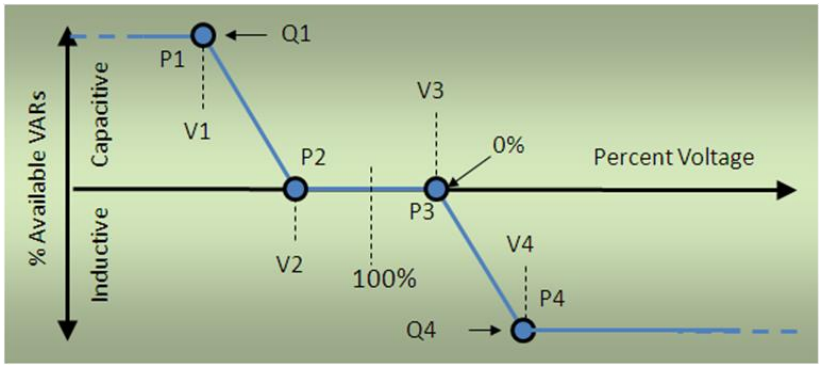
Volt-Watt Adv. Inverter Function

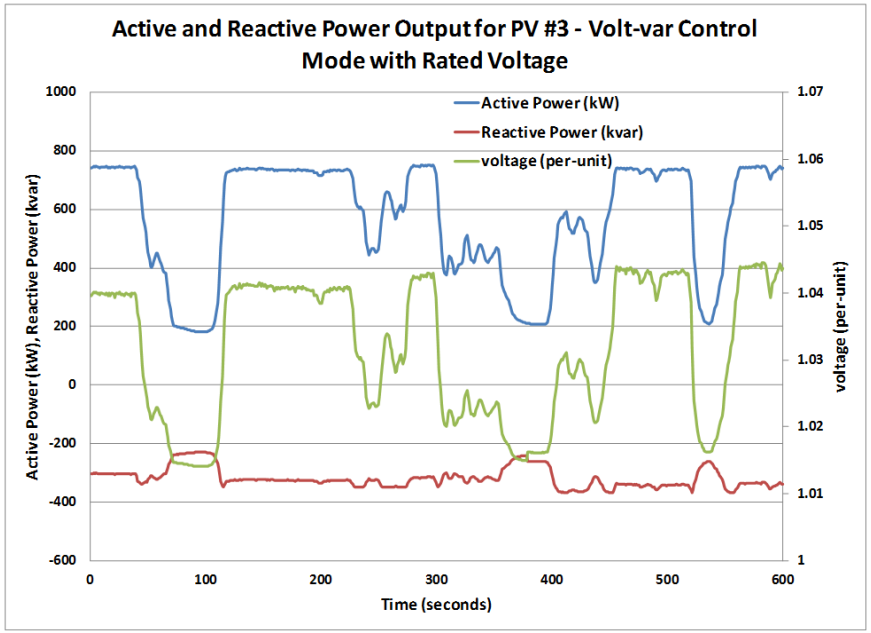





```
New XYCurve.VWcurve npts=4
~ Yarray=(1,1,0,0)
~ XArray=(0,1,1.1,2)
New InvControl.Ctrl mode=VOLTWATT
   ~ voltage_curvex_ref=rated
   ~ voltwatt_curve=VWcurve
```

Volt-Var Adv. Inverter Function

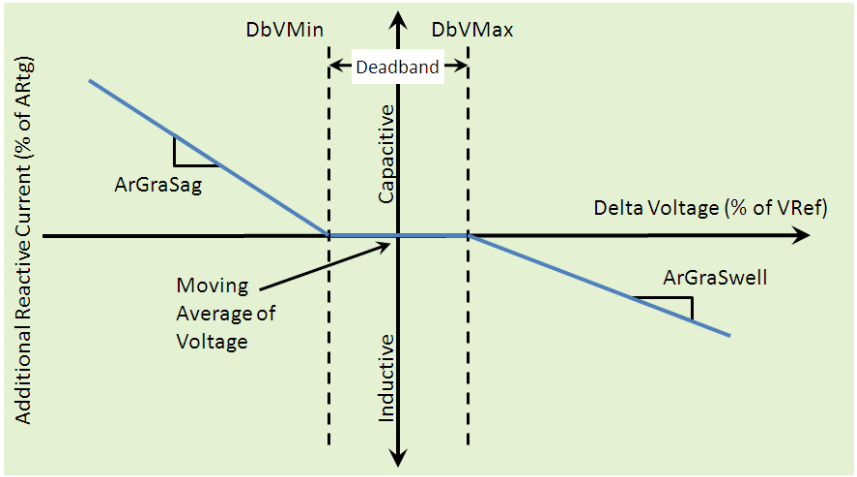


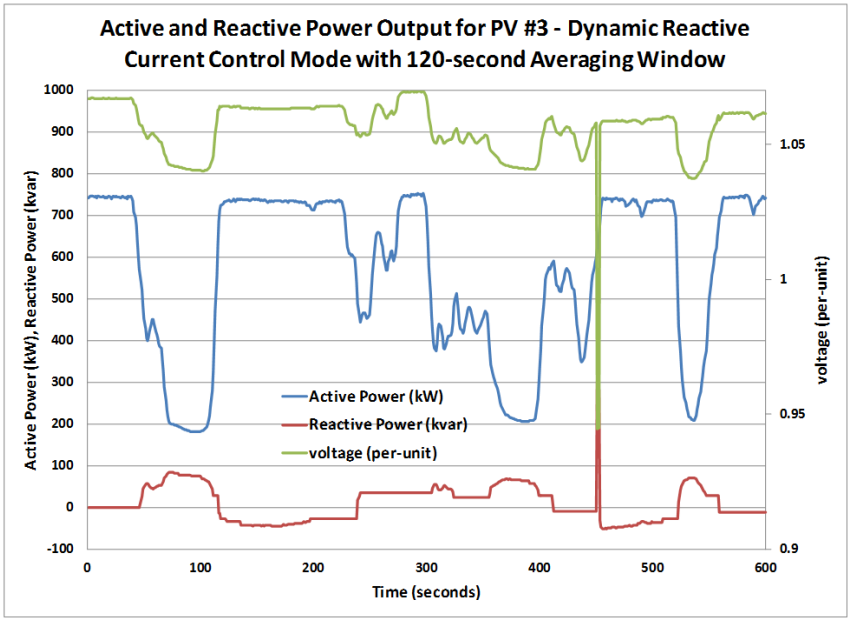



```
New XYCurve.vv_curve npts=4
~ Yarray=(1,1,-1,-1)
~ XArray=(0.5,0.95,1.05,1.5)

New InvControl.Ctrl mode=VOLTVAR
~ voltage_curvex_ref=rated
~ vvc_curve1=vv_curve
```

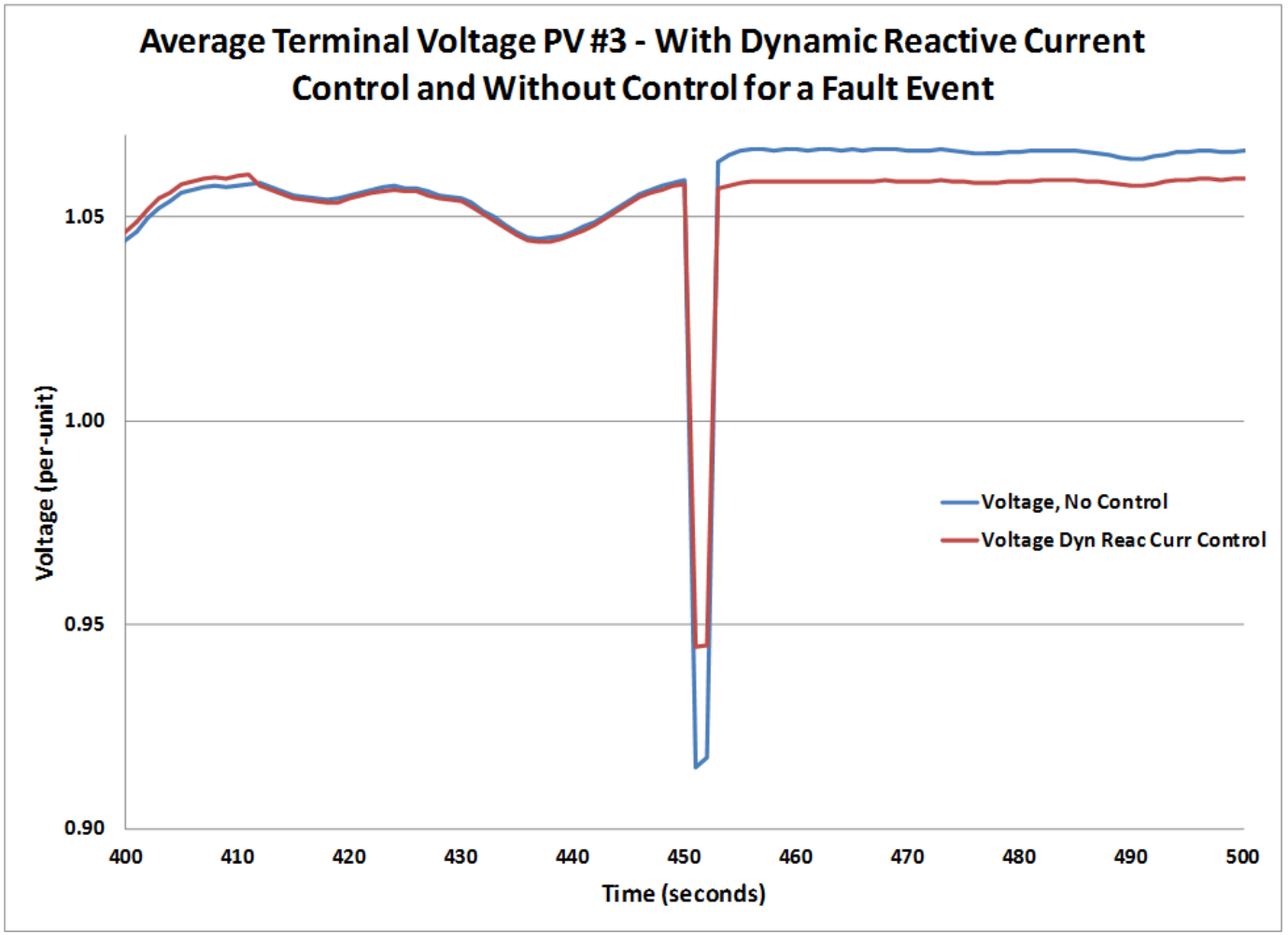
Dynamic Reactive Current Adv. Inverter Function






```
New InvControl.Ctrl
~ mode=DYNAMICREACCURR
~ DbVMin=0.975 DbVMax=1.025
~ ArGraLowV=10.0 ArGraHiV=10.0
~ DynReacavgwindowlen=120s
```

Dynamic Reactive Current Adv. Inverter Function (2)



Summary

- Three advanced inverter functions have been implemented in the OpenDSS for PV systems
- Simulations were performed to validate the advanced inverter control functions
- Researchers can use these advanced inverter functions to evaluate their usefulness and to better understand how parameter settings influence grid performance