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DOE DPV Website Tutorial

dpv.epri.com

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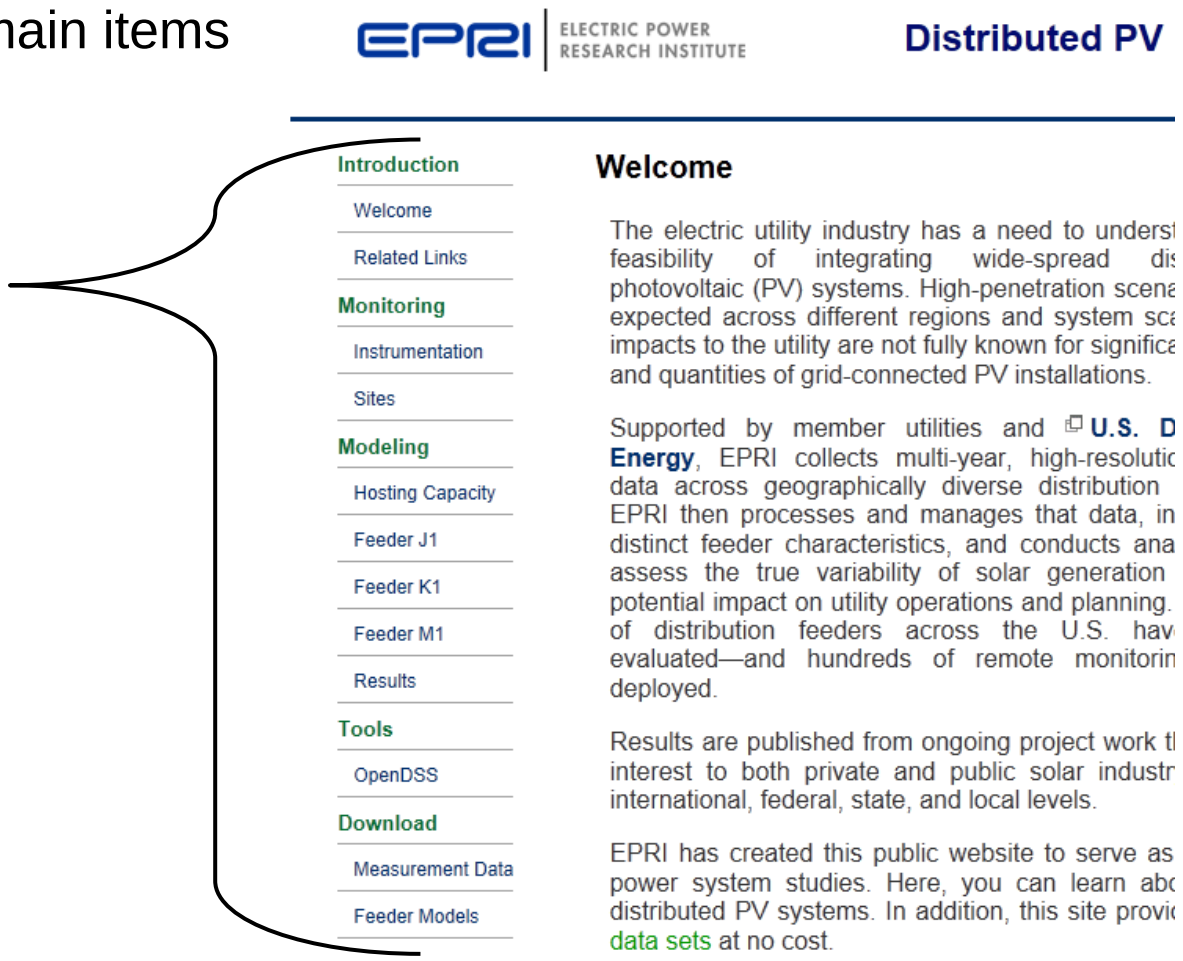
Using the Website

- Shortcuts to the three main items in the website
  - OpenDSS tool
  - Feeder models
  - Monitoring data



OpenDSS Tool

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- Related Links

Monitoring
- Instrumentation
- Sites

Modeling
- Hosting Capacity
- Feeder J1
- Feeder K1
- Feeder M1
- Results

Tools
- OpenDSS

Download
- Measurement Data
- Feeder Models

OpenDSS

OpenDSS is a freely-available, open-source electrical power system analysis tool used to simulate distribution-level power systems. It supports nearly all frequency domain (sinusoidal steady-state) analyses commonly performed on electric utility power distribution systems.

In addition, it supports many new types of analyses that are designed to meet future needs related to smart grid, grid modernization, and renewable energy research.

OpenDSS has been used since 1997 in support of various research and consulting projects requiring distribution system analysis. Many of the features found in the program were originally intended to support the analysis of distributed generation interconnected to utility distribution systems and that continues to be a common use.

Other features support analysis of such things as energy efficiency in power delivery and harmonic current flow. OpenDSS is designed to be indefinitely expandable so that it can be easily modified to meet future needs.

For download information, documentation, and test cases, please visit the EPRI Smart Grid Resource Center.

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Resources
- Use Case Repository
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  - Workshops & Conferences
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- NESCOR
- Related Links

Simulation Tool – OpenDSS

The OpenDSS is a comprehensive elect ms. It supports nearly all frequency domain (si ution systems. In addition, it supports many ne rid modernization, and renewable energy re h and consulting projects requiring distribution l to support the analysis of distributed gener n use. Other features support analysis of such things as energy efficiency in power delivery and harmonic current flow. The OpenDSS is designed to be indefinitely expandable so that it can be easily modified to meet future needs.

Links allow the user to download and install the latest version of the software

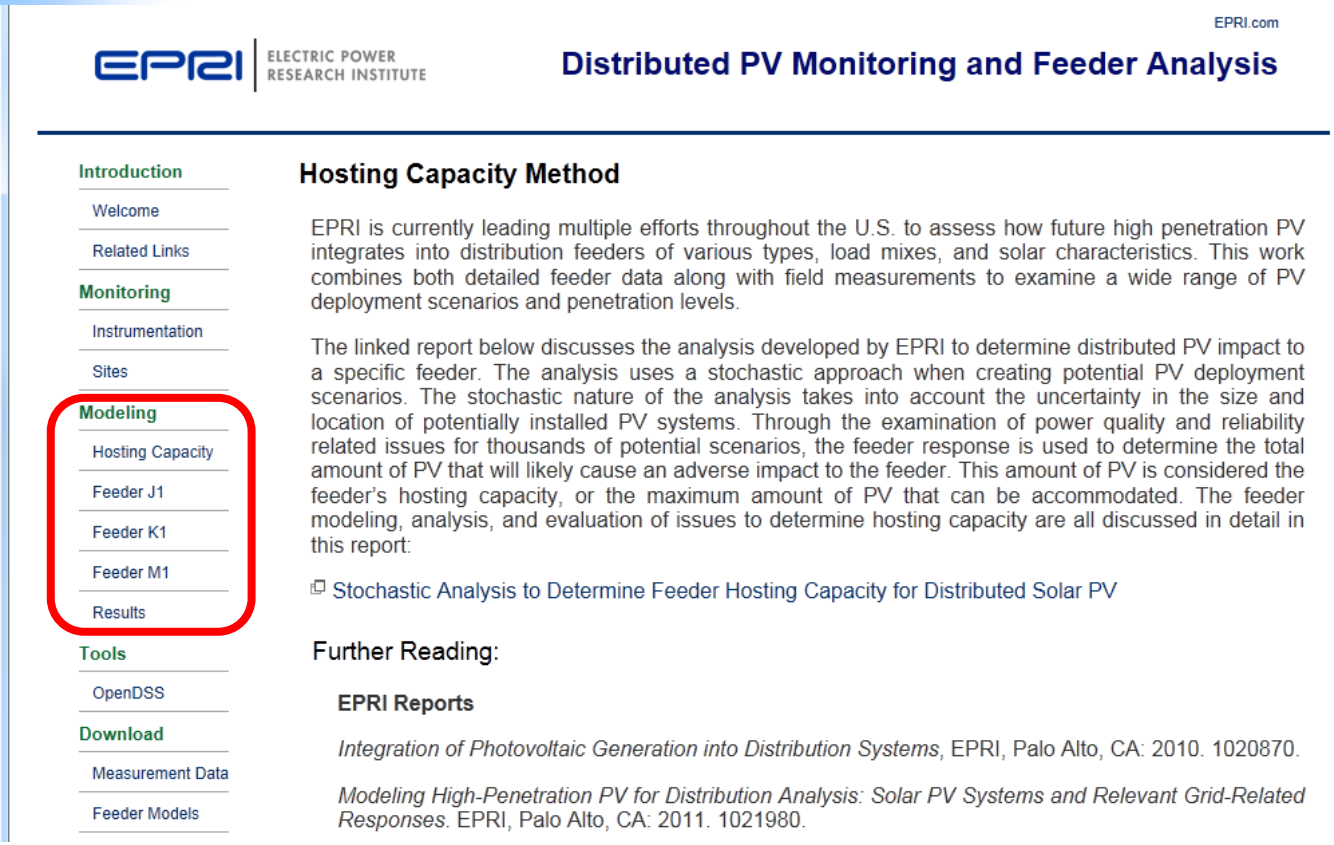
OpenDSS Download Files

This is the main site for obtaining the release versions of the program. You can also get to other parts for the OpenDSS site by following the menu items. Note that release versions are posted irregularly every 3-4 months. If you want to keep up with the latest additions to the program you can either build from the source code or obtain the latest beta build from the Code repository:

32-Bit Version
64-Bit Version

While the newer versions have the more up-to-date features and bug fixes such as those described in the latest Tech Notes in the Wiki or in the Discussion Forum, they could be less tested.

Feeder Models



- Description of hosting capacity
- Three feeder models
- Links included to reports

Feeder Models

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Distributed PV Monitoring and Feeder Analysis

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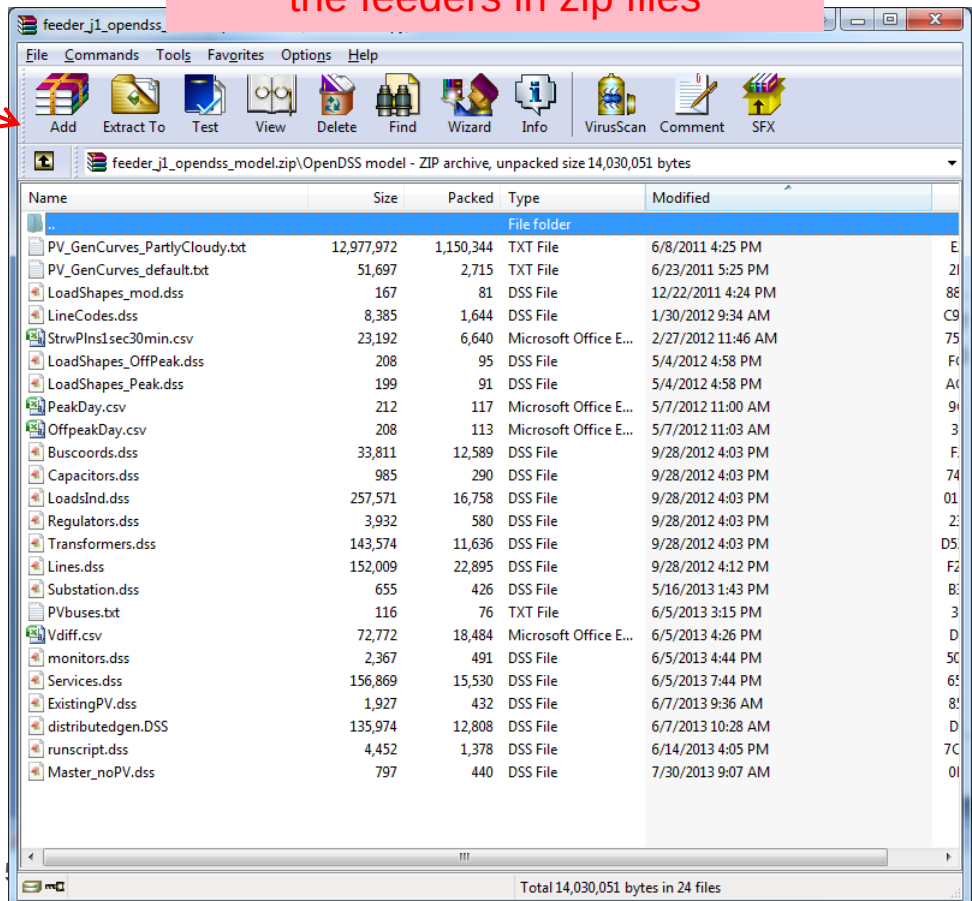
Feeder Models

Use the links below to download the feeder models.

- Feeder J1 OpenDSS model
- Feeder K1 OpenDSS model
- Feeder M1 OpenDSS model

Links allow the user to download the feeders in zip files



Included in the Feeder Model

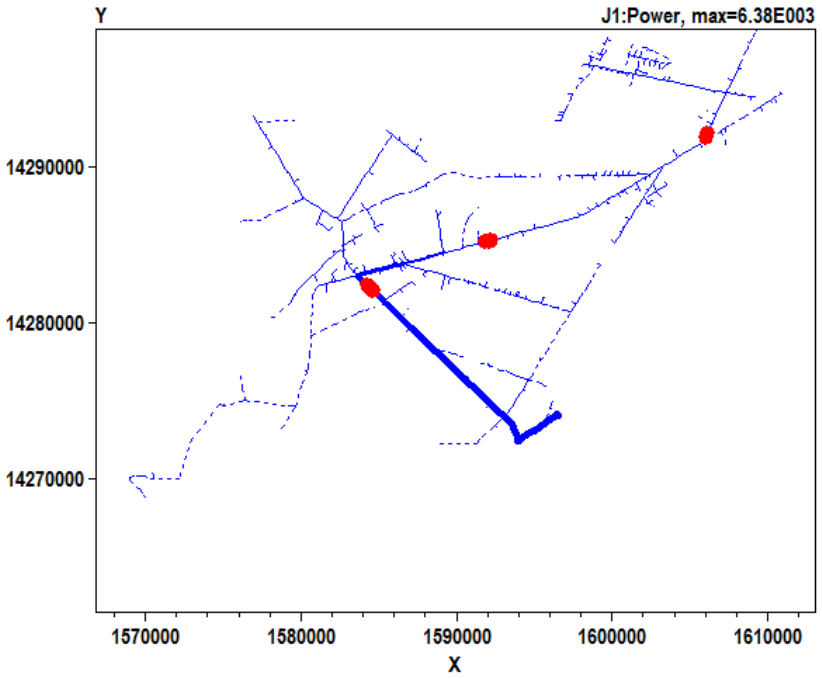
- The complete model is included for each feeder
- The Master_noPV.dss is the top level file that pulls in all feeder information without PV
- Existing or future PV must be added to the master file to simulate the impact
- An example script is included in the J1 feeder model for basic OpenDSS usage

Example Script for Feeder J1

C:\Projects\PV\OpenDSS model\runscript.dss

Font...

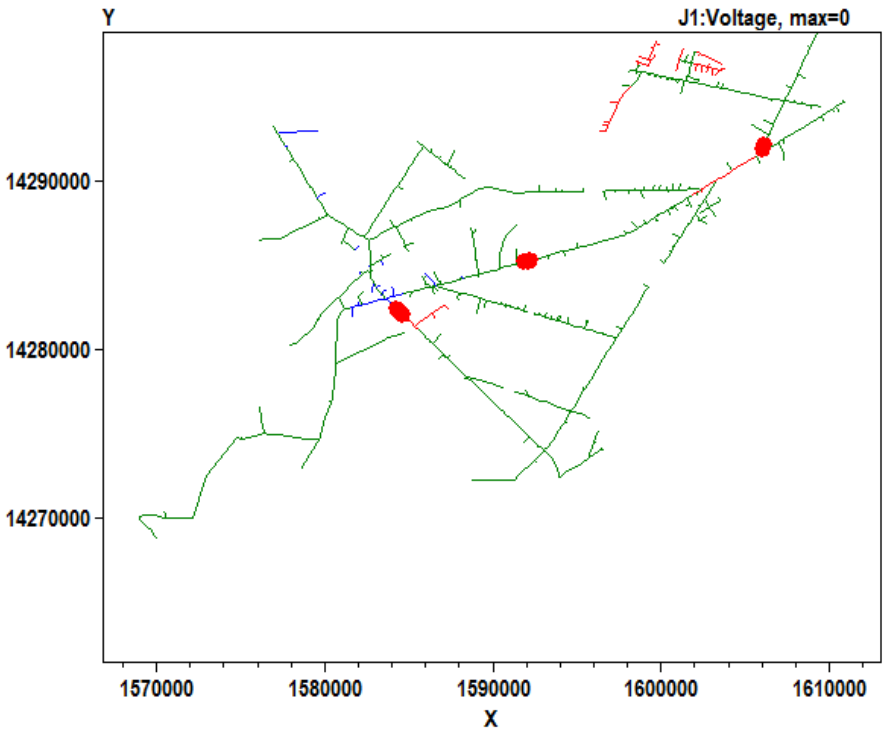
```
!------------------------------
! Sample Script files from EPRI's OpenDSS Training, June 7, 2013, Charlotte, NC.
! ~ Jeff Smith, EPRI
compile "C:\Projects\PV\OpenDSS model\master_nopv.dss"
solve

!-----
!Plot Circuit Power flow
set markercode=24
set markregulators=yes
plot circuit power 1ph=3
```



- Open script in the DSS software
- Modify the data path to the location of the file
- Execute the first few lines of code
  - Highlight lines
  - Press Ctrl+D

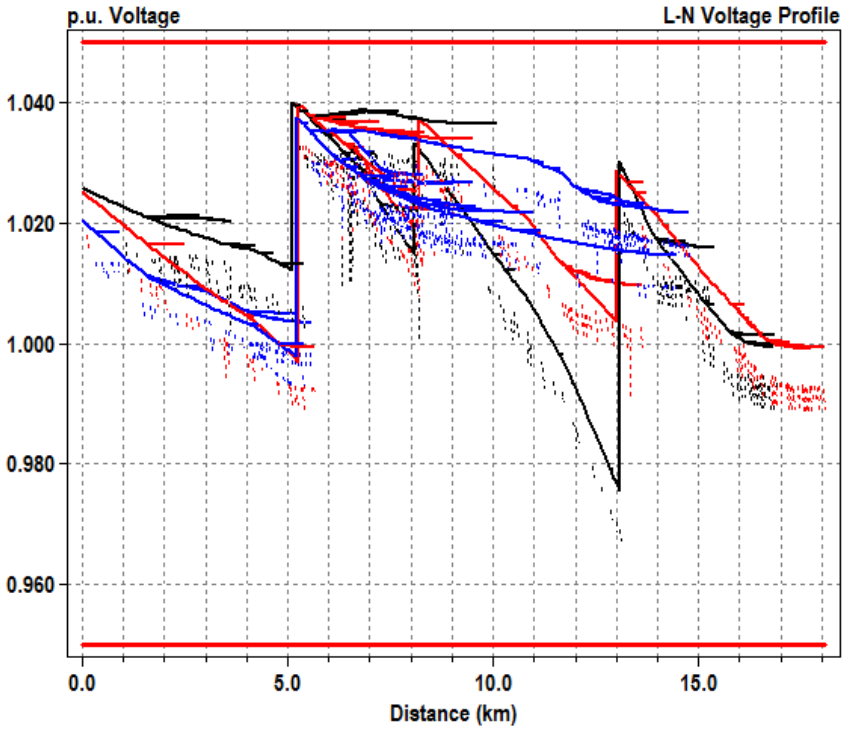
Plotting Voltages on Feeder Layout

```
!--------------------------------
! Sample Script files from EPRI's OpenDSS Training, June 7, 2013, Charlotte, NC.
! ~ Jeff Smith, EPRI
compile "C:\Projects\PV\OpenDSS model\master_nopv.dss"
solve

!-----
!Plot Circuit Power flow
set markercode=24
set markregulators=yes
plot circuit power 1ph=3

!plot voltages
set emergvminpu=1.0
set normvminpu=1.035
plot circuit voltage

!plot profile
set normvminpu=0.95
plot profile phases = primary
plot profile phases = all

!Minimum load case (approximate)
set loadmult=.1
solve
plot profile phases = all
```



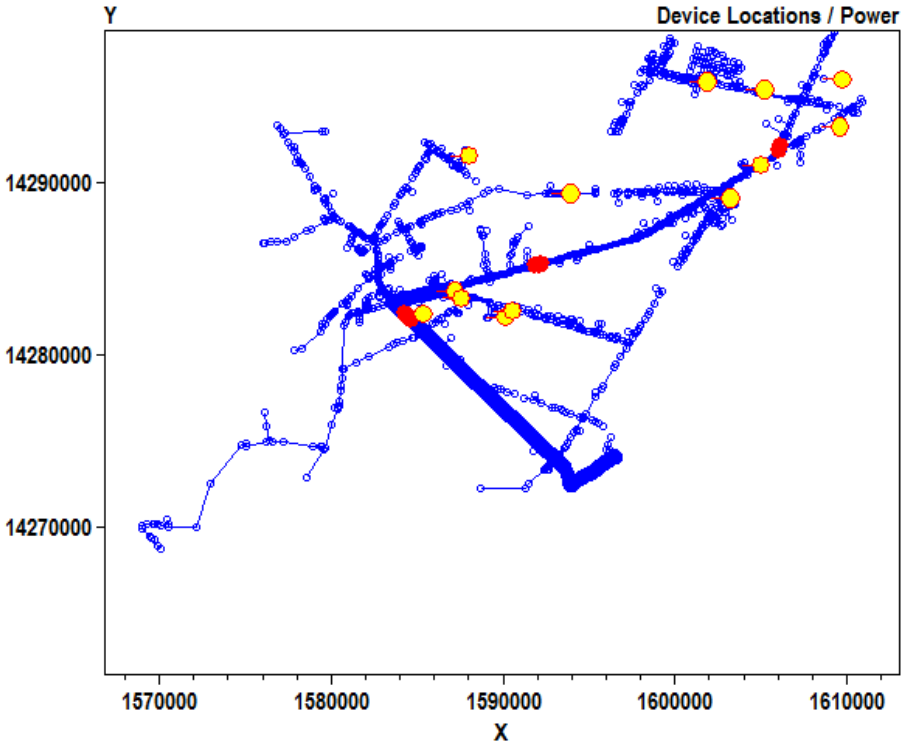
Plotting Voltages as a Function of Distance

```
!--------------------------------
! Sample Script files from EPRI's OpenDSS Training, June 7, 2013, Charlo
! ~ Jeff Smith, EPRI
compile "C:\Projects\PV\OpenDSS model\master_nopv.dss"
solve

!-----
!Plot Circuit Power flow
set markercode=24
set markregulators=yes
plot circuit power 1ph=3

!plot voltages
set emergvminpu=1.0
set normvminpu=1.035
plot circuit voltage

!plot profile
set normvminpu=0.95
plot profile phases = primary
plot profile phases = all

!Minimum load case (approximate)
set loadmult=.1
solve
plot profile phases = all
```



Adding PV to Model

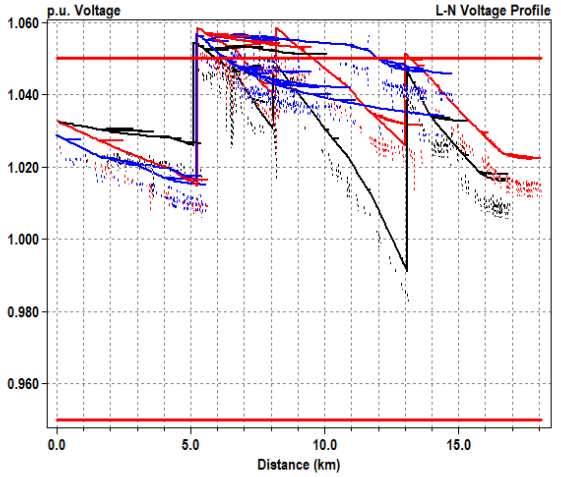
```
!--------------------------------
! Sample Script files from EPRI's OpenDSS Training, June 7, 2013, Charlo
! ~ Jeff Smith, EPRI
compile "C:\Projects\PV\OpenDSS model\master_nopv.dss"
solve

!-----
!Plot Circuit Power flow
set markercode=24
set markregulators=yes
plot circuit power 1ph=3

!plot voltages
set emergvminpu=1.0
set normvminpu=1.035
plot circuit voltage

!plot profile
set normvminpu=0.95
plot profile phases = primary
plot profile phases = all

!Minimum load case (approximate)
set loadmult=.1
solve
plot profile phases = all

!--Add PV to Circuit Model-----------------------------------------------------------
Compile "C:\Projects\PV\OpenDSS model\master_nopv.dss"
solve

!Add PV
Redirect ExistingPV.dss
Set DaisySize=2.5
set markregulators=yes
plot daisy power max=2000 dots=y buslist=(file=pvbuses.txt )
solve
plot profile phases = all
```



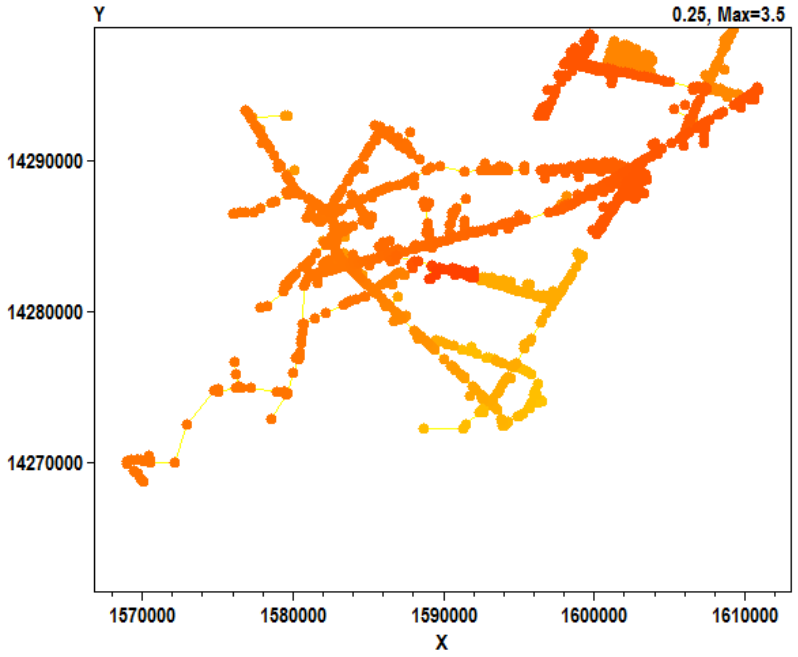
- Yellow dots indicate the existing PV on the feeder

Voltage Change Test Impact from Existing PV

```
!
!----Voltage Change Test-----------------------------------------------------
compile "C:\Projects\PV\OpenDSS model\master_nopv.dss"
solve
save voltages
Redirect ExistingPV.dss
!Disable all controls
set controlmode=off
solve
plot profile phases = all


! Compare saved voltages to current case solved
vdiff           !creates voltage difference file
set markercode=24 nodewidth=2.5
!Plot difference in voltage between no-PV and with-PV cases
plot general quantity=1 max=3.5 min=0.0 dots=y labels=n object=vdiff.csv
```



- Base case is executed
- Existing PV is added
- Controls are locked
- PV case is executed
- Voltage change is calculated



Time Series Analysis

```
!------- Run Time Series Analysis-----------------------------------------------
compile "C:\Projects\PV\OpenDSS model\master_nopv.dss"
Redirect ExistingPV.dss
solve
! - define PV curve
new loadshape.mypv npts=1800 sinterval=1 csvfile=strwplns1sec30min.csv
new monitor.PVSite4VI element=PVSystem.3P_ExistingSite4 terminal=1 mode=0
new monitor.PVSite4PQ element = Line.Site4_PV terminal=2 mode=65 ppolar=no
!Assign same PV curve to all PV systems (single curve used for demo only)
batchedit pvsystem..* daily=mypv

!- change solution mode
solve mode=daily stepsize=1s number=1800

batchedit pvsystem..* pf=-0.98

!--------------Plotting-----------------------------------------------
Export monitors pvsite4vi
Plot monitor object= pvsite4vi channels=(1 )
Export monitors pvsite4pq
Plot monitor object= pvsite4pq channels=(1 )
```

- PV generation curve follows measurement data
- Solution is for 30 minute period
- Voltage and Power are displayed