BEW Engineering

Solar Permitting and Feasibility Session

Tuesday, 7:30 am -9:30 am

HIGH PENETRATION PV INITIATIVE

Ronald Davis
Director of Transmission and Distribution

Hawaiian Electric Company, Inc.

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT
The Power To Do More.℠

Agenda

- Background
  - Goals & objectives
  - Status on Contract
  - Timeliness of Effort
  - SMUD/HECO Issues & Partnership
- Overview of Tasks
- Detailed Tasks
  - Summary of Lessons & Findings
  - Continuing Efforts
- Next Steps

Team

Team	Primary Staff
SMUD SACRAMENTO MUNICIPAL UTILITY DISTRICT The Power To Do More.℠	Elaine Sison-Lebrilla, Obadiah Bartholomy and David Brown
Hawaiian Electric Company	Tom Aukai, Dora Nakafuji (HECO) Laura Rogers, Hal Kamigaki (HELCO) Chris Reynolds (MECO)
BEW ENGINEERING A DNV Company	Ron Davis, Emma Stewart, Billy Quach

High Penetration PV Initiative

Goal:

Enable appropriate capability to reliably plan and operate with high penetration of variable renewable resources on the grid especially during high impact conditions (e.g. variable weather, peak loads, minimum loads, contingencies)

Objectives:

- Inform and pilot the development of visual tracking, field measurement and validated analytical capability including hardware and software to evaluate the impact of high penetrations of PV systems on our grid
- Transfer of lessons learned to other utilities

Why This Effort is Timely?

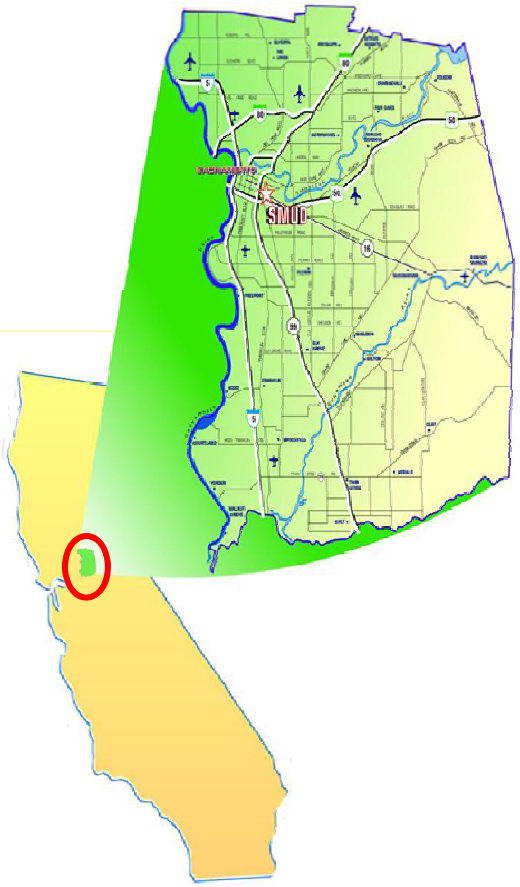
ADDRESS COMMON ISSUES

- Emerging levels of distributed generation "behind-the-meter" generation is increasing
- Levels are exceeding "rules-of-thumb" used in standard utility practices for planning
- Operations lack visibility to control and plan for impact of variable renewables on the distribution grid
- Industry lacks capability (tools/data) to effectively plan for PV impacts on the grid
- No commercially available capability exists to meet solar forecasting needs

Why SMUD/HECO Partnership?

- Aggressive state RPS policies in both California and Hawaii
- SMUD/HECO have very similar system attributes
- SMUD/HECO utilizing similar system and distribution modeling tools
- Facing similar high penetration PV challenges – HECO has high penetration over 30% on a number of circuits
- Cost-effective solutions needed to maintain reliability

Background - SMUD



- Publicly Owned (Sixth Largest in U.S.)
- Service area of 900 square miles, serving 1.4 Million (Sacramento County and parts of Placer)
- Over 578,000 Residential, Commercial and Industrial customers
- Record peak demand-3,299 MW on July 24, 2006
- Aggressive 23.5% Renewable supply by 2010; 37% by 2020
- GHG Reductions by 2050 (10% of 1990 levels, <350,000 metric tonnes/year)
- CSI Goal of 125 MW, Feed-In Tariff of 100 MW

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Background-Renewable Supply

SMUD Renewable Energy Program	2009 Supply Goal	2009 Actual	2010 Goal	2020 Goal
RPS	17.5%	18.8%	20%	33%
Greenergy	3.5%	3.5%	3.5%	4%
Totals	21%	22.3%	23.5%	37%

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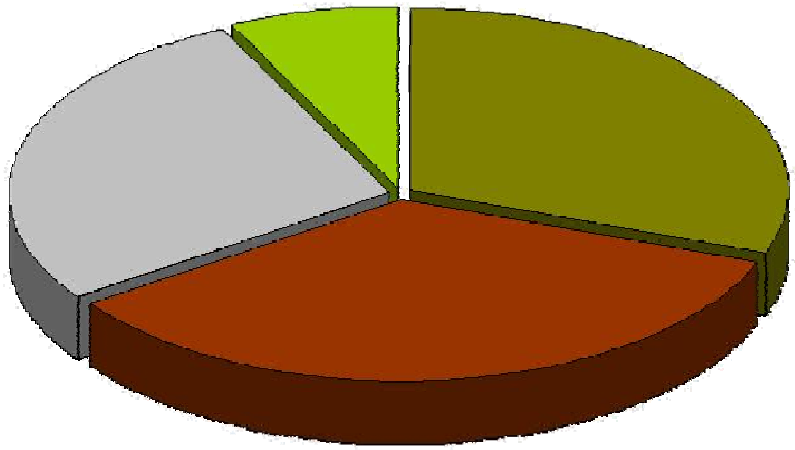
Background – HECO & Hawaii's Energy Use Today

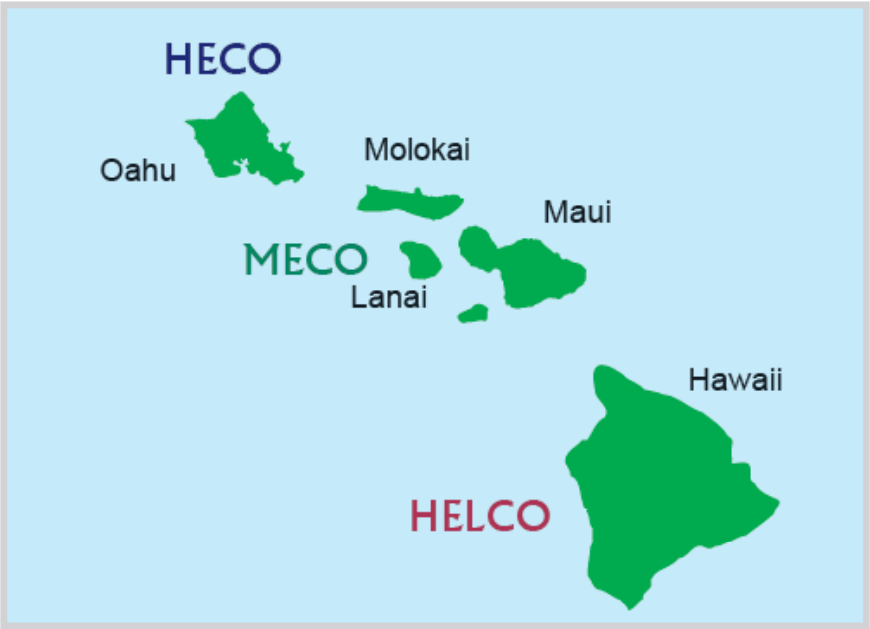
- Regulated utility, providing energy for the islands for over 100 years
- Three utilities - Hawaiian Electric Company, Inc. (HECO), and subsidiaries, Maui Electric Company, Ltd. (MECO), and Hawaii Electric Light Company, Inc. (HELCO), serves 95% of the state's 1.2 million residents on the islands of O`ahu, Maui, Hawai`i Island, Lana`i and Moloka`i.
- Primary energy source (90%) is imported crude oil



JET FUEL	34%
ELECTRICITY	32%
GASOLINE/ MARINE FUEL	27%
OTHER	7%

Where are we Today?

- Act 155 established RPS – 40% renewables from electricity, 70% total (includes transportation)
- Energy efficiency standard of 30 by 2030 (3,400 GWh)



- HECO – 15%, HELCO – 39%, MECO – 23%

BEW'S ROLE IN THE PROJECT

BEW's Role in Project

- Develop detailed utility distribution power flow data sets for SMUD, HECO, HELCO and MECO
- Develop 24 individual feeder data sets with PV installations
- Conversion of unbalance distribution feeder to balance feeder for input into transmission models
- Develop inverter models for input into the power flow models

BEW's Role Cont'd

- Convert distribution balance data into balance transmission data and integrate with transmission models
- Conduct steady state, contingency, fault current, stability, transient and voltage analysis
- Analyze the interrelationship of tap changers to capacitor banks to inverters
- Evaluate ramp rates and spinning requirements of high PV penetrations

BEW's Role Cont'd

- Assist in the locating of solar irridance collectors and feeder demand meters
- Collect one second data for all locations and analyze information
- Develop time sequential load and generation profiles to look at cloud cover impacts and contingency outages on ramp and spin
- Investigate inverter options such as frequency, spin, VAR, voltage, etc. functions

Baseline Modeling of SMUD and HECO Systems

- Identification of Cases (i.e. high penetration circuits with interesting characteristics)
- High Penetration Circuits Data Collection (Voltage, Loads, Production, Faults)
- Distribution Systems Modeling/Visualization (SynerGEE modeling integrated with Powerworld identify high value locations for PV, identify problem areas)

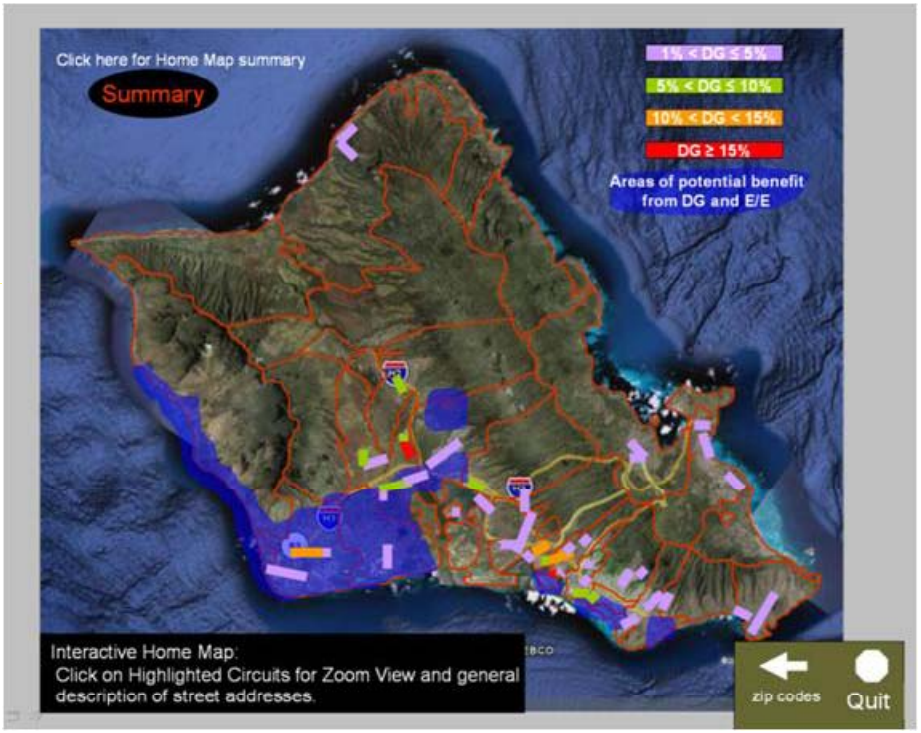
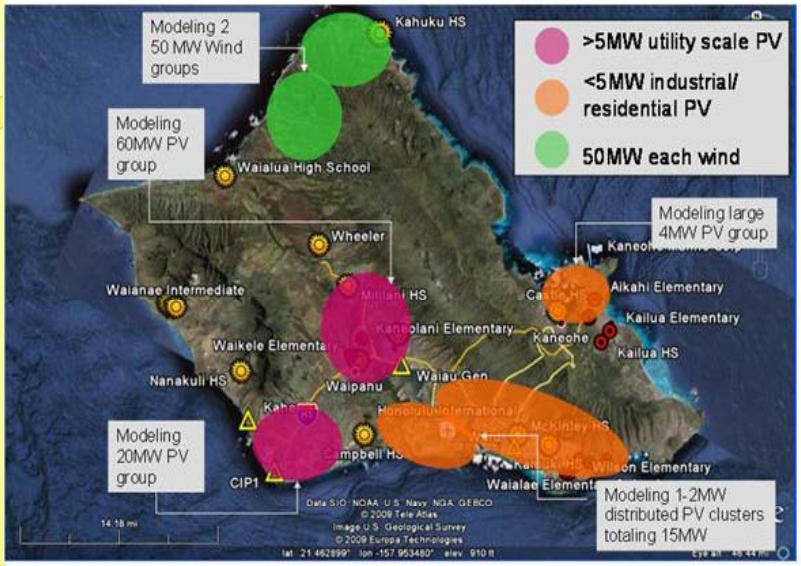


Illustration of a Location value map of Oahu showing various distribution circuit penetration levels.

High Penetration Solar/Wind Visualization Analysis Pilot



Graphical (GIS-based) display of PV and wind resource areas

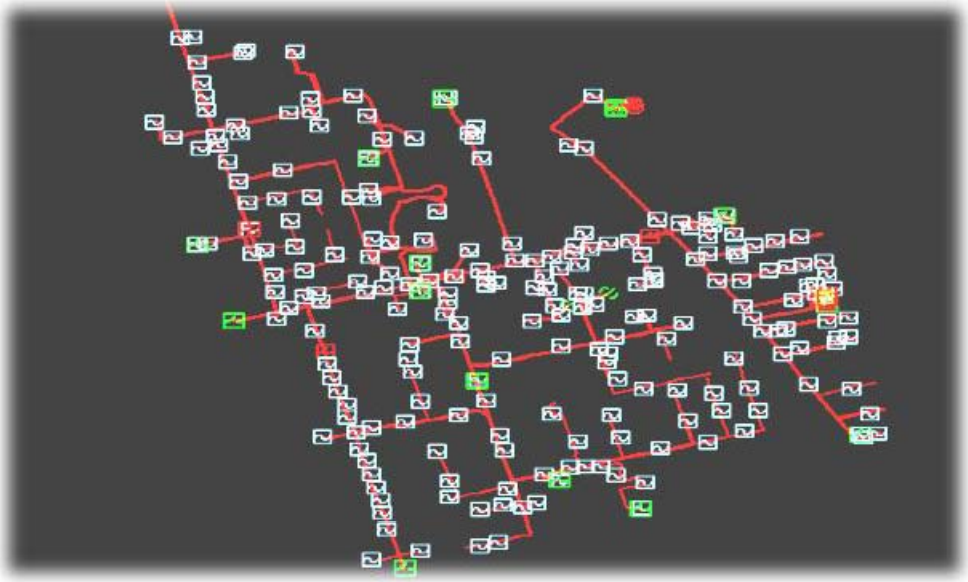
Overlay layers

- Results of Distribution System Modeling/Visualization (Synergee modeling integrated with Powerworld)
- GIS/OMS/EMS/CIS/

- Develop and pilot visualization analysis tool for planning and operations

Field Monitoring and Analysis

- Monitoring Equipment Installation
- Data Collection / Modeling Validation
- Simulation, testing and validation efforts to address grid impacts using Synergee and PowerWorld (e.g. voltage regulation, VAR Control, fault contribution, reverse power flows, etc)

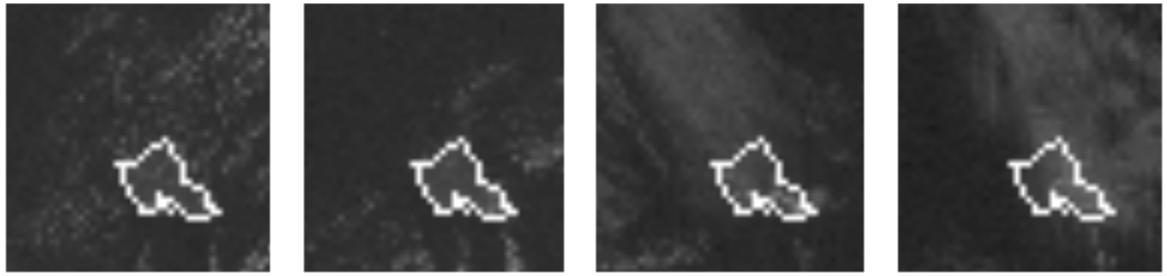


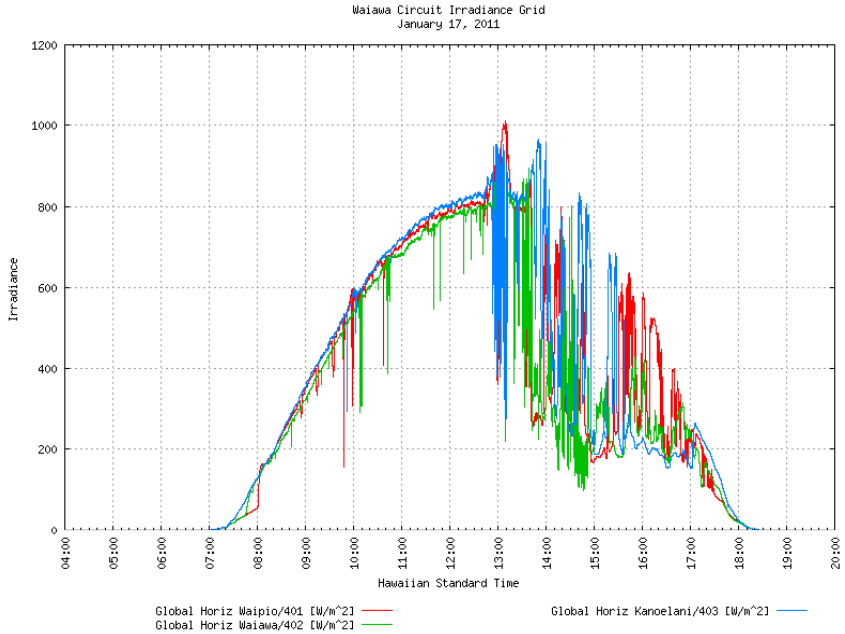
SynerGEE model of SMUD Subdivision

Clouds and Irradiance Correlation

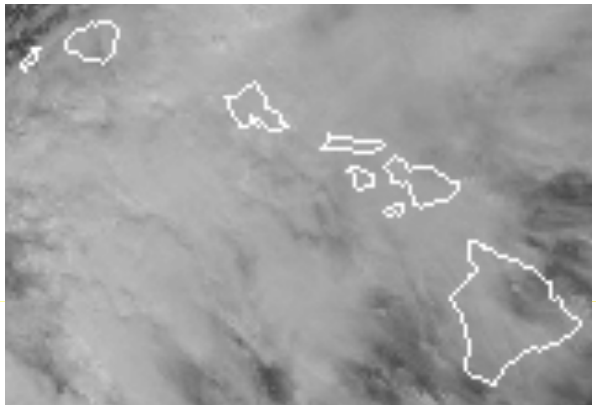
January 17, 2011

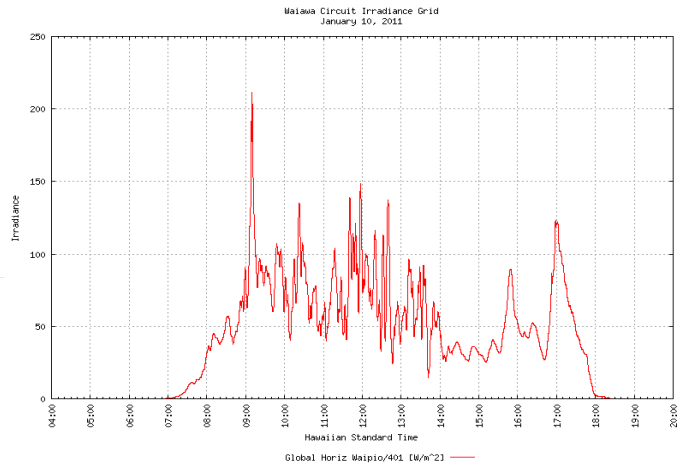
10:00 HST 12:00 HST 14:00 HST 16:00 HST

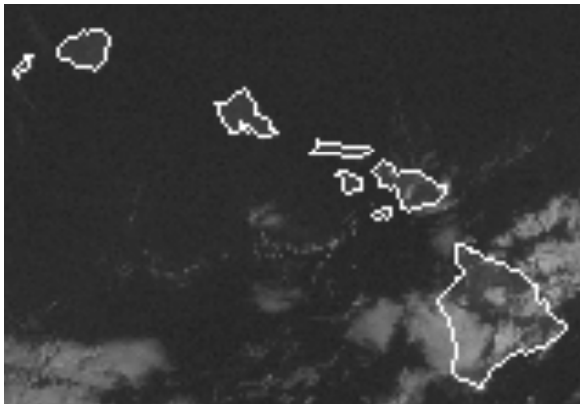


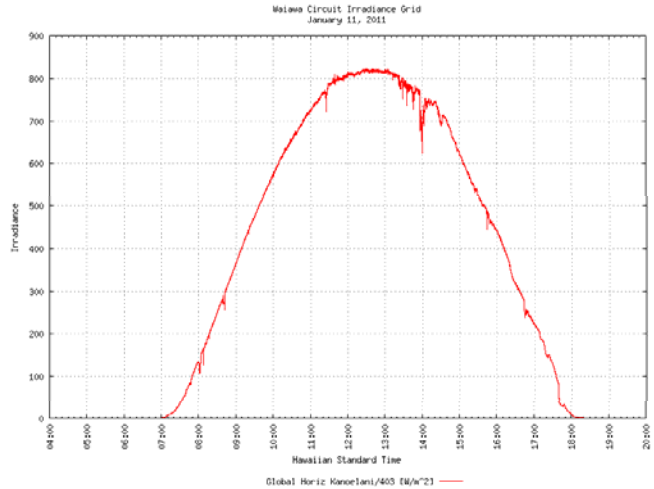


Sample Cloud Cover Impacts

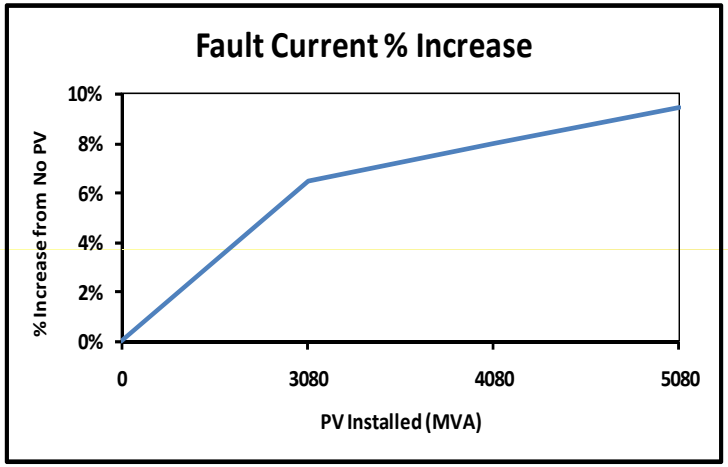


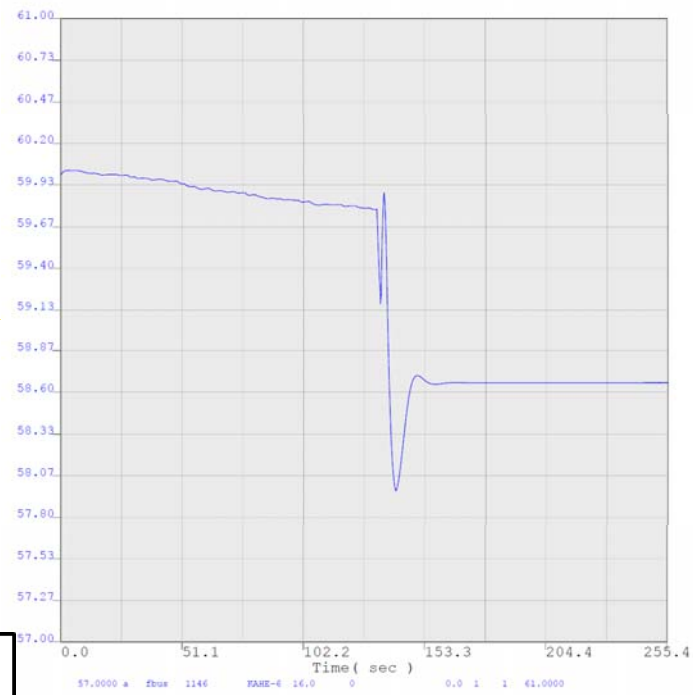


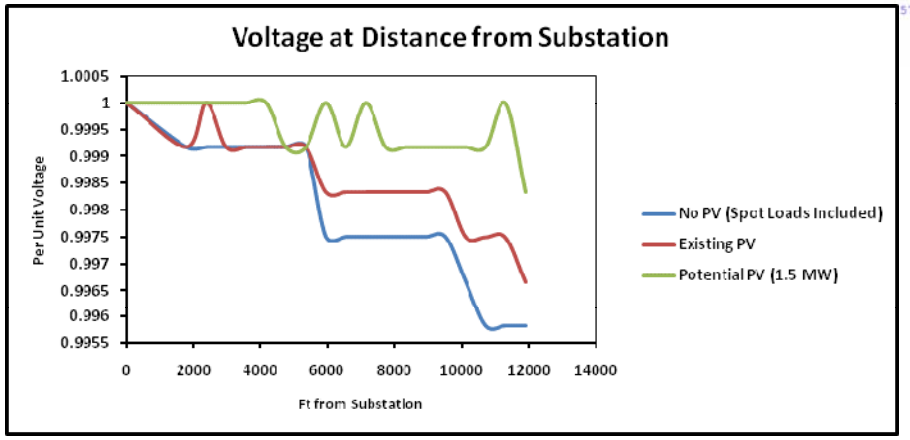




Sample Analytical Results







Next Steps

- Complete the detailed feeder studies
- Develop mapping functions to highlight potential problems areas and ideal locations for higher penetrations
- Prepare report with recommendations on future advancements in computer modeling functions and inverter operations functions