DOE/OE Transmission Reliability Program

Distribution PMU Scoping Study

Joseph H. Eto
Emma Stewart

Lawrence Berkeley National Laboratory

Travis Smith
Mark Buckner

Oak Ridge National Laboratory

Harold Kirkham
Francis Tuffner

Pacific Northwest National Laboratory

David Schoenwald

Sandia National Laboratories

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CERTS
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Overall project objective

- To assess potential uses and benefits of installing phasor measurement units (PMUs) within electricity distribution systems; and

- To identify the associated research and development that is required to realize these benefits.

Why Distribution (or µ) PMUs?

- What is a distribution PMU?
  - A PMU is a Phasor Measurement Unit
  - Measures time synchronized voltage and phase angle at high sample rates ~30/second for transmission and 120/second for distribution
  - The µ-PMU is a power quality recording instrument with GPS receiver to enable highly accurate time stamping for voltage and phase angle measurement
  - Conventional PMUs in use for the transmission system have ± 1^{o} accuracy; µPMU have 0.01^{o}
  - Higher degree of accuracy is required for distribution as the angle differences and changes are significantly smaller than in transmission because of the different X/R ratios
- Why might they be useful distribution planning and operations?
  - Measurement of phase angle and difference in angle between points provides the ability to calculate impedance not possible without the PMU
  - Phase angle also gives information on the direction of power flow for analysis of topology changes or errors
  - Line level measurement represents an improvement over smart metering for estimating loads on a per phase basis.

Looking back

- To date, since project initiation late in FY14, we have developed a draft scoping study that is now undergoing external review
- In order to develop the scoping study, we have initiated conversations with utilities that have a demonstrated a strong interest in deploying PMUs in their distribution system
- Their stated motivations for interest in PMU deployment formed the basis for the use cases presented in the draft scoping study

Scoping Study Use Case Questions

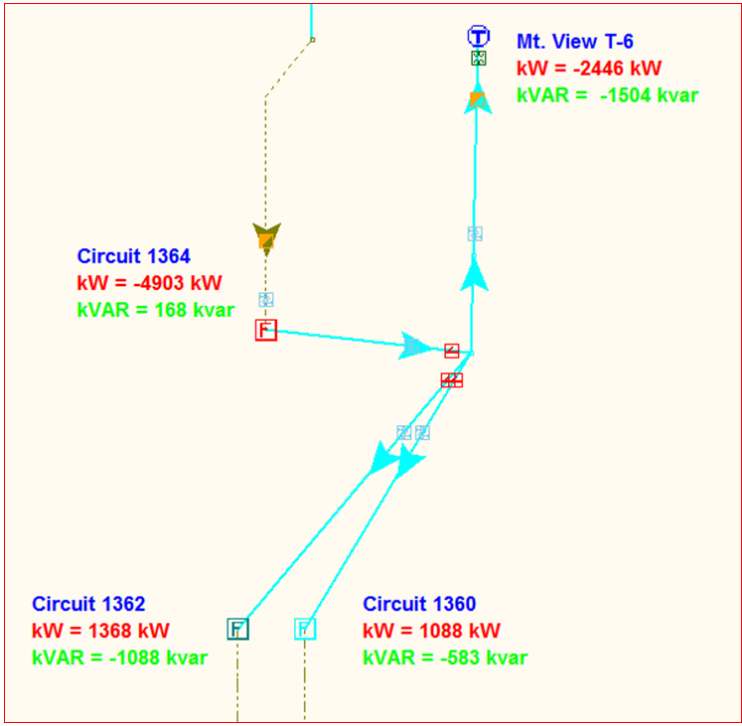
- Existing state of the art and why [Use Case] is rarely done
- How PMU technology can address [Use Case]
- Alternatives to the PMU solution
- Comparison of PMU and alternate solutions

Scoping Study Use Cases

- Automated system reconfiguration
- Controlled islanding
- *Planning (modeling) for high DER penetration*
- Voltage fluctuations and voltage ride-through associated with interconnection of distributed generation and energy storage
- FIDVR detection

Utilities Have Already Encountered Issues Requiring Better Model Validation

- A 7.5 MW PV site was initially requested for distribution interconnection review via RPU Rule 22 (=CPUC Rule 21)
  - Initial analysis based on peak power was deemed satisfactory
- On further investigation, substation load data was reviewed, to determine daytime minimum load
  - A time series power flow model detected reverse power flow and high line voltages
- Riverside Public Utility's current solution:
  - Improve the existing distribution infrastructure to limit the effects and allow for a reduced capacity site to be integrated (5MW)
  - Upgrades being planned include re-conductoring, permanent transfer of loads, and relocation of capacitor banks



Looking forward

- Major technical accomplishments that will be completed in FY15—current stage in RD&D cycle
  - Completion of scoping study
  - Solidification of utility partnerships
  - It is not appropriate to assign a TRL

- Deliverables and schedule for activities to be completed under FY15 funding
  - Technical scoping study – Summer 2015
  - Research proposals for utility cost-shared demonstrations – Fall 2015

Looking forward

- Risk factors affecting timely completion of planned activities as well as movement through RD&D cycle
  - Solidification of utility partnerships
  - Commitment of DOE funding to pursue demonstrations with utility partners
- Early thoughts on follow-on work that should be considered for funding in FY16
  - Initiate cost-shared demonstrations with utility partners