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# Interconnecting and Integrating DG into the Distribution System

**CEC IEPR Committee Workshop**

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**Distribution Engineering and Operations**

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# Topics

- **Planning for the Future**
- **Interconnecting DG to the Distribution System**
- **Smart Grid and State Environmental Goals**



# Planning for the Future Distribution System

- **Reliability and operational flexibility of the electric distribution system**
  - Modernizing - advanced automation, monitoring and control technology
  - Focusing capital investments to improve reliability performance, reduce operation and maintenance expenses
  - Using performance and condition-based assessments to improve reliability, increase maintenance effectiveness, prioritize repair and replacement, and extend asset life
  - Improving human performance



# Aging Infrastructure

- **PG&E plans to address aging infrastructure.**
  - Substation transformer replacement
  - Breaker replacement
  - Wood pole asset management
  - Cable replacement
- **Details for these and other plans in PG&E's GRC applications.**
- **PG&E will build on these plans in its Smart Grid filing with the CPUC.**
  - Automation and improved control schemes as part of routine equipment replacement.
  - Providing increased information to PG&E's engineers and operators including a foundation for further automated control schemes envisioned in PG&E's Smart Grid plans.



# Challenges Associated with High Penetration of DG

- Maintaining service voltages within limits
- Voltage transients
- Integrating with system operations
- Forecasting resources
- Monitoring and control
- Potential for inadvertent islanding



## Accommodating More DG

- CAISO test pilot on the efficacy of using demand response in CAISO markets to firm renewable resources.
- 2MW, 14 MWh, battery system at Vaca Dixon substation to test the use of energy storage in combination with solar PV to mitigate distribution system impacts.
- As part of its Smart Grid plan, proposing to test the efficacy of commercially available voltage control systems (Volt/VAR optimization tools), in a laboratory and pilot environment to address concerns about voltage control in areas with high penetrations of solar PV.



# Existing and new tools/models to analyze the impact of DG projects

- New Load flow program in 2011
  - Capable of analyzing new loads and DG projects
  - Integrating program into electric engineering and operating functions in 2011 and 2012.
- GE PSLF program to model CAISO controlled DG projects
  - Analyze impacts and determine delivery upgrades for Resource Adequacy purposes and reliability upgrades for safe and reliable interconnection.
- Generation Interconnection Services
  - New database tool to track interconnection requests.
  - Can aggregate the local DG interconnection projects for accurate technical review



# Interconnecting DG to the Distribution System

- **Planning process -- Distribution system**
  - New Load (new customers and load growth) drive the need and timing for expanding and increasing the capacity of the electric distribution system
    - Based on customer circumstances (location, load, service voltage and service point, etc.) - each examined individually.
  - New Distributed Generators - based on the circumstances associated with the specific generator.
    - As with new customer applications, distributed generator interconnections are also examined individually (interconnection studies).



# CAISO Planning Process Coordination

- Need for CAISO Planning Process Coordination
  - For large amount of proposed distribution and transmission generation in certain areas (Fresno and Bakersfield), due to impact to the CAISO controlled grid.
  - Deliverability Assessment is CAISO responsibility to determine “Full Capacity” status for CPUC’s Resource Adequacy program.
  - CAISO schedules any wholesale generator > 1MW



# Interconnecting DG to the Distribution System

- **T&D Integrated infrastructure planning process**
  - It is unnecessary to coordinate distribution studies on a statewide basis.
  - Even in PG&E's own service territory it is generally unnecessary to coordinate distribution planning studies from a technical perspective (i.e., distribution studies in Fresno do not affect studies in Stockton).
- **Suggestions for process improvement**
  - Education to developers and utilities on DG interconnection process may be helpful
  - Coordinate procurement programs (Feed in Tariff, Renewable Auction Mechanism and interconnection process).
  - Increased transparency to the constantly changing DG market in reference to power purchase agreements and interconnection rules and timelines
  - Pre-identification of sites may be useful
  - Sunsetting projects



## Smart Grid & State Environmental Goals

- **American Recovery and Reinvestment Act (ARRA) Smart Grid projects**
  - WECC Synchro-phasor Project
    - PG&E is a sub-recipient of WECC grant.
    - PG&E will receive \$22M and will contribute \$25M of its own funds as part of \$108M project.
  - Compressed Air Energy Storage (CAES)
    - Scope: investigate the feasibility and begin environmental reviews and design work for a 300MW, 10 hour compressed air energy storage project to mitigate renewable resource intermittency.
    - \$25M grant with \$25M matching funds.
    - If feasible and cost effective, PG&E to issue a competitive solicitation to construct the project.



## Smart Grid & State Environmental Goals

- **Smart grid technologies 2011 General Rate Case (GRC)**
  - 2011 GRC forecast maintained spending on historical activities that are now viewed as Smart-Grid related (i.e., automation, relay upgrades, etc.)
  - In addition, PG&E included approximately \$66 million in its 2011-2013 capital expenditure forecast for foundational Smart Grid deployment scenarios.
  - The technology infrastructure upgrades are focused in the areas of information exchange, data management and data storage.



## Smart Grid & State Environmental Goals

- **Emerging smart grid technologies and software that support the monitoring and management of DG on the distribution system**
  - Automated voltage control systems, also known as Volt-VAR optimization technology, are being tested and piloted across the industry. PG&E proposed to investigate this promising technology as part of its Smart Grid plan.
  - Capabilities within the recently installed Smart Meters are being examined to see how they could support monitoring the impacts of solar PV on the distribution system, most notably is the voltage sensing features.
  - The inverter manufactures are examining ways for new generations of inverters to communicate generator output and other operating parameters to Smart Meters as a means of providing information about the generator to system operators.



## Smart Grid & State Environmental Goals

- **Cost benefit analysis of smart grid technologies**
  - PG&E has taken a conservative approach to calculating the economic benefits of its proposed Smart Grid deployment plan.
  - To the extent environmental and societal benefits such as the reduction of CO<sub>2</sub> emissions can be directly attributable to a proposed Smart Grid project, PG&E has quantified those benefits in terms of CO<sub>2</sub> reductions and the potential financial value of those reductions in a future CO<sub>2</sub> market.
  - However, PG&E has not included these potential financial benefits in its financial benefits calculations because the CO<sub>2</sub> market has not yet been established in California.
  - PG&E does list environmental and societal benefits as non-quantified benefits in its plan.