Enhancing Efficiency and Robustness of Modern Distribution Systems

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Masoud Nazari presentation, Carnegie Mellon, October 2010
Transmission & Distribution Losses

- T&D losses in U.S.: 6.5% in 2007 (270 Billion KWh per year)
- Greater than total electricity consumption of Pennsylvania (148 Billion KWh in 2005)

Source: US EIA and Department of Energy, Masoud Nazari presentation, Carnegie Mellon, October 2010
Case study

• IEEE 30-bus distribution system:
  • 15 MW demand
  • DGs: 2 combustion turbines (C-T), 10% of demand
• Distribution power losses before placing DGs: 1.4 MW
• Power loss reduction by optimum placement and optimum voltage set:
  (0.7 MW) 50%

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Policy Implications

• Operation and planning of today’s distribution systems should use optimization algorithms

• Optimal location of DGs might violate the *laissez-faire* policy, so it is critical to develop incentive mechanisms

• IEEE1547 standard needs to be revised for robust control purposes
Thoughts from RED on Study Import of DG to Line Losses

- One MW of correctly located DG, with grid control of power factor, can displace, on average 1.5 MW of grid generation and associated costs and pollution.
- The same 1 MW could displace 2 to 2.25 MW of central generation on peak, and avoid a similar investment in peaking generation and wires.
- One MW of DG in less ideal grid locations could still displace 1.2 to 1.4 MWs of central generation and even more on peak generation.
- Most avoided cost calculations do not even give credit for the 6.5% line losses, much less 20% to 50% savings of central power.
- Recognition, new pricing signals, and FERC focus could significantly reduce U.S. line losses, in addition to other benefits of CHP.

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