Transmission Line Loss

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Generation

- There are about 19,023 individual generators at about 6,997 operational power plants in the United States with a nameplate generation capacity of at least one megawatt.
- A power plant can have one or more generators, and some generators may use more than one type of fuel.

Losses Defined

- Losses – A term used to define the difference between the electrical energy delivered to a customer (or a given point on the electrical distribution system) and the amount of electrical energy that must be generated at the power plant to serve that customer.
- In other words, losses refer to the amount of power lost in transferring power from the power plant to the point of delivery (often referred to as line loss).

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Losses Defined

- Line losses will vary by rate class based upon the voltage level at which each class is served.
- Losses occur at every step in the electric system providing power to customers.
- Transmission and distribution lines (as well as substation and transformation equipment) result in various amounts of losses as the energy makes its way to individual customers at their particular level of service and voltage level.

U.S. Line Loss

- National, annual electricity transmission and distribution losses average about 7% of the electricity that is transmitted in the United States.
- To calculate T&D losses as a percentage, divide Estimated Losses by the result of Total Disposition minus Direct Use.
- Direct Use electricity is electricity that is generated at facilities that is not put onto the electricity transmission and distribution grid, and therefore does not contribute to T&D losses.

U.S. Estimated Line Loss 1990 Through 2010 (Million Kilowatt Hours)

- 1990: 203,216
- 1995: 228,755
- 2000: 243,511
- 2005: 269,217
- 2010: 261,990

Estimated Michigan Line Loss

- Million Kilowatt Hours
- 1990: 6,171
- 1995: 7,189
- 2000:7,457
- 2005: 7,941
- 2010: 8,468

Loss Prevention Options

- Technology
- System Operation
- Transmission Planning
- Customer Behavior
- Renewables?

Potential Transmission Technologies

- Some potential solutions: (listed in decreasing cost & complexity):
- Re-rating (static)
- Real-time (dynamic) rating
- Sagging Line Mitigator (SLiM)
- Re-conductoring
- Bundled conductors
- Single-circuit to double circuit conversion
- High-temperature, low-sag conductors
- Compact lines
- Voltage uprating
- Advanced and creative towers & conductors
- High phase order design
- Underground cables (AC)
- HVDC (conventional)
- HVDC (new VSC- based)
- Superconducting cables

Loss Reduction Techniques Circuit Improvements Examples

- Phase balancing by re-phasing taps
- Load balancing across phases
- Improving power factor close to unity
- Locating large loads near the substation
- Reducing circuit lengths/adding new circuits
- Re-conductoring to larger wire size

Loss Reduction Techniques Technology Improvements Example

- Volt VAR Optimization (VVO): Monitoring of reactive power load (VARs) And near real time control of capacitor banks can optimize the control of capacitor banks can optimize the power factor at the circuit level.

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Solar Power Grid Augmentation

- Small-scale solar installations placed along Transmission line routes could compensate for current loss and leakages, and add surplus solar power to the grid as the current flows towards the end users.
- Power producers and their partners the power transmission companies could install solar arrays every 50 or 100 miles along the line to compensate for the electrical current that is lost in transit.
- A tiny substation at each solar array along the routes could transmit the solar generated power directly to the lines in real time, to make up for the electrical current that is normally lost in transit.
- As most electricity demand occurs during the daylight hours, solar panels would add power to the grid exactly when it is experiencing its highest rate of electricity demand and leakage.

WIND POWER GRID AUGMENTATION

- In Northern latitudes, wind power might be the preferred Grid Augmentation method. Installing a 1MW wind turbine every 50 miles along high tension wire routes would cover existing electrical current leakages, as well as adding surplus power to the grid.

- New and sophisticated vertical axis wind turbines could be installed close to existing high-tension lines with no danger of them ever hitting the wires or pylons.

Modular Option

- By employing a modular approach to such installations, results could be seen right away, as a new design/engineering/construction method would not required for each installation.

- Electrical leakage results in a huge cost to electrical producers, electrical power transmission companies, and especially to end-users. It is a well understood factor in the course of moving electrical power over long distances and merely adding electrical current to the grid at regular intervals — of a kind which has no fuel cost, no production cost, and is not operator-assisted — will solve the problem, completely.

- New and innovative uses for renewable energy could complement electrical power producers — instead of competing with them.

- Using renewable energy in this way could make our grids and the huge, otherwise empty tracts of land they occupy, 30% more efficient in less than two years, if we immediately begin to deploy Modular, Renewable, Grid Augmentation.

Questions?