# **Electric System Losses**

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## **Typical Loss Study Results**



2004 SYSTEM LOSS STUDY -- ENERGY LOSSES AND DELIVERIES (TOTAL YEARLY MWh)

Combined Method (Each Component Includes Transformation to that Component)

- Loss %'s are calculated as Loss % = (MWh Loss/MWh Delivery)\*100
- Cumulative Loss %'s are calculated as one minus the product of
- one minus the Loss %(pu) for that component and all higher components.
- Loss % for Distribution Primary Lines (1.86%) provided by DP&P
- Generation Transformers were combined with the 345 & 138 kV system because all customers are connected at lower voltages (components).
- Cumulative Loss % is adjusted based on the weighted average amount of load served from 138 kV and 46 kV
- First, [(22908898)\*(3.91) + (5295858)\*(2.41)]/(22908898 + 5295858) = 3.63%
- Then, (1-(1-0.0243)\*(1-0.0363))\*100 = 5.97%



## **Electric System Loss Study Overview**

- Losses and loss %'s are calculated for each subsystem category between generation and end-use customer voltage levels.
- Results are based on actual, historical system load conditions.
- Last study was completed in 2006.
- A new study is underway and is expected to be completed this year.
- Future goal is to update the loss study annually.



## How are Electric System Losses Calculated?

- Hourly data from SCADA and billing sources for a calendar year are compiled and checked for errors.
- Each hour of data from Consumers' entire system is used to create hourly power flow cases (8,760 cases created).
- Cases are solved and MW deliveries and losses are calculated for each subsystem category desired.
- This hourly output is fed into a spreadsheet that is used to calculate all appropriate loss percentages.
- Theft and other unaccounted for losses are included in the secondary losses.



#### What are the Calculated Losses Used For?

- The calculated allocation of energy losses and monthly peak demand losses are used in ratemaking to appropriately allocate losses between rate categories.
- System efficiency at various load levels can be used in estimating the amount of power to reserve based on expected the load.



#### How can Electric System Losses be reduced?

- Losses can be reduced by moving generation/transmission sources electrically closer to large load centers.
- Shunt capacitors added close to load points improve power factor and voltage which reduces current flow (amps) and I<sup>2</sup>R losses.
- Replacing small line conductor with larger conductor reduces the resistance and I<sup>2</sup>R losses.
- Consumers Energy cannot typically justify capital projects based on loss savings alone, but does consider loss savings when comparing cost/benefits of capacity capital projects.



- Several large load centers were served by long, radial 46 kV lines.
- Addition of a 17-mile 138 kV line and a new 138/46 kV substation closer to the large load centers reduced overall peak system losses by 7.7 MW.
- Electric system loss savings helped justify the project cost.
- Project also increased capacity and provided voltage support for the area.

