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Technical Methods of Minimizing Losses

Day 1 – Session 2 Network Design & Configuration

David Cleaver, Public Utilities Commission of Ohio

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Review of Types of Losses

- No-Load Losses – Non productive energy to energize circuits and equipment

- Load Losses – Losses in the form of heat that varies directly with the current

Note: coordinate with Paul's presentation on losses

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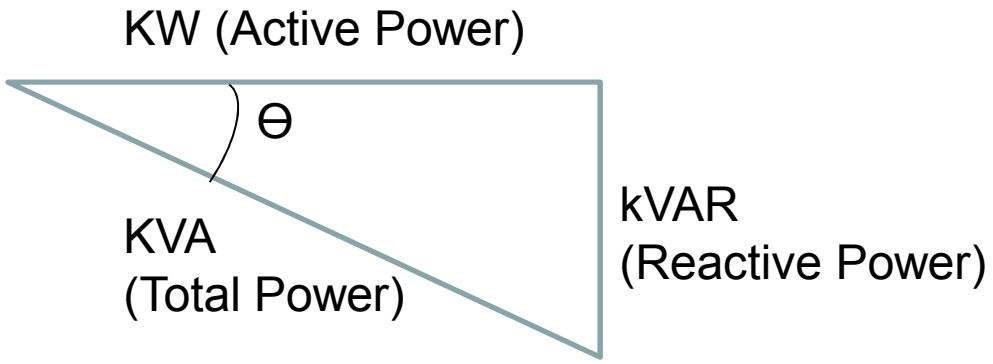
Basic Formulas for Considering Strategies to Minimize Losses

- Active power is measured in KW (1000 watts)
- Reactive power is measured in kVAR (1000 volt-amperes reactive)
- Total power is measured in KVA (1000 volt-amperes)

$$PF = \frac{KW}{KVA} = \cos \Theta$$



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Basic Formulas for Considering Strategies to Minimize Losses

- Total power (1000 volt-amperes) = voltage x current

  Total power = V x I

- Losses (watts) = Current squared x resistance

  Losses = $I^2 R$

Losses are minimized if R↓, I↓, V↑, kVAR ↓

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Optimize Transmission and Distribution Systems

- Re-conductoring of lines
- Substation projects
- Addition of capacitor banks
- Voltage regulation projects

Re-conductoring of lines

- Replacing existing wires with larger wires between transmission towers or distribution poles
  - Lowers resistance (R↓) of the system reducing losses
  - Analogous to improving traffic flow on a highway by adding an extra lane

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Substation Projects

- Tying together previously unconnected lines and/or adding or upgrading of transformers and circuits
  - Provides additional energy transformation point closer to load center
  - Greater portion of energy flows across high-voltage lines (V↑) instead of lower-voltage lines reducing losses
  - Analogous to adding extra exit to a fast moving highway which is closer to your destination

Capacitor Bank Projects

- Addition or expansion of capacitor banks in a substation and/or on transmission or distribution lines
  - Reduces losses by placing a reactive source at or near the load (kVAR ↓)
  - A portion of the load no longer travels across the entire transmission or distribution center (I ↓)
  - Similar to smoothing out hills and valleys along a highway for more efficient travel

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Voltage Regulation Project

- Replacement of existing equipment with larger an/or more efficient equipment
  - Reduces losses and heating associated with smaller equipment (R ↓)
  - Similar to re-conductoring projects
  - Like improving traffic flow on highway by adding another lane

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Special Provision in Ohio Energy Law

- Allows utilities to meet energy efficiency and demand reduction benchmarks with projects that project power system losses
- Both transmission and distribution system projects qualify

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Examples at the PUCO

- First Energy met statutory requirements for energy efficiency and demand reduction benchmarks through projects that reduced losses
- DPL met energy efficiency and demand reduction benchmark by converting 205 miles of existing 4kV distribution to 12 kV

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First Energy Projects

Project Name	In Service Date	Loss Reduction (MW)	Annualized Loss Reduction (MWhrs)
Distribution Projects			
Re-conductor line along North Street	7/12/2010	0.018	49
Jefferson Substation – replace transformer	10/26/2010	0.01	27
Capacitors – additions	6/1/2010	0.11	287
Total 2010 Loss Reductions		**0.138**	**363**

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First Energy Projects

Project Name	In Service Date	Loss Reduction (MW)	Annualized Loss Reduction (MWhrs)
Transmission Projects			
Lakeview 34.5 kV capacitor bank	1/4/2010	0.20	741
New 138 kV delivery point to Cleveland Power	7/12/2010	0.90	3,335
Total 2010 Loss Reductions		**1.1**	**4,076**

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DPL Projects

Project Name	Date	Loss Reduction (MW)	Annualized Loss Reduction (MWhrs)
4 kV to 12 kV Conversion Project	2010	2.9	10,299
	2011	1.4	5,017
	2012	7.1	24,626
	2013	4.2	14,628
	2014	1.2	4,316
Total		16.8	58,886

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Questions