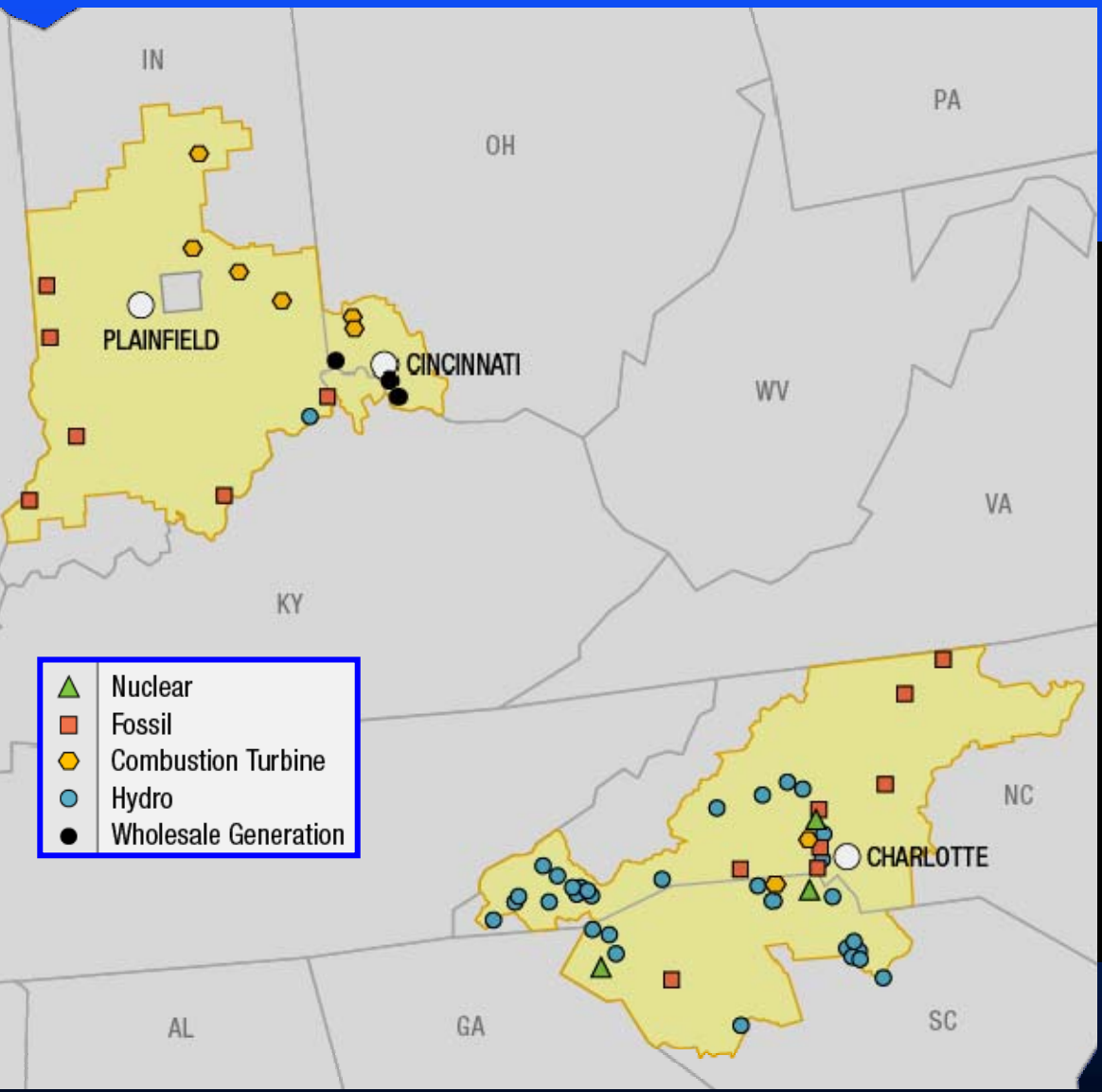
Duke Energy Power Quality Today

Presented by:

Kevin Little

Who are We?

US Franchised Electric & Gas



- 5 states: North Carolina, South Carolina, Indiana, Ohio and Kentucky
- 47,000 square miles of service area
- ~28,000 MW
- 3.8 million retail electric customers
- 500,000 retail gas customers

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Power Quality Team

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Midwest

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Carolinas

Kim Craven; Alan Ebel; Randall Emanuel; Charles Jensen; James McGee; Robert Metz; Greg Palmer; Herb Stuckey; Jim Weddington

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What are two aspects which affect the quality of the supplied electrical service?

A: Wire & Poles

B: Use & Supply System

C: Capacitor & Control

D: State & Local Governments

Is that your *final* answer?

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Use Affects Quality - Ohm's Law!

Use of electricity causes current flow

Flow of current causes voltage drops

Final Quality = Source Quality - (I x Z)

Loads vary over time - Statistical approach may be appropriate.

A partnership must exist between suppliers and their customers!

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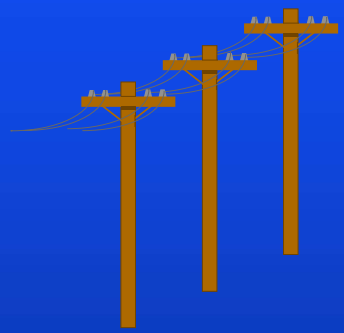
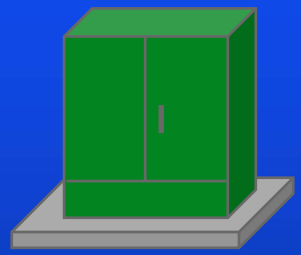
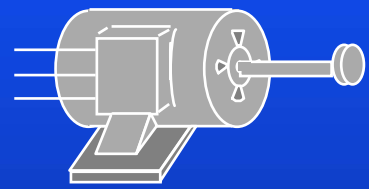
Special Nature of Electricity: Use Affects Quality

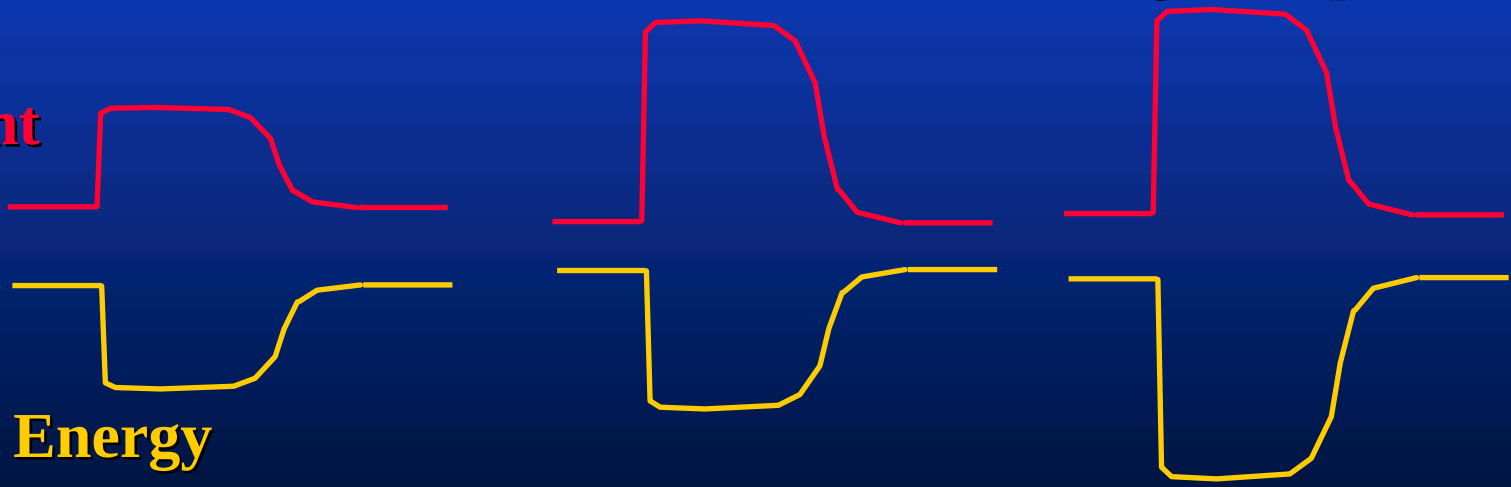






Standard Service Causes too Much Voltage Drop!

Motor Current



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Four Part Approach to Power Quality

1. Education for employees and customers:
   Harmonics, grounding, monitoring, solutions

2. Promote system compatibility:
   IEEE Standards, EPRI, ANSI, etc.

3. Diagnostic services:
   Monitoring, audits, troubleshooting, design

4. *Improve delivered quality and reliability*

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Definition of Power Quality (PQ)

"Any abnormality from the electric supply that disrupts my business is a power quality problem."

PQ issues fall into one of three areas:

- Problems internal to customer facilities building wiring and design problems
- Customer actions interfere with utility supply - arc furnaces, welders, harmonics
- Utility supply events that disrupt customer business

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Utility supply events that disrupt customer business

- Customer disconnected from supply
  - Traditional reliability - SAIFI, CAIDI, ASAI, ...
  - “Duke Energy is 99.975% reliable”
  - “Our customers average 1.28 outages/year”
- Customer connected to supply
  - Voltage sags from nearby line faults
  - Capacitor ringing transients
  - Transient overvoltage from lightning
  - Voltage distortion from electronic loads

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Sources of Power Quality problems

CUSTOMERS

- **Building wiring errors**
- **Standards protection - *it should work***
- **Distributed computing**

EQUIPMENT

- Price pressures
- Many new technologies
- New designers & designs
- Different standards
- Cheaper to quit than ride through
- Data line connections

UTILITY

- Price pressures
- Same technology
- Stable design standards
- Weak quality standards
- Quality varies with location

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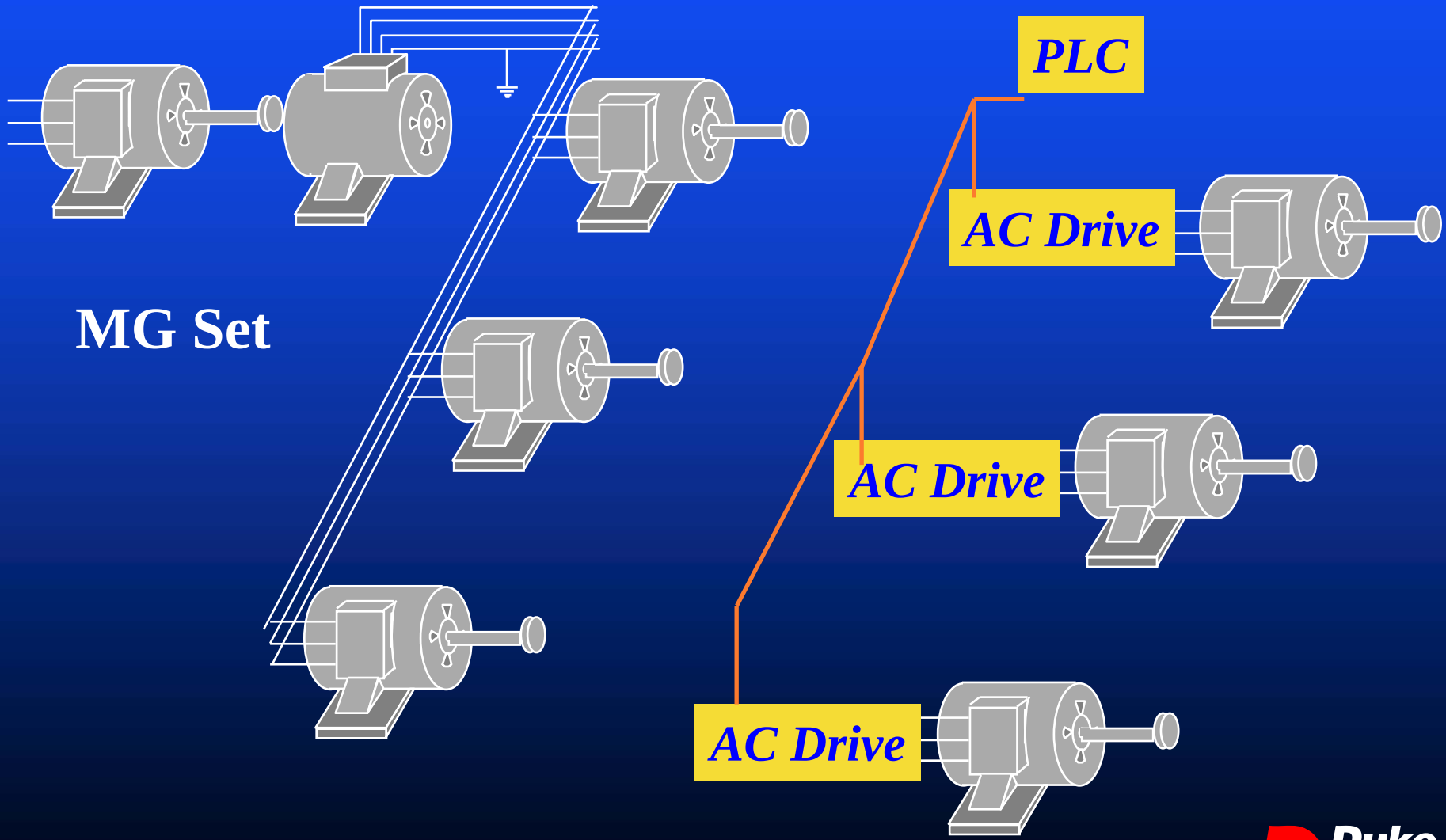
Changes in Utilization Equipment



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Utility Perspective Past

Old Utility PQ Definitions

- Longer Interruptions Important
- Momentary Interruptions Small Importance
- Customer Outage Minutes not seconds
- 1 Second Outage is not bad

Utility Perspective Today

New Utility PQ Definitions

- Momentary Interruption is Very Important
- Sags are Very Important
- Ringing Transients
- Waveform Distortion
- 1 Cycle (0.016 Seconds) is a Lifetime

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Our Approach

Assist customers having trouble

- site visits and in plant analysis
- monitoring services
- Help with equipment specifications
- Referral to reputable manufactures and
- consultants

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Our Approach

Improve our performance

- Better tree trimming
- Lower tower footing resistance
- Better high voltage capacitor control
- Probabilistic reliability analysis
- Ability to predict voltage sags
- Operation strategies on subtransmission
- Distribution relay practices

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Case Study 1

- Plant in Eastern Indiana
- Multiple CNC machines & Lathes
- Prone to voltage sags & outages

- Improve Feeder Reliability
- Sag mitigation

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Case Study 2

Plant in Southern Indiana

Manufactured glass windshields

Voltage sags caused dc drive trips

Extended downtime & lost production

Identified setting changes on drives

Recommended drive replacements

Eliminated nuisance trips

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Questions?

More Information

Internet:

http://www.duke-energy.com