

# Duke Energy Power Quality Today

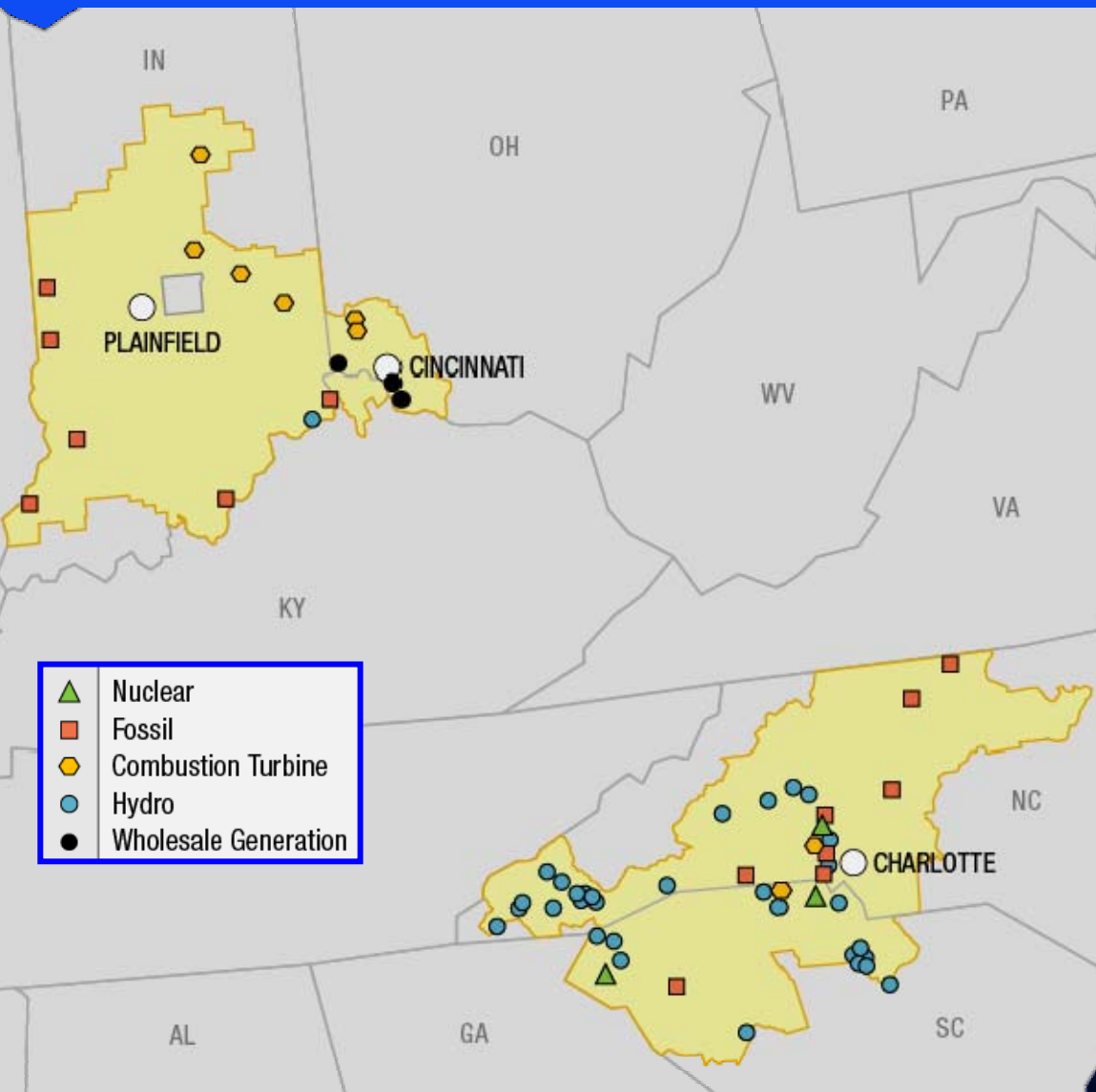
Presented by:

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

# Duke Energy Power Quality Team



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## Carolinas

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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?

# Use Affects Quality - Ohm's Law!

Use of electricity causes current flow

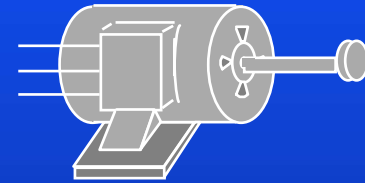
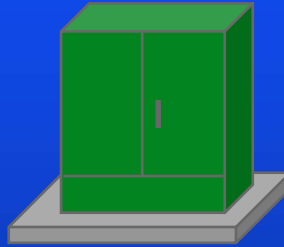
Flow of current causes voltage drops

$$\text{Final Quality} = \text{Source Quality} - (I \times Z)$$

Loads vary over time - Statistical approach  
may be appropriate.

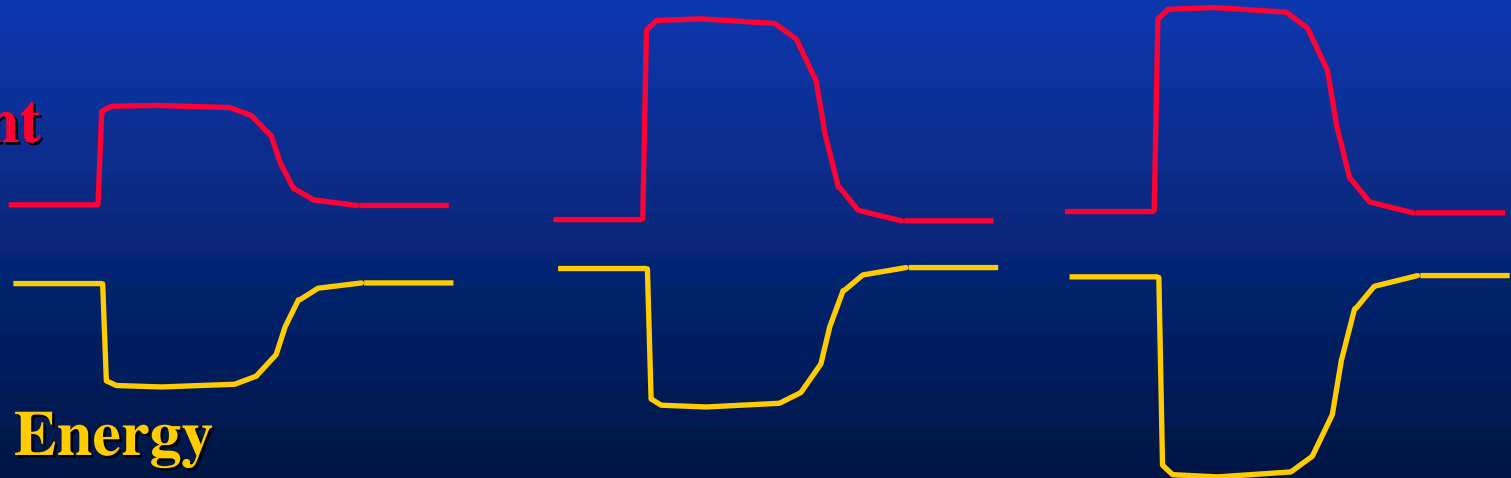
*A partnership must exist between suppliers  
and their customers!*

# Special Nature of Electricity: Use Affects Quality



**Standard Service Causes too Much Voltage Drop!**

**Motor  
Current**



**Duke Energy  
Voltage not Good!**

# 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*

# 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**

# 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

# Sources of Power Quality problems

## CUSTOMERS

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

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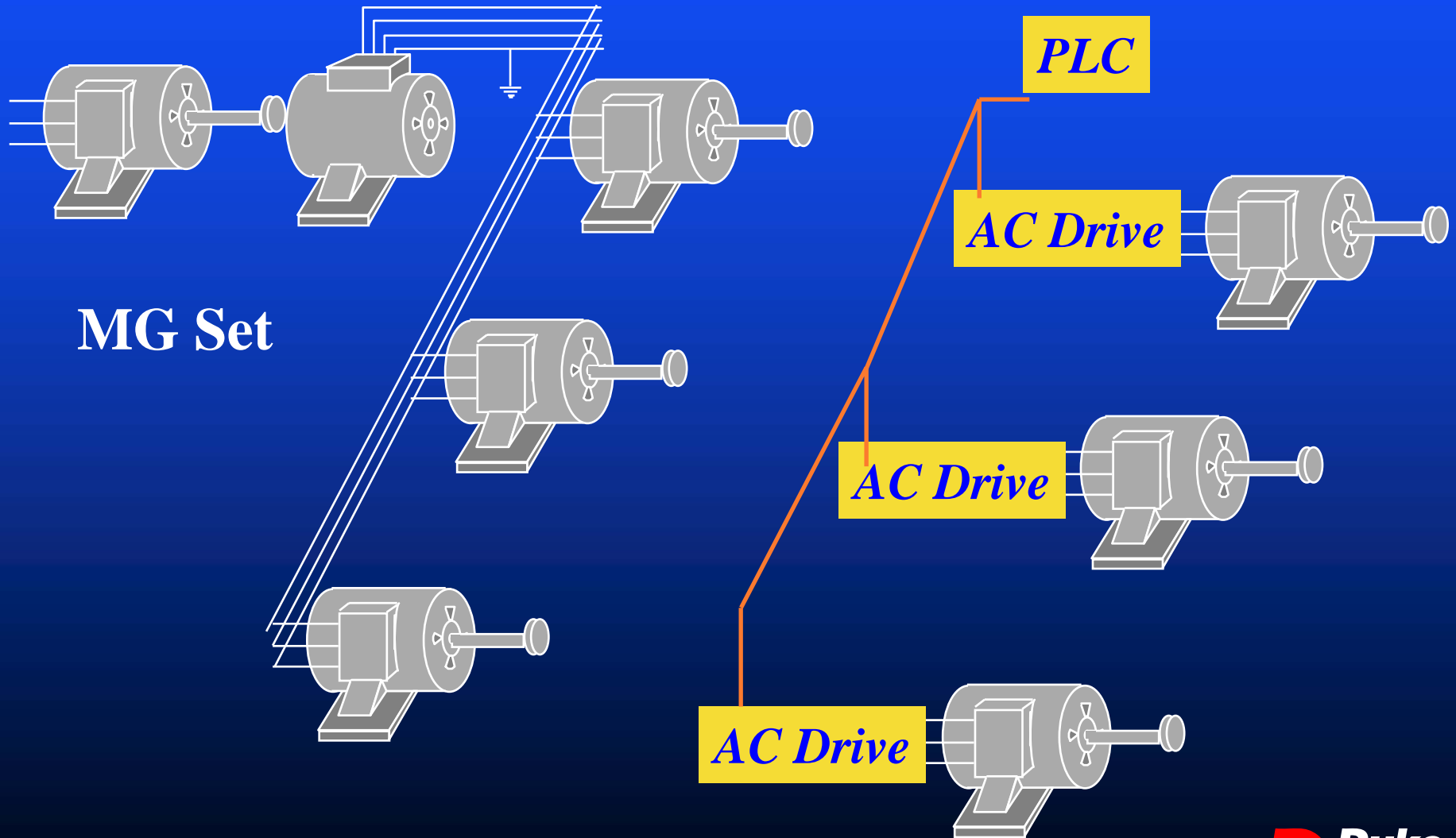
## EQUIPMENT

- 👉 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

# Changes in Utilization Equipment



MG Set

PLC

AC Drive

AC Drive

AC Drive

# 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**

# **Our Approach**

## **Assist customers having trouble**

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

# **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**

# Case Study 1

- Plant in Eastern Indiana
- Multiple CNC machines & Lathes
- Prone to voltage sags & outages
  
- Improve Feeder Reliability
- Sag mitigation

# **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**

***Questions?***

# More Information

**Internet:**

<http://www.duke-energy.com>