

LONG TERM ANALYSIS OF LINE ARRESTER APPLICATION FIELD STUDY

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Reliability Programs

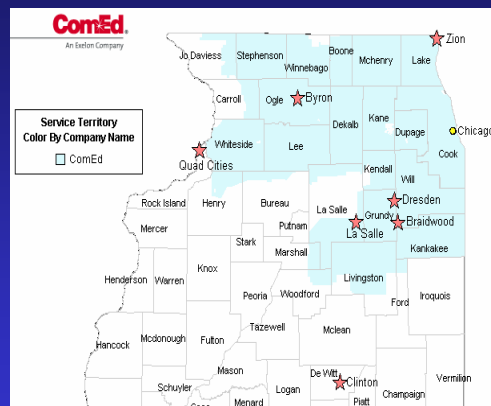


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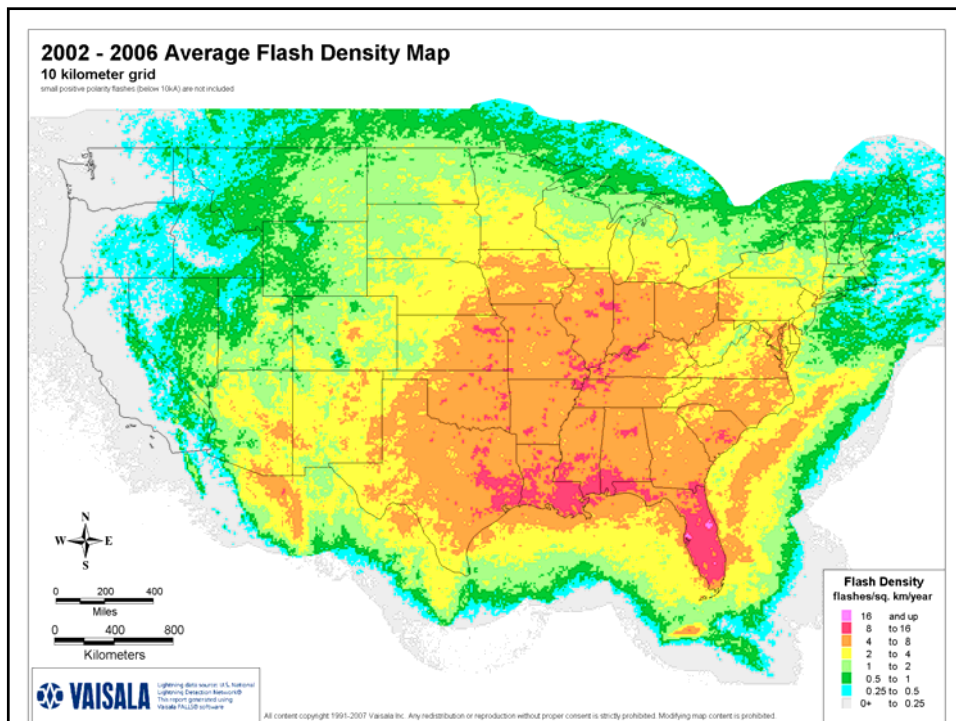
ComEd Service Territory

- More than 3.7 million customers
- 11,400 square miles
- 1.4 million distribution poles
- Distribution Circuits
 - 44,000 miles of overhead circuits
 - 46,000 miles of underground circuits
- 5,182 circuits
 - 4,912 4/12kV Circuits
 - 270 34kV Circuits
- 1,042 substations

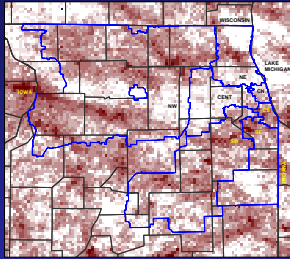


Lightning Caused Interruptions

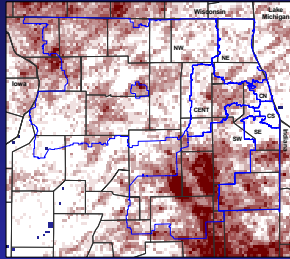
- 10% of system SAIFI in 2007 (IEEE Def)
- 480,000 Customer Interruptions
- Historically a significant contributor to sustained outages



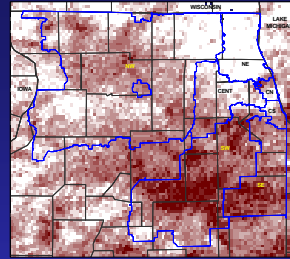
ComEd Summer Lightning Activity



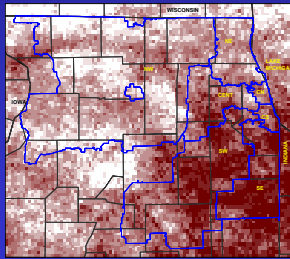
2006



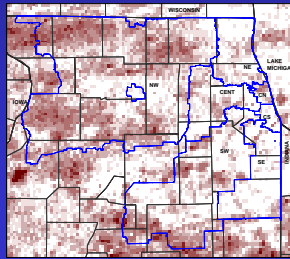
2005



2004



2003



2002

Key Points

- Intensity varies by year and by region
- Over time, greater in Southern regions

1992 Study

- Software could model various parameters

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- Output was predicted flashover rate

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- Assess current standard for lightning arrester application

1992 Study

- Software could model various parameters
- Output was predicted flashover rate
- Assess current standard for lightning arrester application
- Recommend changes for improved performance

1992 Study

- Results
 - Predicted 70% reduction in flashover rate by reducing arrester spacing to 180 m (600 ft)

1992 Study

- Results
 - Predicted 70% reduction in flashover rate by reducing arrester spacing to 180 m (600 ft)
- Recommendations (New Standard)
 - New construction
 - Arresters every 180 m (600ft)
 - Existing circuits
 - Follow new standard as needed
 - Bring grounds up to spec

1995 Field Trial

- Objective
 - Verify predicted performance improvement

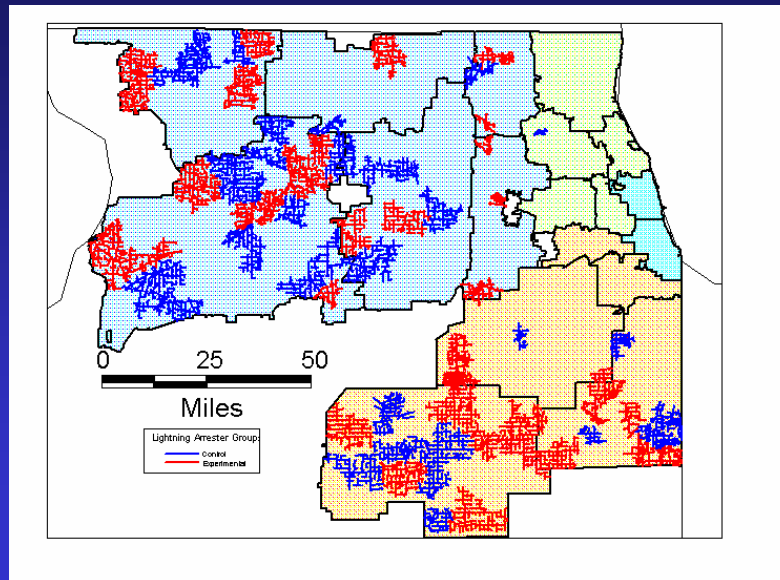
1995 Field Trial

- Objective
 - Verify predicted performance improvement
- Methodology
 - Select 2 groups of circuits
 - Upgrade 1 group to new standard
 - 1 group left as a control
 - Compare performance after some time period

1995 Field Trial

- 60 circuits selected
 - Based on 5 year outage data
 - 30 control, 30 experimental

1995 Field Trial



1995 Field Trial

- 60 circuits selected
 - Based on 5 year outage data
 - 30 control, 30 experimental
- Upgrade of experimental group took from November 1995 to May 1997
 - 40,000 arresters
 - 70,000 ground rods

1995 Field Trial

- After 3 “lightning seasons” compare performance

1995 Field Trial

- After 3 “lightning seasons” compare performance
- ComEd database of outages coded as lightning
 - IEEE outages (> 5 minutes)

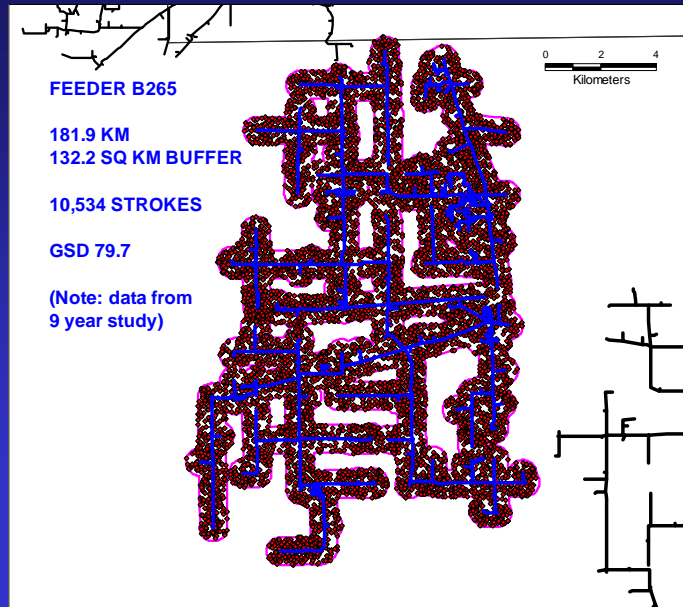
1995 Field Trial

- After 3 “lightning seasons” compare performance
- ComEd database of outages coded as lightning
 - IEEE outages (> 5 minutes)
- Lightning data obtained using FALLS™ software from Vaisala, Inc
 - 1 kM buffer

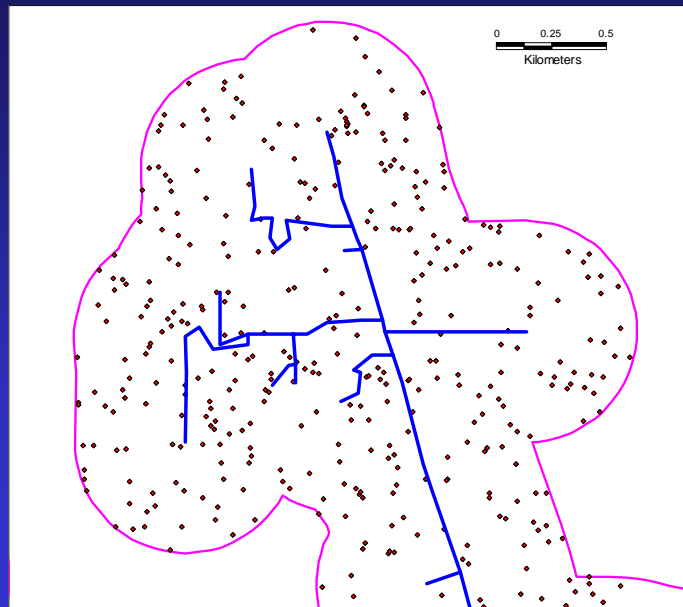
1995 Field Trial

- After 3 “lightning seasons” compare performance
- ComEd database of outages coded as lightning
 - IEEE outages (> 5 minutes)
- Lightning data obtained using FALLS™ software from Vaisala, Inc
 - 1 kM buffer
- Compare lightning timestamp to outages
 - 3 hour window

1995 Field Trial



1995 Field Trial



1995 Field Trial

- Results

- IEEE paper in 2001 by John McDaniel
- Used # interruptions / 100km / GSD

1995 Field Trial

	<u># INTER</u>	<u>LENGTH</u>	<u>GSD</u>	<u>INT/100KM/GSD</u>
CONTROL AVG	14.43	150.7	21.27	0.457
EXPER AVG	11.93	183	21.88	0.305

- Statistical analysis: 16% improvement, 95% confidence

2007 Study Update

- Validate results of earlier study
- 9 Years: 1998 through 2006
- Same methodology

2007 Study Update

- Question: Are the 60 circuits still valid?
 - Mostly rural
 - Less change over time

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2007 Study Update

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 - Mostly rural
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- Initial assumption was: Yes
- Study update was performed

2007 Study Update

- Detailed circuit by circuit comparison
 - 2006 vs. 1997 configuration

2007 Study Update

- Detailed circuit by circuit comparison
 - 2006 vs. 1997 configuration
- Control circuits
 - 21 of 30 unchanged

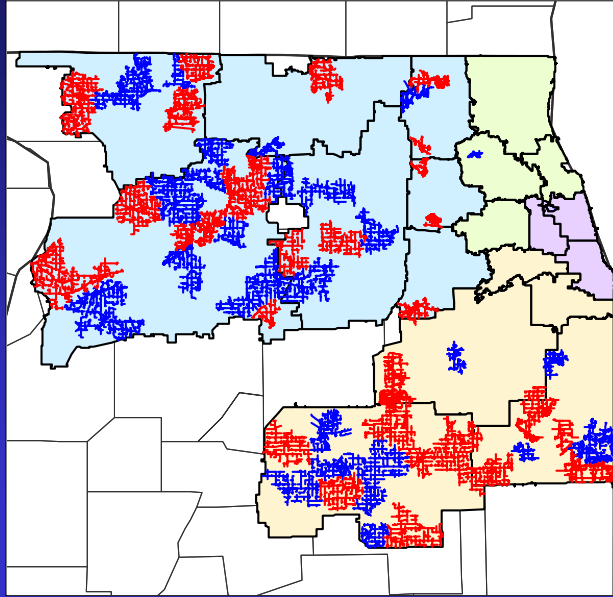
2007 Study Update

- Detailed circuit by circuit comparison
 - 2006 vs. 1997 configuration
- Control circuits
 - 21 of 30 unchanged
- Experimental circuits
 - 20 of 30 unchanged

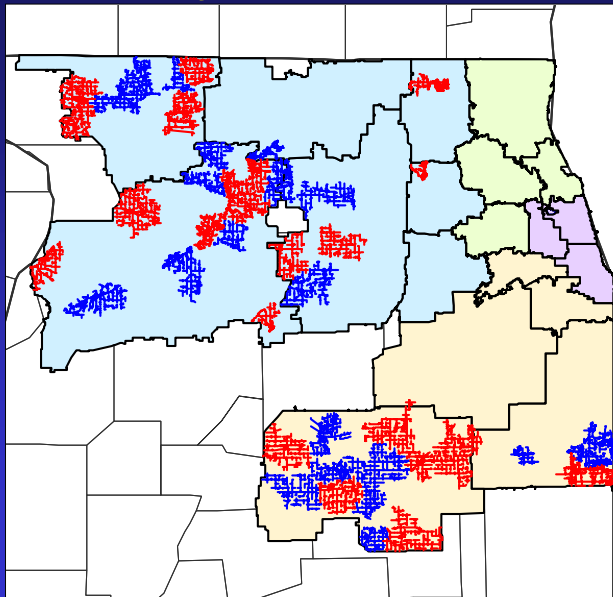
2007 Study Update

- Conclusion
 - Assumption was reasonable – *but*
 - Rerun study using the 41 circuits

2007 Study Update – 60 Circuits



2007 Study Update – 41 Circuits



2007 Study Update – 41 Circuits

	<u># INTER</u>	<u>LENGTH</u>	<u>GSD</u>	<u>INT/100KM/GSD</u>
CONTROL AVG	60.8	148.6	104.8	0.390
EXPER AVG	56.2	185.7	105.5	0.291

- Statistical analysis: 16% improvement, 95% confidence

2007 Study Update – 41 Circuits

- 2007 study update results exactly the same as the original study
 - 16% improvement, 95% confidence

2007 Study Update – 41 Circuits

- Results not as great as prediction (70%)
 - Calculation actually *Flashover* rate, not *Outage* rate
 - Reclosers – Not all flashovers are outages

2007 Study Update – 41 Circuits

- Results not as great as prediction (70%)
 - Calculation actually *Flashover* rate, not *Outage* rate
 - Reclosers – Not all flashovers are outages
 - Model vs. Field Conditions
 - Arrester spacing in control group
 - Pole height
 - BIL

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QUESTIONS???

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