

# 20,000-Mile Electric Utility Overhead Distribution Reliability Survey



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## Executive Summary

# 20,000-Mile Electric Utility Overhead Distribution Reliability Survey

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### Observations:

- Worst-Performing Circuits were the priority target for surveys by utility management.
- Efforts to improve reliability are largely reactive in nature.
- There is a strong focus on Asset Management—not Asset Health Management.
- Utilities are not using predictive measurement technology to assess the state of failing electrical equipment.
- There is no clear problem ownership regarding reliability. Different departments take on aspects of the problem. There is no integrated solution empowering change.

### Participants:

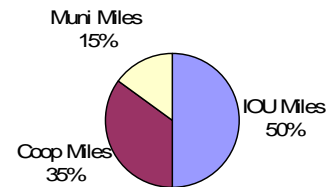
- Seven Investor Owned Utilities – 11,353 miles
- Five Rural Electric Cooperatives – 7,947 miles
- Seven Municipal Utilities – 3,406 miles

### Territory Surveyed:

- 15 States
  - 41% Urban
  - 24% Suburban
  - 35% Rural
- One overseas utility (50 Hz)



### National Survey Mileage



### Survey Results:

- Exacter survey demonstrates the problem of failing electrical equipment may be worse than the DOE study prediction by a factor of nearly 2 to 1.
- Exacter survey located 26,450 failure signatures. DOE 3,000,000-mile study, interpolated to the 22,706 miles survey by Exacter, projects the number of failures at only 13,624, or roughly 50% of Exacter's findings.
- This discrepancy may result from latent damage that goes unnoticed with traditional preventive-maintenance technologies and methods.
- Damaged electrical equipment can be difficult visual targets to locate and often do not present a thermal signature for IR camera detection.

### Next Step:

- Design and implement the 2008 100,000-Mile U.S. Survey with up to 50 utilities in the U.S.
- Continue working with utilities to develop specific device failure signatures for targeted preventive maintenance.

# **I. About the 20,000-Mile Electric Utility Overhead Distribution Reliability Survey**

From January through December of 2007, Exacter, Inc. conducted reliability surveys of electrical distribution systems for 19 U.S. utilities in 15 states. The surveys identified and located failing equipment across more than 20,000 miles of distribution overhead.

This is the single, largest measurement of U.S. electrical distribution systems ever conducted, covering more miles, identifying more problem locations, and delivering more field data on failing equipment than any other survey of its kind.

This is the first attempt to characterize the second-largest reliability issue next to weather and the first attempt to proactively reduce SAIFI through a cost-effective method of preventive maintenance.

## **II. Methodology**

Multiple utilities commissioned Exacter, Inc. to use our proprietary signal-measurement technology—the EXACTER® Outage-Avoidance System. They deployed the measurement unit of the system in various utility vehicles and non-utility vehicles for periods of up to six months. While the vehicles drove their daily routes, failure emissions were detected, identified, and located with GPS coordinates. Exacter, Inc. then generated maps indicating the locations of any failing electrical equipment so the participating utilities could take corrective measures.

All survey data were analyzed and distributed by Exacter, Inc. to our customers and made available through an interactive Web Information Portal. The cumulative data gathered across 19 different utilities is the basis of the 20,000-Mile Electric Utility Overhead Distribution Reliability Survey and proves the opportunity to deploy technology to reduce SAIFI.

## **III. Measuring Technology**

The EXACTER Outage-Avoidance System was the primary source of data for this survey.

EXACTER monitors the sources of distribution line emissions and coordinates date, time, GPS location, and maintenance priority. The system uses an advanced sensor array to locate predictive conditions that precede hardware failure. EXACTER rides in any vehicle as it travels throughout an electrical distribution system. There is no operator interaction required. The measurement unit collects line emissions information and transmits it to a Knowledge Database where it is analyzed for known failure-prediction signatures. Using a Web portal, mapped locations and processed information are returned to the utility for review, analysis, and preventive maintenance scheduling.

During the survey, utilities used complementary infrared (IR) camera and radio-frequency (RF) sensor technology to verify and pinpoint disturbances located by EXACTER, thus validating the accuracy and ability of this new technology to automatically locate failing electrical equipment before outages result.

## IV. Geographic Coverage

Surveys were conducted in the following states:

Florida	Kansas	Mississippi	Pennsylvania
Georgia	Kentucky	New Jersey	South Carolina
Indiana	Maryland	New York	West Virginia
Illinois	Michigan	Ohio	

These surveys included a variety of system configurations and design standards. Within the 19 participating utilities and using the data from over 40 technology demonstrations, more than 1,000 electrical components were prioritized and replaced, resulting in more than 1,000 avoided outages. The study included seven IOUs covering 11,353 miles, five Rural Electric Cooperatives covering 7,947 miles, and seven Municipal utilities covering 3,406 miles. The areas covered included urban systems (41%), suburban systems (24%), and rural systems (35%). In addition, an overseas utility's results (50 Hz) were included in the survey.

## V. Survey Data

### Exacter Survey Data

Miles Surveyed	22,706
Sites Analyzed	600,723
Failing Equipment Sites Located	26,450
Outages Avoided	1,122

The 20,000 miles of survey resulted in a number of interesting findings:

1. Equipment on the aging distribution infrastructure is almost always replaced rather than maintained.
2. New replacement components are inferior in quality to the original components being replaced.
3. Well-maintained systems do not exhibit failure signatures.
4. Results indicate that this technology applied to preventive maintenance provides an effective methodology for outage avoidance and SAIFI improvement.

## **Survey Data Compared to the DOE National Study<sup>1</sup>**

In 2003, the DOE commissioned a study to analyze the cost of reliability to the U.S. economy. In this study, the economic cost to our economy was defined as \$79 billion annually. This cost was associated with the failure of the infrastructure and did not include catastrophic events like the 2003 Northeast blackout. The study's definition of the problem is startling: Six million outages in the U.S. each year, and 30% of these outages were related to electrical equipment failures.

The Exacter survey demonstrates that the problem of failing electrical equipment may be much worse than the prediction of the DOE study by a factor of nearly 2 to 1. This discrepancy may result from latent damage that goes unnoticed with traditional preventive-maintenance technologies and methods. Items such as cracked insulators, damaged cutouts, lightning arrestors, and connectors can be difficult visual targets to locate and often do not present a thermal signature for IR camera detection.

In our survey, 26,450 failure signatures were located. The DOE 3,000,000-mile study, interpolated to the 22,706 miles surveyed by Exacter, projects the number of failures at only 13,624, or roughly 50% of Exacter's findings.

## **VI. Survey Summary**

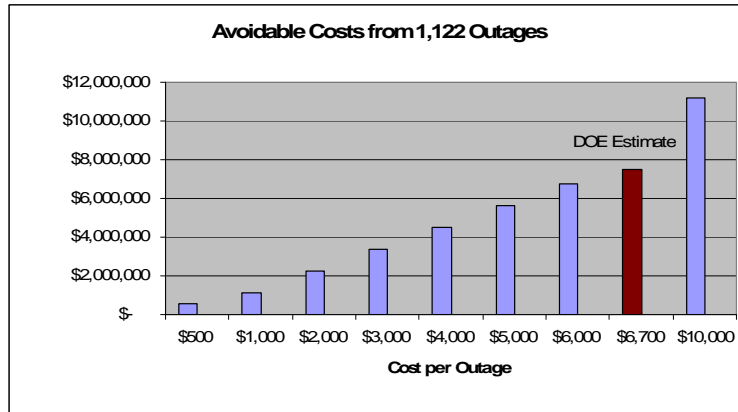
In addition to calculating survey data, Exacter team members had the opportunity to spend significant amounts of time in the field and in conversation with various utility maintenance and management personnel responsible for improving distribution system reliability. The comments below reflect some of their findings and observations:

- Department of Energy studies indicate that 30% of all power outages are due to failing equipment. This estimate has been confirmed by the utilities Exacter worked with (estimates varied from 28% to 35%) and in publications and presentations by EEI, NRECA, APPA, and IEEE.
- EXACTER measurements show that early indications of equipment failure are detectable on twice the estimated number of devices. These failing devices can be detected, located, and prioritized for replacement, allowing predictive, preventive maintenance.

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<sup>1</sup> Hamachi La Commare, Kristina, and Ho, Joseph H., "Understanding the Cost of Power Interruptions to US Electricity Consumers," Energy Analysis Departments, Ernest Orlando Lawrence Berkeley National Laboratory, University of California Berkeley

- Using DOE estimates of the avoidable costs through outage prevention (\$6,700 per outage), this group of surveys produced an opportunity for cost savings of \$7.5 million by avoiding 1,122 outages. The study proved that these outages can be detected, located, and prevented using predictive, preventive-maintenance strategies.



- Over the 22,706 miles, DOE indicates 13,624 equipment failures over the course of the year. EXACTER measurements over its one-to-six-month survey period identified 26,450 failures, or about twice the DOE annual statistic.
- The majority of reliability improvement efforts are “REACTIVE” affecting SAIDI (duration), or after the outage has occurred—not “PROACTIVE” which would affect SAIFI (frequency).
- Utilities have made significant progress and investment in Asset Management, but have not yet found a means to measure Asset Health which corresponds to reliability and SAIFI improvement.
- There is no clear problem ownership regarding reliability. Different departments take on aspects of the problem. There is no integrated solution empowering change.
- With regard to reliability, there are few RESULTS-BASED SOLUTIONS being offered by utility suppliers despite being sought after by utility management.

## **VII. Utility Responses**

The utility response to the data generated by the EXACTER System was initially one of skepticism. However, using existing IR camera and RF technology, utilities investigated and validated EXACTER failure locations. As part of the collaboration process, new analysis methods were created that resulted in 100% equipment failure identification rates. Below is a sample of utility responses to the data generated by this survey:

- More than 100 communities in Ohio HAVE ALREADY banded together to address the issue of electric reliability at the cooperative and municipal level. These communities are using EXACTER technology and data to drive their efforts.
- One large northeast utility is CURRENTLY USING EXACTER technology and data as a reliability strategy in their three-year rate-base request to the PUCO. In their first year of EXACTER use, they achieved a 30% improvement in the SAIFI objective, from 1.30 to 1.02.
- An Automatic Meter Reading (AMR) user was able to find a disturbance that had interrupted AMR data flow for six months that they had not been able to locate with conventional technology (including IR).
- One municipal utility identified a ceramic cutout that was literally cracked in half. It was at a strategic point that would have eventually shut down about 30% of the city's distribution system.
- An IOU has been suffering fused cutout failures that result in \$30 million to \$50 million in maintenance costs per year. EXACTER is now part of their targeted strategic reliability initiative to eliminate these devices.
- A municipal has received an APPA grant to study the problem of failing lightning arrestors using EXACTER as the locating and discriminating technology.
- A major provider of Broadband-over-Power-Line (BPL) technology to utilities has selected EXACTER for pre-installation surveys and post-installation maintenance surveys as a way to locate and have replaced failing electrical equipment that inhibits broadband communication of power lines.
- A cooperative located and replaced a failing ceramic cutout that would have led to a power failure at a large high school.

## **VIII. Recommendations**

In 2008, Exacter, Inc. will be recruiting up to 50 electric utilities from across the country to participate in a 100,000-mile distribution survey to draw attention to the need for intelligence-based preventive maintenance. This survey will be designed to include all regions and climates of the country. The data will provide a valuable benchmark to the national problem of maintaining the aging distribution overhead infrastructure.

## **IX. Situation White Paper**

The Exacter, Inc. situation White Paper, "*Distribution Reliability – Nine Important Issues*," is available at:

[http://www.exacterinc.com/UserFiles/File/Dist\\_%20Reliability%20White%20Paper.pdf](http://www.exacterinc.com/UserFiles/File/Dist_%20Reliability%20White%20Paper.pdf)