Electric Distribution Reliability

National Association of Regulatory Utility Commissioners

Ohio Public Utilities Commission

Reliability Standards and Major Storms/Events Exclusions

Historical vs. Current Methodology for Setting Reliability Standards

- An electric utility's reliability standards should reflect its historical performance
- In the past, Staff used a five year average plus one standard deviation for setting targets (each utility had its own definition of a major storm)
- Currently, ten years of historical data are used for setting targets (all utilities use the 2.5 Beta methodology for excluding major events)
- Staff expects all pertinent historical performance data to be included in each electric utility's application for new standards

Reasons for Changes to Historical Performance Data

- Exclusion of transmission outages
- Replacing major storms with major events (2.5 Beta)
- Impact of outage management systems

Outage Management Systems

- Beginning with 1999, electric utilities started implementing automated outage reporting systems
- Previously, much of the outage data were collected manually on paper in the field as part of restoration activities
- Automation resulted in more accurate reporting, which made it look like performance was getting worse
- It is more likely that the old manual reporting was making performance look better than it actually was

Reliability Indices

“Old” vs. “New” Performance Targets

- Performance targets were originally set around 1999 and were first used in reporting for the year 2000
- Most utilities’ targets were based on performance for the five-years ending 1998
- Most utilities averaged the performance for those five years and added one standard deviation
- Some of the utilities’ targets were based on a rough average of older historical performance without adding one standard deviation

Measuring Reliability Performance

- The targets are established based on three reliability measures (indices):

  - ✓ **SAIFI** – System Average Interruption Frequency Index
  - ✓ **CAIDI** – Customer Average Interruption Duration Index
  - ✓ **SAIDI** – System Average Interruption Duration Index

Measuring Reliability Performance

- The new standards will be set for SAIFI and CAIDI as SAIDI is simply the product of SAIFI and CAIDI

$$\text{SAIFI} = \frac{\text{Total number of customer interruptions}}{\text{Total number of customers served}}$$

$$\text{CAIDI} = \frac{\text{Sum of customer interruption durations}}{\text{Total number of customer interruptions}}$$

$$\text{SAIDI} = \frac{\text{Sum of customer interruption durations}}{\text{Total number of customers served}}$$

Exclusions
(Major Storms vs. Major Events)

- The “old” rules required the exclusion of “major storms” from performance data
- The “old” rules allowed each utility to develop its own “major storm” definition
- As a result, there were variations among utilities on how their major storm exclusions affected their respective performances
- To address this problem, the IEEE developed the “2.5 Beta” methodology for establishing a standardized “major event” threshold
- The “new” rules adopted a modified version of the IEEE methodology

The 2.5 Beta Methodology

Methodology Development

- This methodology was developed by an IEEE working group (WG) on system design,
- The WG had over 130 members
- The “2.5 Beta Methodology” is now included in standard 1366-2003.

Purpose

- The methodology is used to determine calendar days upon which either the system design limits or operational limits are exceeded
- These days are classified as “Major Event Days” (MEDs)

2.5 Beta Methodology Described

- Collect values of daily SAIDI for five sequential years ending on the last day of the last complete reporting period.
- If any day in the data set has a value of zero for SAIDI, do not include that day in the analysis
- Take the natural logarithm (ln) of each daily SAIDI value in the data set
- Find α (Alpha), the average of the logarithms of the data set
- Find β (Beta), the standard deviation of the logarithms of the data set
- Compute the major event day threshold, $T_{MED,}$ using the equation:
- $$T_{MED} = e^{(\alpha+2.5\beta)}$$
- Any day with a daily SAIDI greater than the threshold value, T_{MED} ,that occurs during the reporting period is classified as a major event day

Additional Methodology Information

- When calculating daily SAIDI, interruption durations that extend into subsequent days accrue to the day on which the interruption begins
- Even though only SAIDI is used to determine major event days, CAIDI and SAIFI will be calculated after the data is segmented.

Benefits of 2.5 Beta Methodology

- Will allow consistent calculation of reliability performance standards
- An objective major event definition for classifying major events
- Major event definition is the same for all electric distribution utilities

Customer Perception Survey

- Survey Use
  - Used as one of the Inputs in the Methodology Utilized to Determine the Electric Utilities' Minimum Performance Standards for the CAIDI and SAIFI Service Reliability Indices
- Measurement of Customer Perception
  - Expectations of Service Reliability
    - Service Interruptions
      - Frequency
      - Duration
      - Economic Impact
- Minimum Frequency and Sample Size
  - Frequency
    - Every three years, an annual survey program is conducted using a quarterly administered survey to smooth out or eliminate bias
  - Sample Size
    - Sample Size Meets a Standard of 95 Percent Confidence Level with a Plus/Minus 5 Percent Absolute Error Rate
    - Surveys Will Be Conducted Separately on Residential and Business Customers

- Staff Oversight
  - Assess the Electric Utilities' Submitted Survey Instruments
    - ✓ Review the Content of the Survey Questions
      - Contains questions related to the customer's perception of service interruptions related to frequency, duration, and economic impact
      - The way the questions are asked
      - The order in which the questions are asked
      - Looked for bias within the questions
    - ✓ Review the Sampling Procedures
    - ✓ Review the Methodology for Administering the Survey
    - ✓ Review the Methodology Used to Analyze the Results
    - ✓ Ensure that the Survey Instruments are Designed to Separately Capture Residential and Business Customers' Perception of Reliability
  - Ensures the Sample Size Used By Each Electric Utility Meets the Level of Confidence in the Results
  - Ensures Transparency of Results as it Relates to the Setting of Performance Standards
    - ✓ How the Survey Results are Incorporated into the Electric Utilities' Methodologies for the Development of Their Respective Performance Standards

Technological Changes in the Electric Utility Industry

Changes in Technology since 2000

- **Mobile Substations** – "A Substation on Wheels" used to facilitate O&M in Distribution Substations, provide spare capacity for overloaded transformers, temporarily replace failed transformer.
- **SCADA** – Supervisory Control and Data Acquisition used to remotely monitor and control the flow of power within a electrical substation. Requires metering, communications, and switching capability.
- **Distribution Automation (DA)** – Provides remote sensing and remote control capabilities such that outages on distribution circuits can be shortened. Faulted portions of circuits can be remotely and/or automatically isolated from the unfaulted portions of the circuit.
- **Advanced Metering Infrastructure/Smart Grid** – Combines the advantages of SCADA and DA and extends the sensing and control functions to the customer's meter.

Outage Reporting, Emergency Planning, and Commission Enforcement

Outage Reporting

- Each electric utility must immediately report each outage to the commission
- An outage means an interruption to service
- An outage is reportable when involving 2500 customers or more for a projected period of at least four hours or 100 customers for a projected period of 24 hours or more
- Outage notifications are circulated to PUCO Call Center and other PUCO Staff & maintain outage information

Emergency Planning

- Each electric utility shall maintain and implement an emergency plan and make it available for review by the Commission's Outage Coordinator
  - ✓ Review employee activities to determine whether the emergency plan is effectively followed;
  - ✓ Establish and maintain policies/procedures to train its emergency response personnel to ensure they can implement the emergency procedures;
  - ✓ Establish procedures for analyzing equipment/facility failures that result in major outages;
  - ✓ Maintain a list of critical customers, and provide them annual notifications of the utility's critical-customer program;
  - ✓ Conduct an emergency exercise every three years to test and evaluate major components of its emergency plan
  - ✓ Coordinate the implementation of its emergency plan with any entity in control of electric transmission lines, any generation provider or electric utility connected to the utility's system

Commission Enforcement

- Rule 4901:1-10-30, O.A.C. states that if an electric utility fails to comply with the rules in this Chapter (4901:1-10), the utility may be subject to:

  - ✓ Forfeitures of not more than ten thousand dollars for each offense, with each day's continuance being a separate offense
  - ✓ Corrective action to effectuate compliance
  - ✓ Restitution or damages to the customer/consumer
  - ✓ Any other remedies available under law

Inspection, Maintenance, Repair, and Replacement of Distribution Facilities

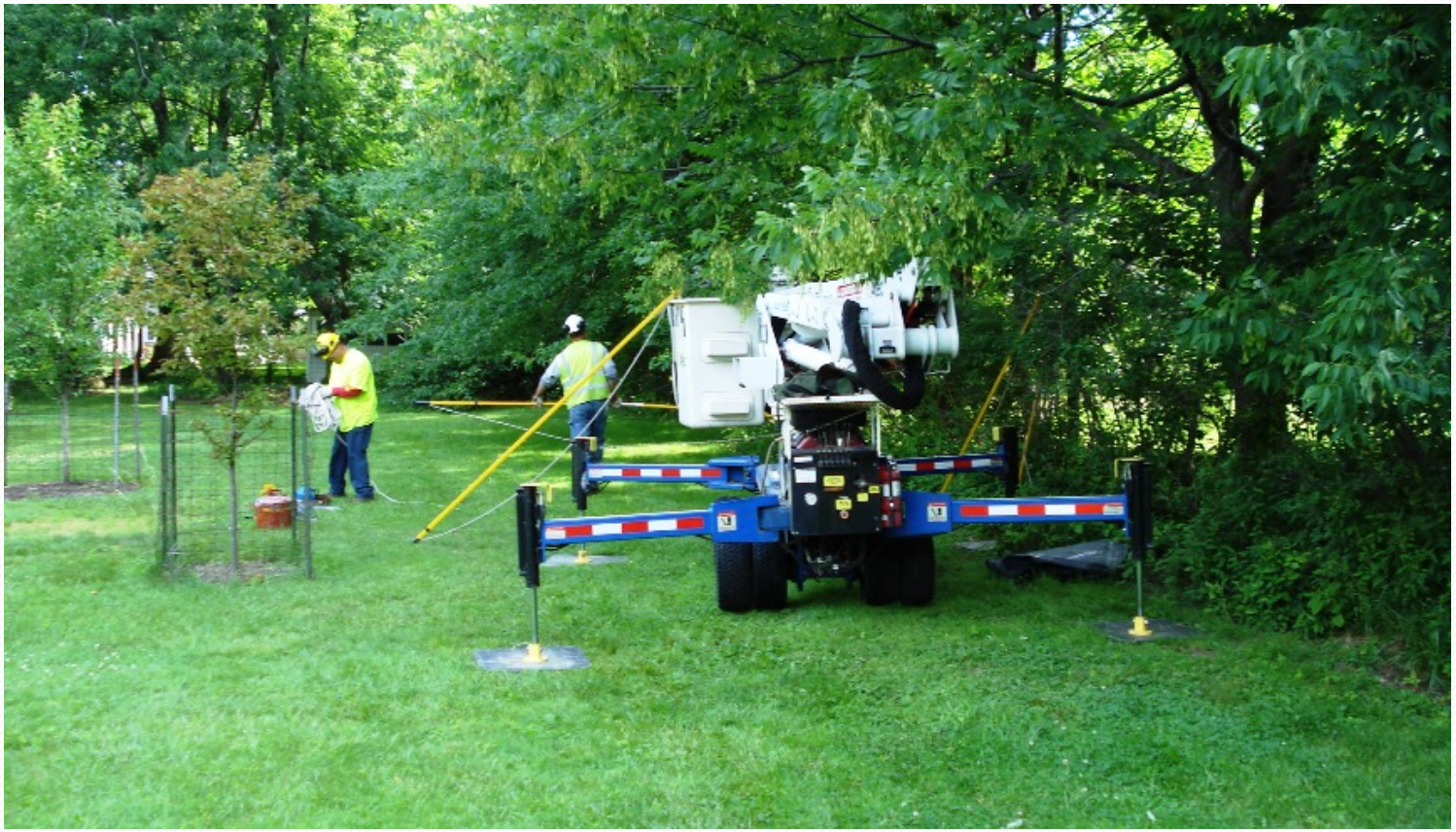
- Each electric utility shall establish, maintain, and comply with written programs, policies, procedures, and schedules for the inspection, maintenance, repair, and replacement of its distribution circuits and equipment.

  - ✓ These programs are filed in a public docket and approved by the PUCO.
  - ✓ These programs shall establish preventative requirements for the electric utility to maintain safe and reliable service.
  - ✓ Programs shall include: (a) Poles and towers, (b) Circuit and line inspections, (c) Primary enclosures (e.g. pad-mounted transformers and switch gear) and secondary enclosures (e.g. pedestals), (d) Line re-closers, (e) Line capacitors, (f) Right-of-way vegetation control, and (g) Substations.

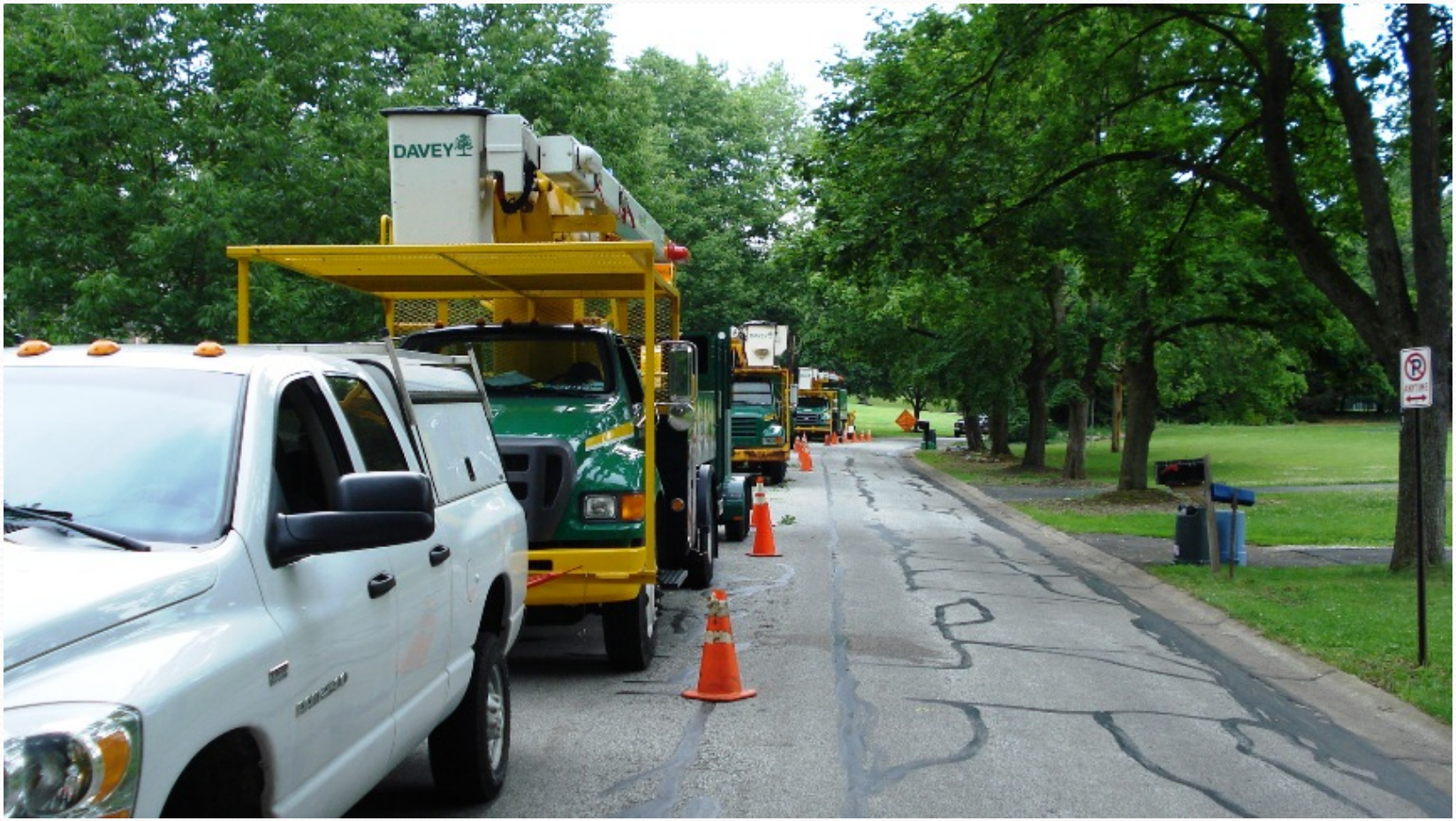
Inspection, Maintenance, Repair, and Replacement of Distribution Facilities (Continued)

- ✓ Schedule and conduct independent staff investigations to identify safety and reliability issues (known as Corrective Action Items or CAI's) to be provided to utilities for remediation
- ✓ Schedule and conduct inspections with utility companies to ensure maintenance programs are being performed in accordance with filed and approved programs
- ✓ Schedule and conduct desk audits (records audit) to ensure maintenance programs are being performed in accordance with filed and approved programs
- ✓ Conduct field inspections to verify that planned remediation initiatives have been conducted
- ✓ Document inspection findings in database and analyze results for trends

Back Yard Bucket



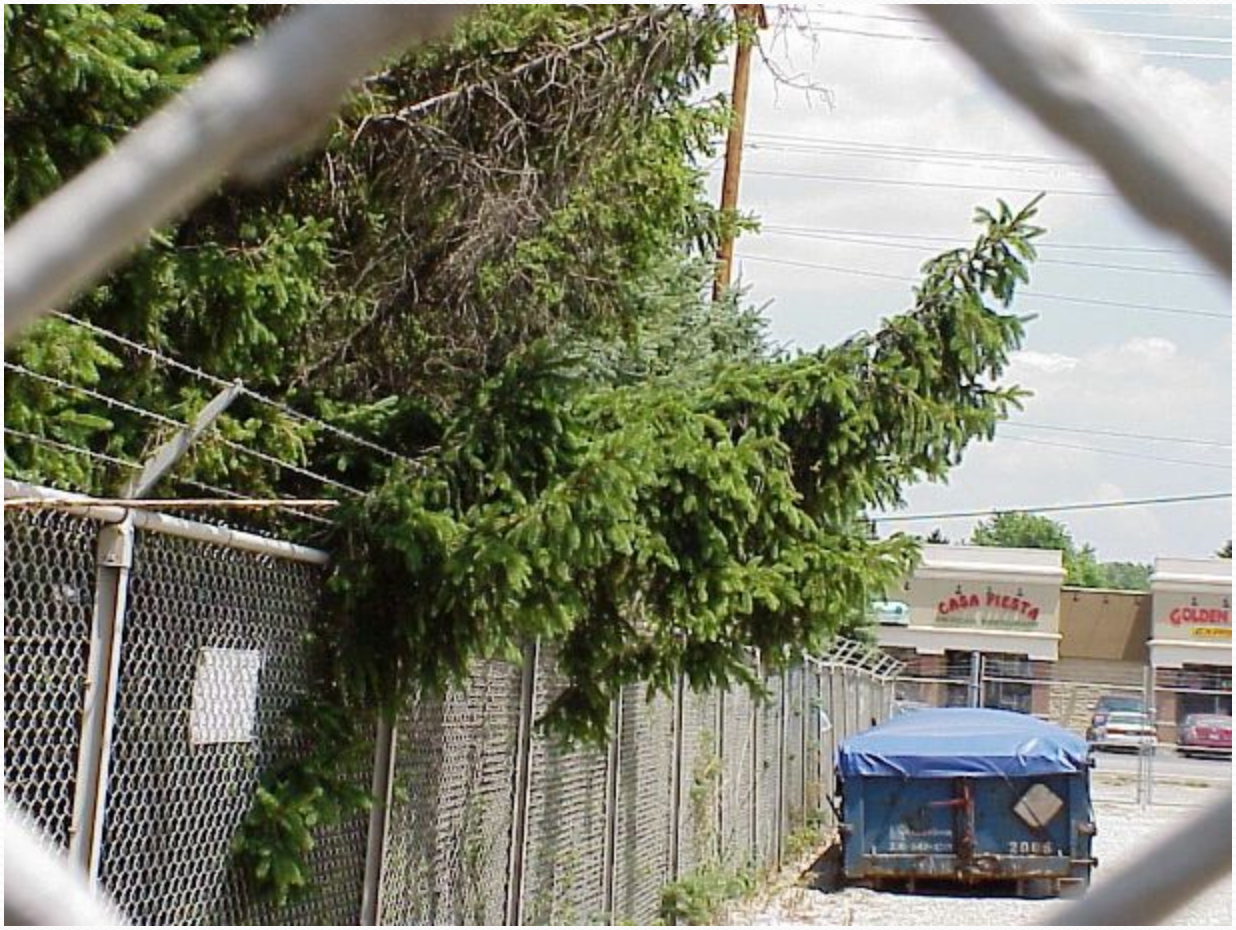
Contract Crews



Aerial Saw

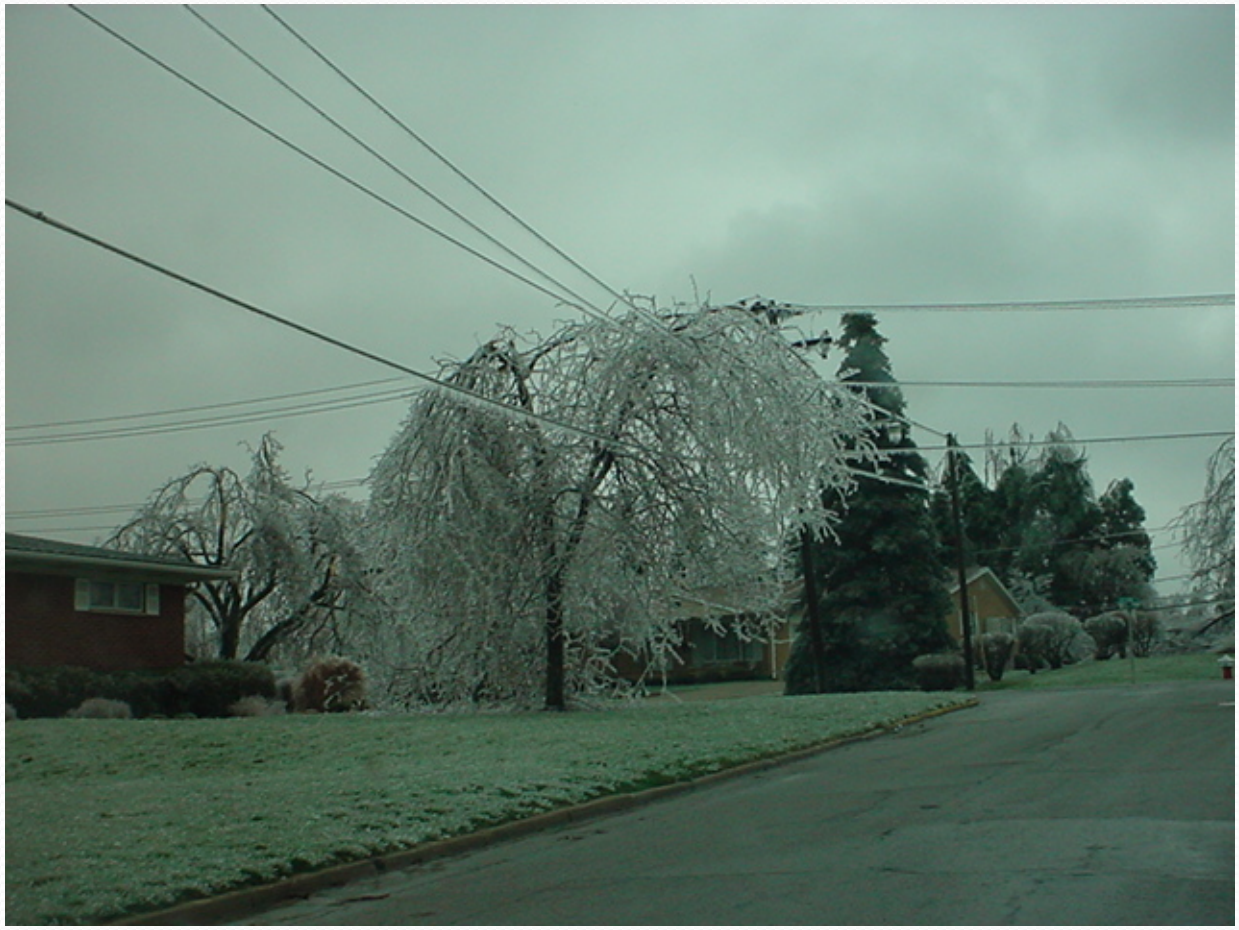
Cleared Corridor

Vegetation Encroachment in Substation



Vegetation Encroachment on Primary Conductor

Tree Contact Due to Ice



PUCO Consumer Hotline

- Assists residential and business consumers
- Resolves disputes between consumers and utility companies
- Receives contacts via a toll-free hotline, mail, email, fax, or walk-in
- Informally contacts utility companies for facts about customers' concerns

PUCO Consumer Hotline

- When staff receives a consumer complaint, all information must be documented in Contact Management System (CMS). Includes:
  - ✓ Customer demographics
  - ✓ Company name / issue code
  - ✓ Important details and facts noted to summarize the call
- Call is handled as an educational reference or investigation

PUCO Consumer Hotline

Educational Reference (provide information to customer)	Investigation (mediate disputes)
✓Identify various options / solutions for customer, depending on the nature of the question or concern ✓Provide information on payment plans ✓Explain rules and regulations - Disconnection Rules - Bill Format & Notice Requirements ✓Explain low income programs ✓Explain the Choice process for gas and electric industries	✓PUCO gathers facts about customer issue ✓Investigate issue by contacting utility, reviewing applicable rules, and evaluating the two sets of information ✓Possible result: customer account may be credited, or the situation may be corrected by the utility company ✓If informal process does not resolve issue, customer can have dispute heard before the PUCO through the formal complaint process