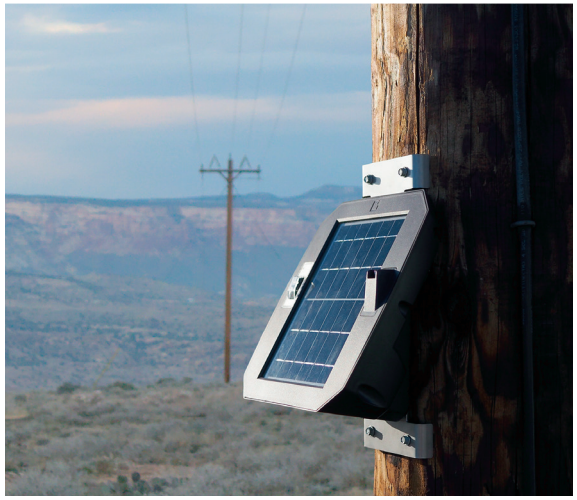
STARTUP Gridware

HOST conEdison, inc.

Identifying the Severity of Distribution Faults using Mechanical Sensors



TECHNOLOGY SOLUTION

Gridware has engineered an advanced sensing system designed to optimize the monitoring of overhead power infrastructure. Utilizing high-precision sensor arrays, the system continuously measures and analyzes both the electrical and mechanical behavior of grid assets to identify and allow preemptive mitigation of potential vulnerabilities. This proactive diagnostic tool accurately detects and identifies disturbances such as vegetation strikes on power lines, fallen lines, broken poles, and conductor clash incidents. By employing real-time data acquisition and analysis on the edge, Gridware ensures prompt identification and mitigation of grid anomalies. This not only bolsters safety and reliability but also significantly reduces customer outage durations.

At the core of this innovation lies a distributed network of hardware devices termed Gridscopes. Equipped with piezoelectric sensors and acoustic transducers, these devices are affixed to power poles. They continuously monitor vibrational and acoustic spectral data, which provides critical insights into the structural, electrical and operational status of grid assets. When a Gridscope's embedded analytics algorithm detects spectral anomalies indicative of potential faults or degradation, it triggers an instantaneous alert. This data-driven, real-time feedback loop facilitates swift decision-making, ensuring the grid's robustness and the safety of the associated infrastructure.

PROJECT OVERVIEW

Like many utilities, Con Edison faces escalating challenges due to evolving climate conditions. Extreme weather conditions, such as intense winds, are exerting pronounced stress on the electric infrastructure and reliability of the system. These can increase safety risks and can add significantly to utility operating costs.

To combat these challenges, Con Edison initiated a pilot project demonstrating the Gridware system. The aim was to assess the system's proficiency in enhancing safety protocols, fortifying grid resilience, and augmenting system reliability. By doing so, Con Edison envisioned a more streamlined approach to prioritizing response for distribution line events, ultimately shortening response time and reducing public safety hazards.

The goals Con Edison sought to achieve through this pilot included:

- Augmenting situational intelligence by pinpointing line failure occurrences both during inclement weather and during periods of meteorological stability (referred to as "blue sky days").
- Enhancing situational awareness by detecting compromised poles and infrastructure, leading to expedited dispatch of repair crews, accelerated power restoration, and risk mitigation.
- Exploring the feasibility and effectiveness of expanded Gridware deployments as a tool to bolster overall system dependability.
- Confirming the benefit of Gridware's delivered intelligence as an addition to Con Edison's suite of advanced grid technologies.

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In addition to the live monitoring and reporting of events on Con Edison's distribution grid, this project also included evaluation and demonstration activities at EPRI's Lenox Lab facility.

Blind testing was successfully performed to assess the Gridscope and a live demonstration of detection capabilities provided additional points of verification for Con Edison.

RESULTS & LEARNING

Deployment & Commissioning

1. Implementing Gridware's Gridscope sensor proved efficient and uncomplicated. Notably, there was no need to de-energize the lines or deploy specialized diagnostic equipment during installation.
2. One hundred (100) Gridscopes were deployed and installation took fewer than fifteen (15) minutes each, on average. Devices were strategically placed on alternating poles across four distinct circuit segments.
3. Establishing connectivity with each device was quick and easy, without intricate network setups, carrier contracts, or specialized communication hardware.
4. Gridware ensured smooth system initiation and integration.
5. Users found Gridware's customizable communication protocols for Emergent and Non-emergent events useful and easy to modify.

> In a short period of time and with only 100 units deployed, we received 3 alerts which were all validated with actual events on our system. Each event notification was received within minutes with pinpoint accuracy on locations. We believe a second phase of the pilot with a larger scope is warranted to test the technology more extensively in addition to evaluating recently developed additional sensors which could further assist OH storm response planning and restoration activities.
>
> **Darren Scarimbolo,**
> **General Manager of Electric Operations**
> **at Con Edison of New York**

Operational Outcomes of the Pilot System

During the pilot, Gridware adeptly detected, pinpointed, and classified eleven (11) distinct events across the quartet of deployment zones. Con Edison independently corroborated the accuracy of all eleven (11) events. Gridware categorized and prioritized two (2) of these events as Emergent, subsequently escalating them to the dispatch operator and one (1) event as an Equipment Stress event that was reported as Non-emergent/ For follow up:

Emergent:

- Overhead equipment failure, leading to a recloser lock-out and a sustained service disruption.
- Large tree on power lines, leading to a recloser lock-out and a sustained service disruption.

Equipment Stress:

- Conductor clash and arcing, leading to a momentary service disruption.

Importantly, the Gridware system did not generate any false positive alerts.

IMPLICATIONS & NEXT STEPS

Observations & Implications

1. The deployed system detected and reported grid conditions with 100% accuracy.
2. It's noteworthy that the system did not generate any false positives. Similarly, there's a high probability that it didn't produce any false negatives as no system events were observed that were not detected by Gridware.
3. The system adeptly differentiated between emergent and non-emergent events, showcasing its nuanced analytical capabilities to determine the criticality of events. This supports prioritization of critical events during inclement weather events.
4. The installation, commissioning, and configuration process was straight forward

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and fast, negating the need for specialized equipment or IT interventions. The device's compact design and intuitive mechanism allowed for swift deployments, averaging less than fifteen (15) minutes per installation.

5 During the demonstrations at the EPRI facility in Lenox, MA, the system effectively detected and reported additional scenarios, including vegetation strikes on lines and fallen live conductors.

6 Testing at the EPRI facility also confirmed the pole tilt sensor's accuracy, registering a deviation margin of ±1 degree.

Conclusions

1 The system's performance met or surpassed expectations during the pilot, testing, and demonstration.

2 System installation and commissioning are simple and fast.

3 Gridware's solution is effective at delivering critical information to dispatch operators during Emergent events.

4 When envisioned on a broader commercial scale, it seems likely that this system will help improve public safety metrics, especially through the rapid detection of live fallen and broken conductors.

5 At scale, it shows promise towards curtailing patrol durations and hastening outage restoration, and ultimately improving SAIDI and SAIFI and reducing operating expenses.

Identified by Gridware	Verified by Con Edison
Line Break	✓
Pole Tilt	✓
Conductor Clash	✓
Arcing	✓
Vegetation Contact	✓
Outage – Sustained	✓
Outage – Momentary	✓
Line Energization	✓
Protection Device Operation	✓

Next Steps

Con Edison is poised to expand this initiative into a more expansive project to amass more comprehensive data on the advantages of real-time detection, pinpointing, and categorization of distribution faults at a per-span level of granularity.

"The Gridware Gridscope provides a novel approach to a difficult problem for utilities – identifying line issues as they emerge, such as downed conductors or fallen tree branches. EPRI demonstrated the Gridscope's potential through blind testing, and it was able to accurately detect and classify each test scenario. I especially appreciated Tim's willingness to make a visit to the lab to give utilities a 'look under the hood' and observe the alerts as they emerge."

Joseph Potvin, Distribution Systems Research Program Manager, EPRI

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I'm deeply proud of our system's performance during the Con Edison pilot. Our technology demonstrated unparalleled accuracy and reliability, a testament to our team's dedication. The results from both field and EPRI Lab evaluations affirm our vision: to revolutionize power infrastructure with enhanced safety and efficiency. With gratitude to Con Edison for their trust, we remain committed to protecting the grid today, while we build the grid of tomorrow."

Tim Barat, Gridware, Co-founder & CEO

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