High-Density Distributed Sensor Network For Monitoring Grid Events

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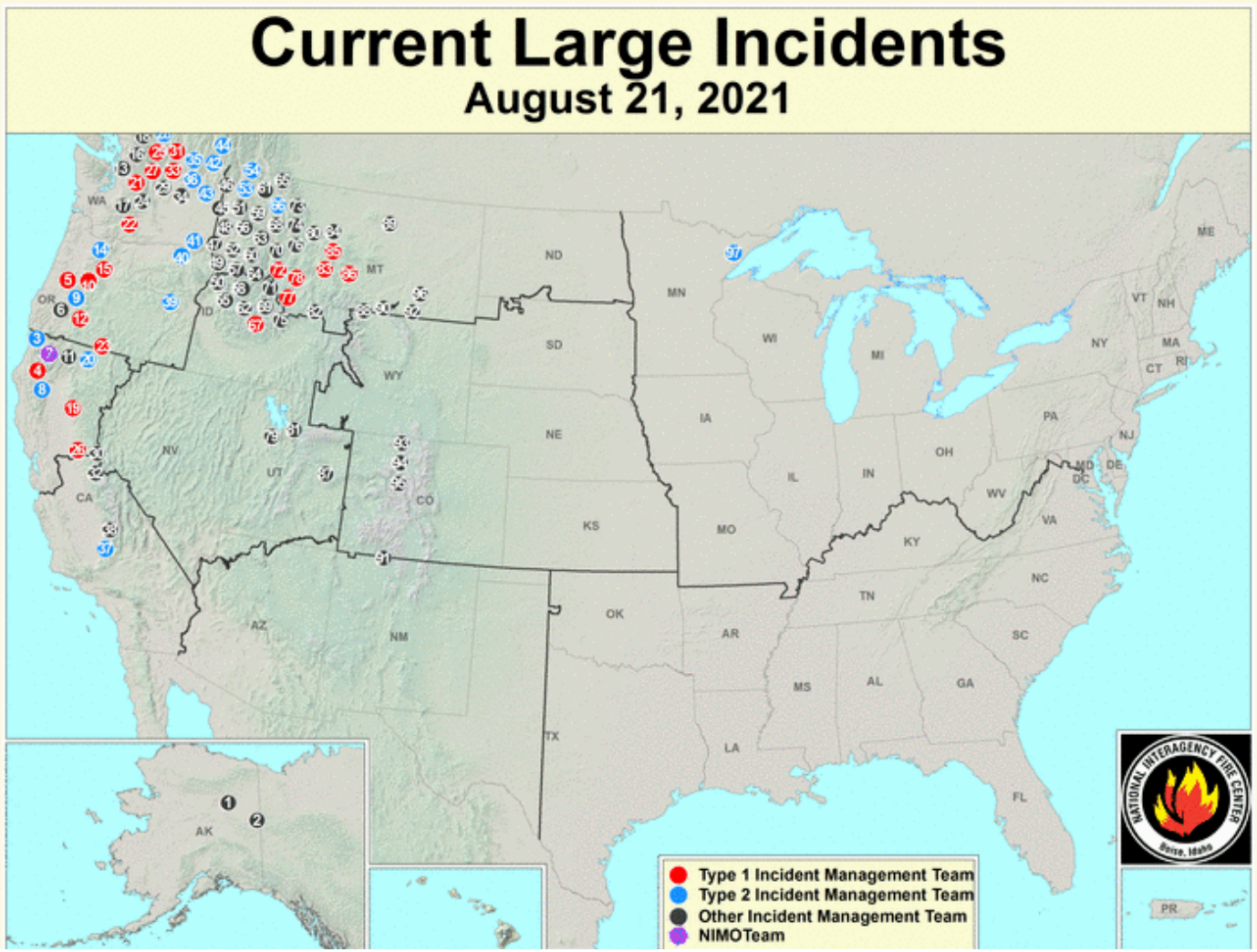
Overview

- Introduction
- Risks / Liabilities
- Causes
- Existing Detection Systems
- High Density Network
- Case Studies
- Conclusions

Introduction

Risks Liabilities



PGE –

- 2400 grid-caused fires from 2014-2019
- $13B in liability

Texas Wildfire Mitigation Project –

- 4000 fires caused by Transmission and Distribution utilities
- Transformer fire

Wisconsin –

- Transformer Exploded

New York –

- Feb 21, 2021 - Bronx, Blown Transformer

Causes

Residential

- Electrical malfunctions
  - Fires begin in walls or other hidden cavities.
  - Gain significant heat before detection by smoke detectors
  - 420 Deaths
  - 1370 injuries
  - $1.4B in residential damages annually.

Grid

- Downed lines
- Vegetation Contact
- Conductor Slap
- Arcing / Deteriorating equipment
- Repetitive faults
- Apparatus failures

Existing Detection Systems

Table 1 - Monitoring Solutions			
Type	Detects	Density	Utility Cost
DFA	Incipient Faults on Lines	Low	High
DFR	Faults on Lines	Low	High
Pole Monitoring Solutions	Faults on Poles	High	High
Smart Line Reclosers	Faults on Lines	Medium	High
Smart Meters	Sags, Swells, Outages	High	High
Smart Relays	Faults on Lines, Substation Equipment	Low	High

High Density Network

- Based on lightning detection technology
- Uses machine learning and big-data analytics
- Plugs into a wall outlet (roughly the size of a night light)
- 30 MHz sampling rate.

Case Studies

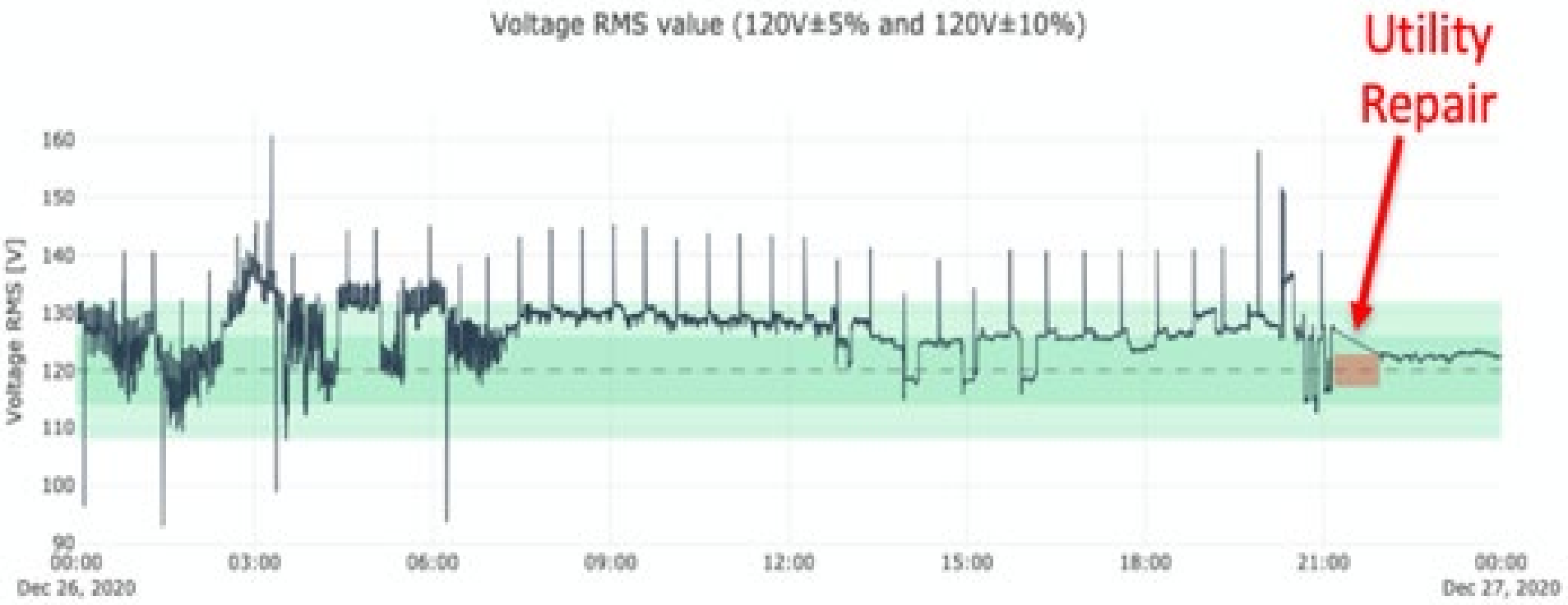
Damaged Wall Outlet

Failing Radon Pump

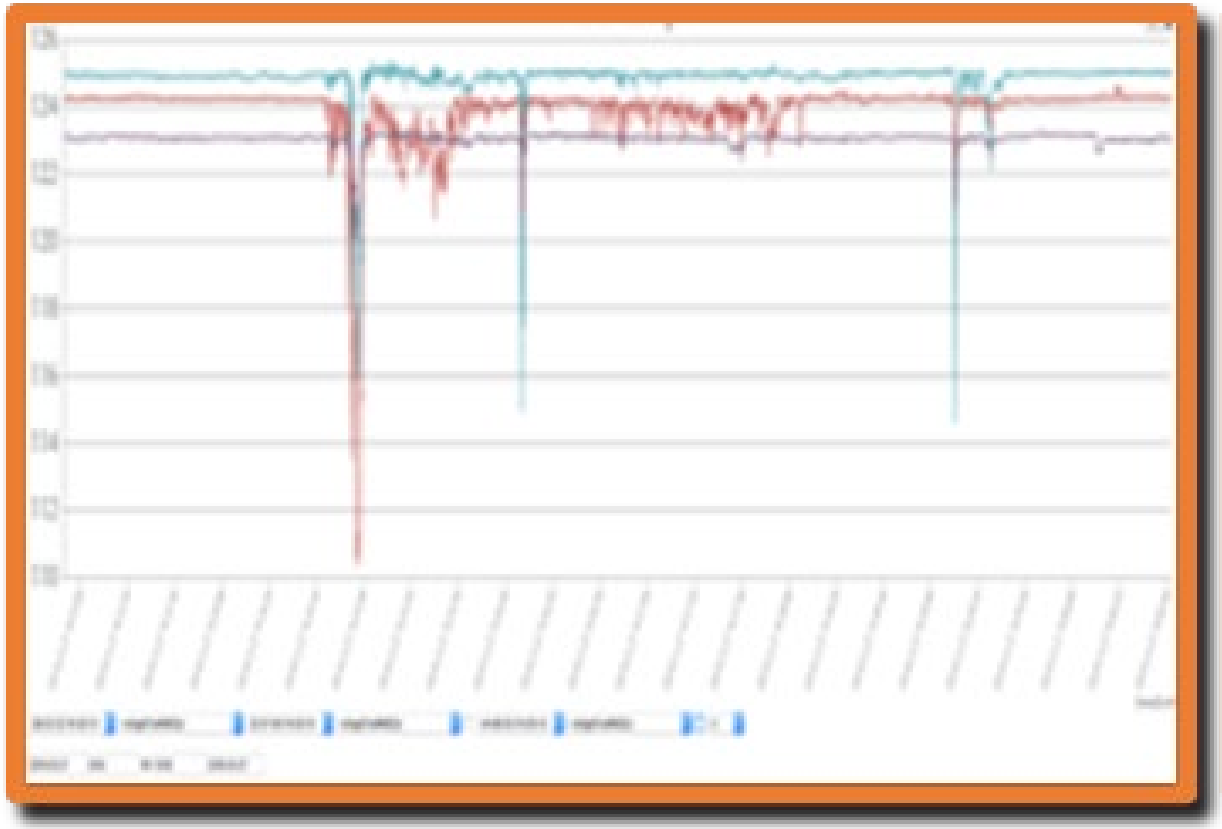
Loose Neutral

Table 2 – Loose Neutral Cases					
WL Case No.	**Location**	**Utility**	**Arc Event**	**ID Date**	**Repair Date**
PQ2019-006	Atlanta, GA	Georgia Power	Loose Neutral	9/6/19	11/5/19
PQ2019-001	Nashville, TN	TVA	Loose Neutral	7/30/19	8/29/19
PQ2019-002	Knoxville, TN	KUB	Loose Neutral	8/11/19	2/24/20
PQ2019-003	Woodbridge, VA	NOVEC	Loose Neutral	9/24/19	10/1/19
PQ2019-004	Richardson, TX	TXU	Loose Neutral	10/3/19	10/28/19
PQ2019-008	Shaker Heights, OH	First Energy	Loose Neutral	6/11/19	12/13/19
PQ2020-001	Waterford, WI	We Energy	Loose Neutral	2/19/20	2/26/20
PQ2020-002	Ocala, FL	Duke	Loose Neutral	1/24/20	2/29/20

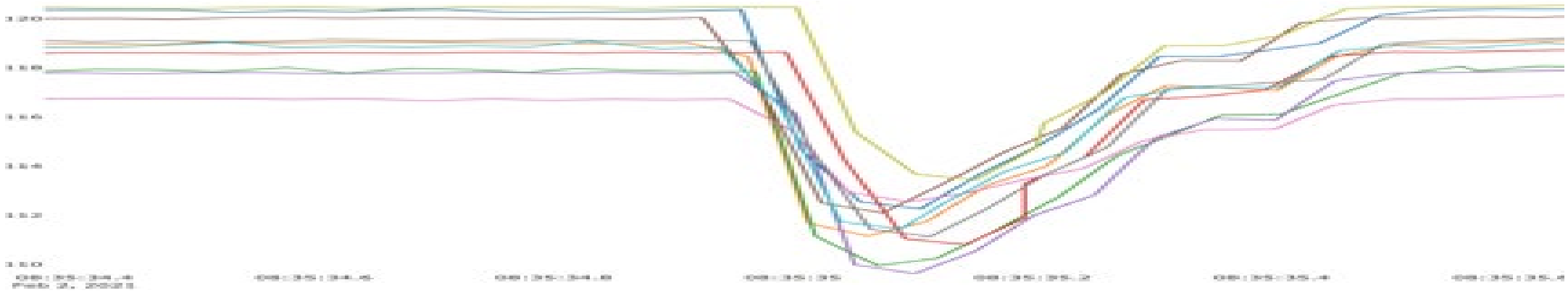
Loose Neutral Continued

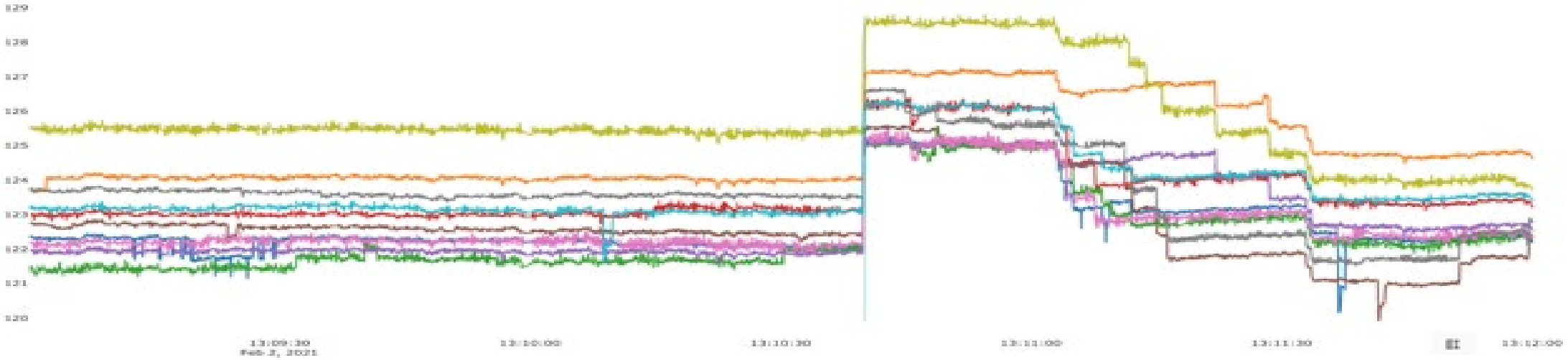


Blown Transformer

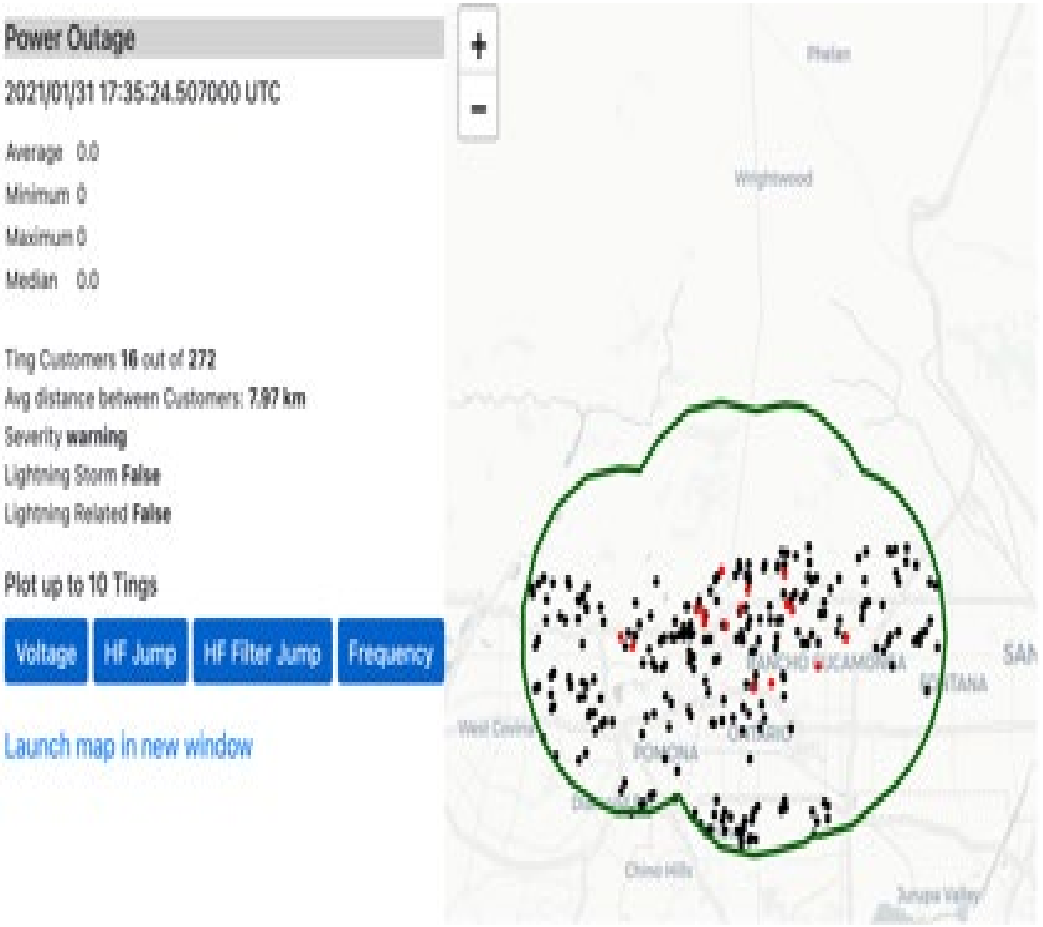


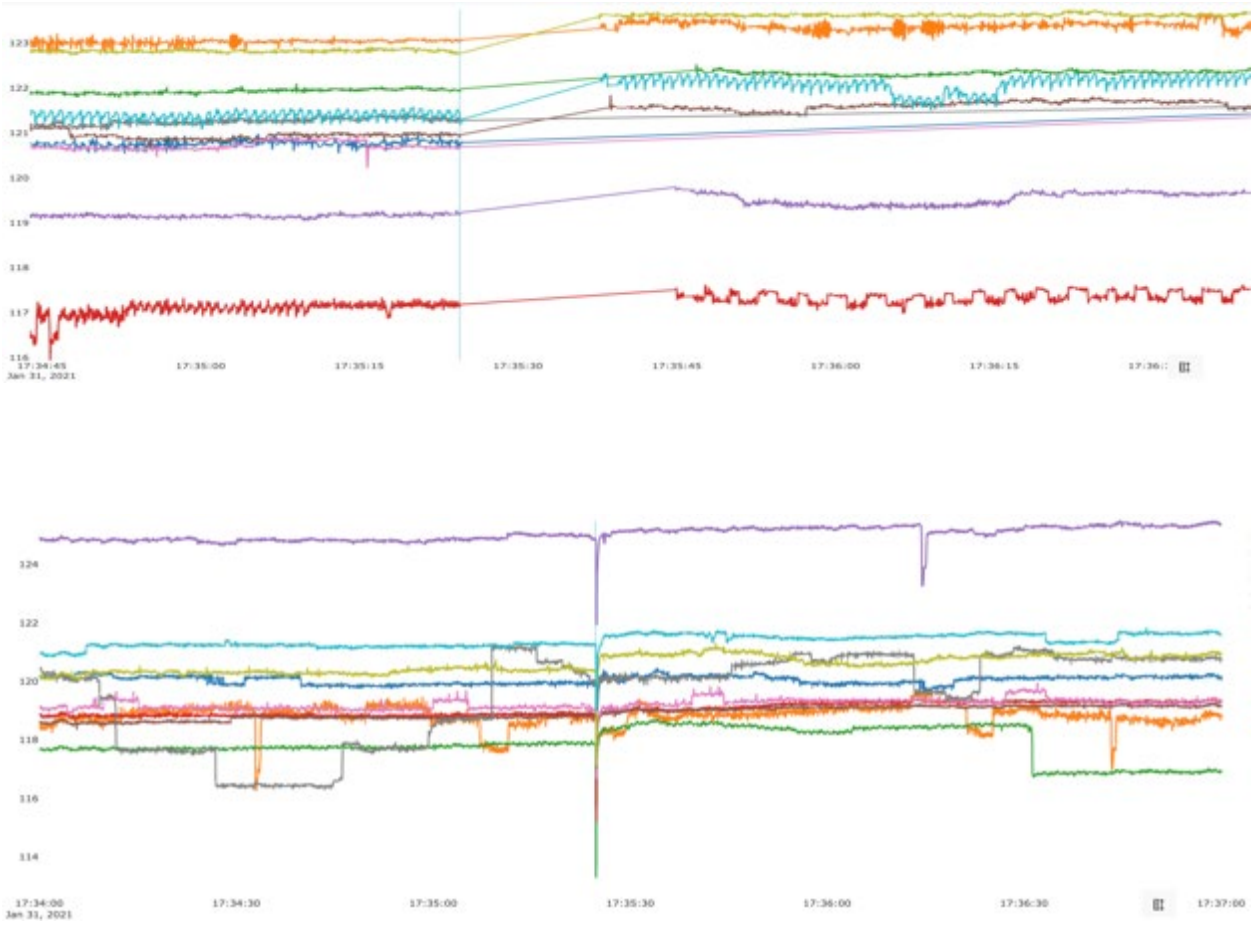
Voltage Disturbances





Outages


Power Outage
2021/01/31 17:35:24.507000 UTC
Average 0.0
Minimum 0
Maximum 0
Median 0.0
Ting Customers 16 out of 272
Avg distance between Customers: 7.97 km
Severity warning
Lightning Storm False
Lightning Related False
Plot up to 10 Tings
Voltage
HF Jump
HF Filter Jump
Frequency
Launch map in new window
Phelan
Wrightwood
RANCHO CUCAMONGA
FONTANA
POMONA
ONTARIO
Chino Hills
Jurupa Valley



Conclusions

- Nearly 90,000 devices deployed already
- 100,000 additional devices deployed in the next 10 months
- Initially deployed to prevent home electrical fires
- May serve as a complimentary technology to fill in blind spots to certain types of grid-based phenomenon