

The logo for enerpak™ is displayed in a red, lowercase, sans-serif font. The letters are outlined, giving it a three-dimensional appearance. The trademark symbol (TM) is located at the top right of the 'k'.

enerpak™

Performance – Long Term Field Test

**A Collaboration Between  
Public Service Company of New  
Mexico (PNM)  
And  
TPL, Inc.**

# SF<sub>6</sub> Monitoring in Circuit Breakers

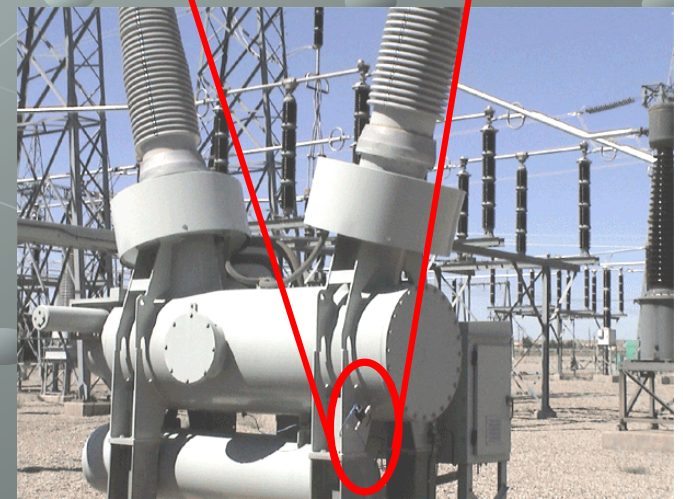
## ● SF<sub>6</sub>

- NM wants continuous monitoring
- Dielectric used in high voltage breakers
- Most potent greenhouse gas – 22,900x CO<sub>2</sub>
- 21% of breakers are 30-40 years old
- 17% are over 40 years
- EPA has recently designated SF<sub>6</sub> as one of six most hazardous gases



# SF<sub>6</sub> Monitoring in Circuit Breakers

- Customers Wireless mesh sensor network
- Data Processing at each node
- Designed for use with Li primary C-cell (8Ahr)
- Batteries lasted 2-8 weeks depending on their location in the mesh



# Substation Map – 8 enerpak™

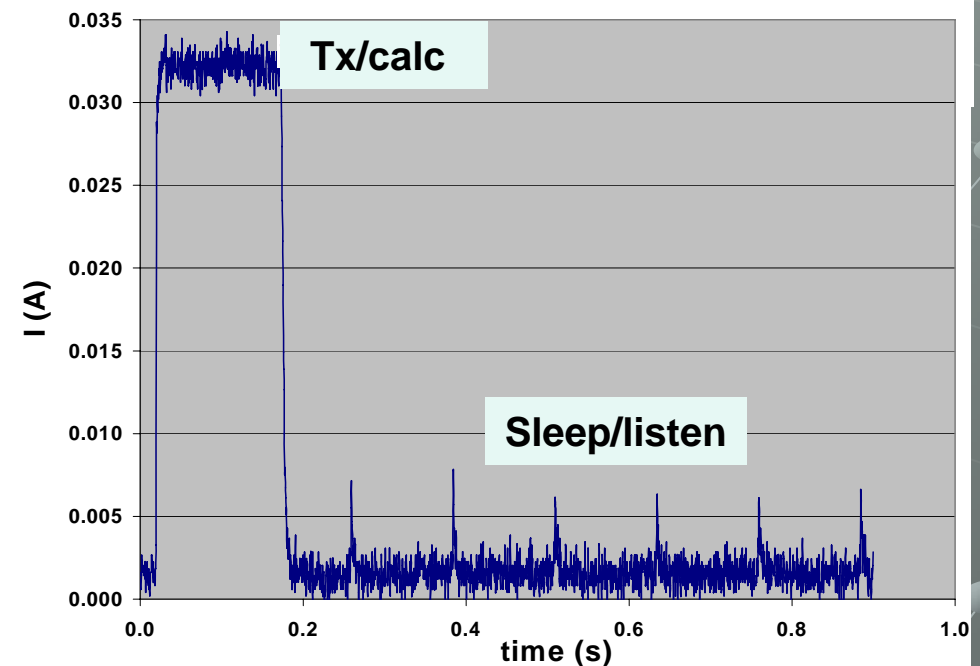
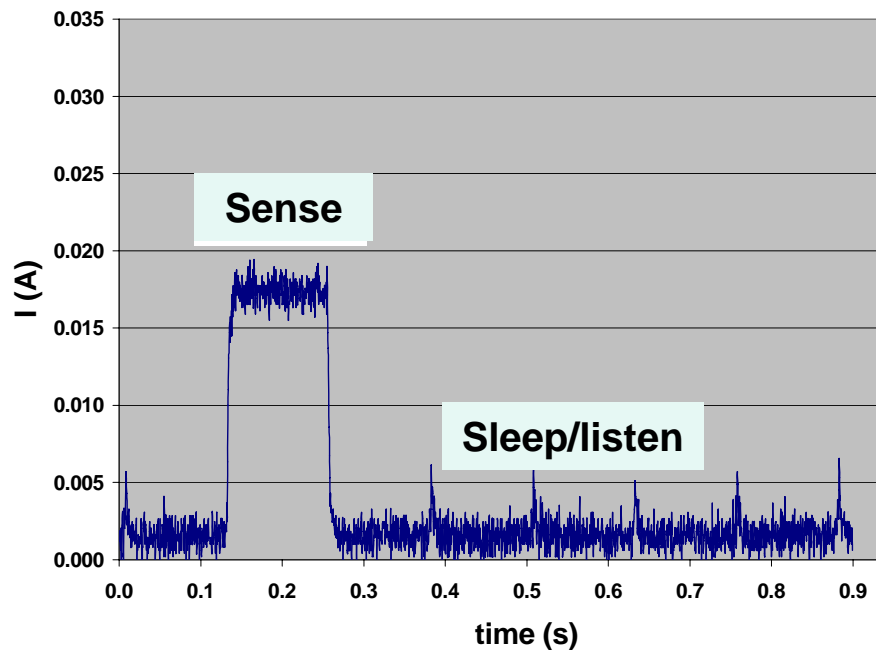


# Key enerpak<sup>™</sup> Components

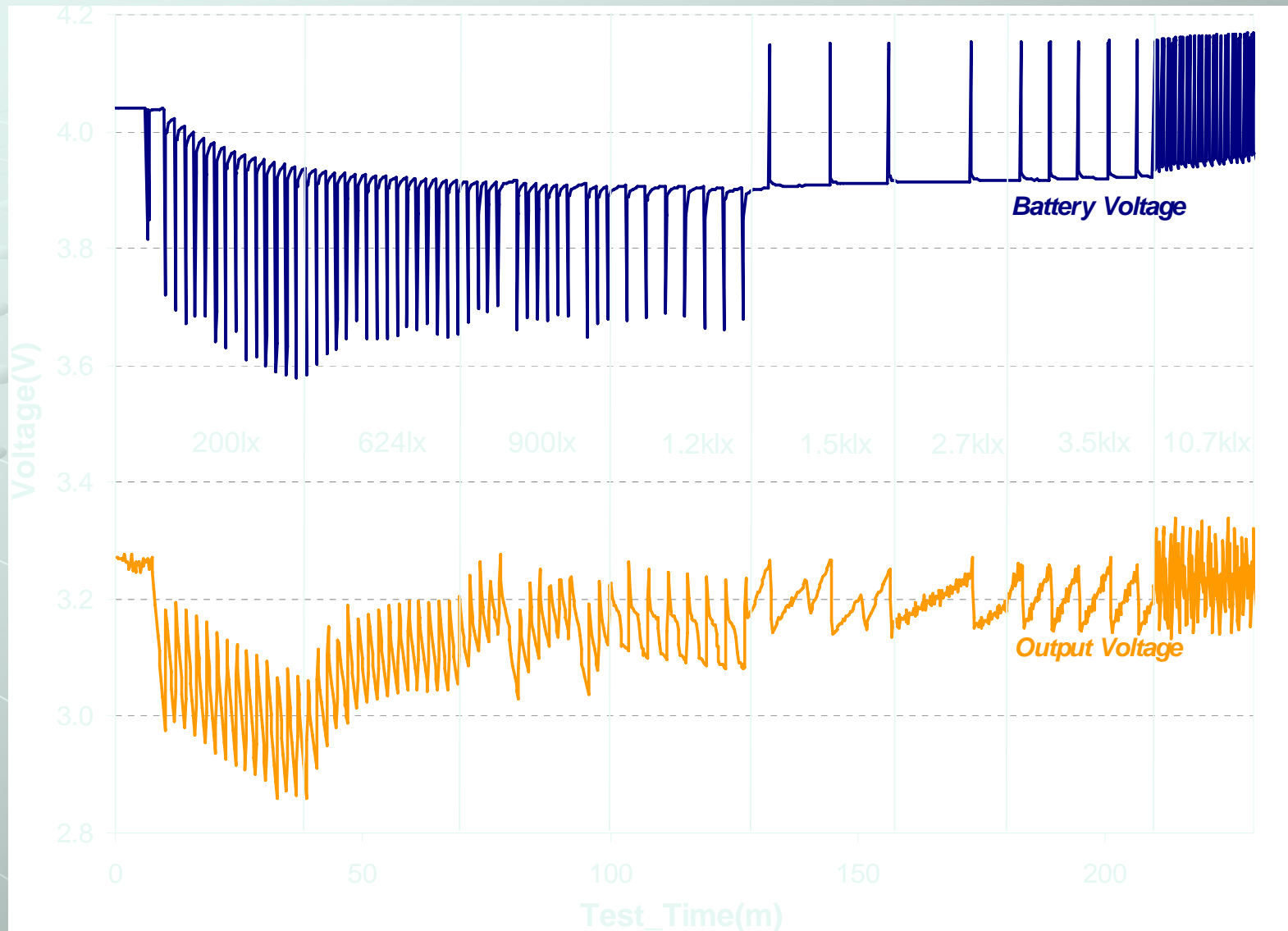
- Energy Harvester – Photovoltaic Array – 2" x 5.4"
- Battery – Rechargeable Lithium Polymer – 150mAh
- Supercaps –
  - One 1.5F (Local Pulse Power)
  - One 0.475F (Battery Recharging)

# SF<sub>6</sub> Sensor Mote Operation

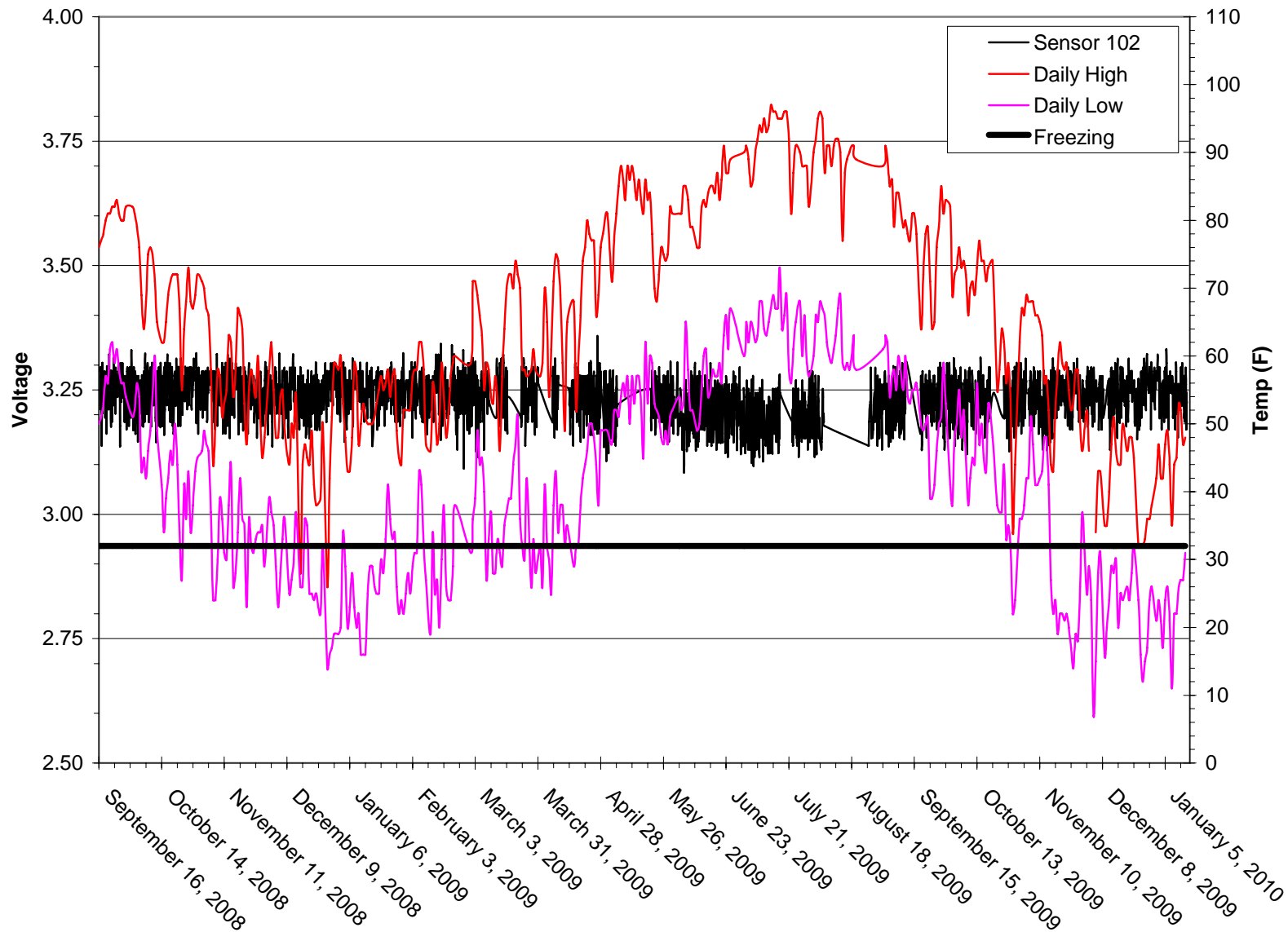
- Sleep/listen: 1.23mA
- Sense: 16.7mA/125ms; 4/hour
- TX/calc: 32mA/150ms; 1/ hour



# SF<sub>6</sub> Sensor Mote Operation



# Continuous Operation for Over Two Years!



# Summary

- EnerPak makes energy harvested power a practical source of energy for autonomous devices
- EnerPak charging electronics allow safe and optimized charging of energy storage components at *very low power*
- EnerPak system performance optimizes the available power from harvesting throughout device load power cycles
- EnerPak power management system has resulted in a product that electrically looks like a battery:
  - Always on
  - Provides stable, regulated voltage
  - Can deliver power over the full range of levels demanded by wireless sensors and other self-powered devices
- EnerPak leverages and improves the stand-alone performance of lithium-polymer and other rechargeable batteries
- EnerPak can be discrete or semi-conductor solution