

## Advanced PIGPEN

**Description:** A buried, wireless infrasonic sensor system which forewarns, identifies and locates potential third party threats to pipelines.

**Status:** Field testing of a lab prototype system using new power localization algorithms is complete. Commercialization efforts are underway.

### BENEFITS

The fully developed Pipeline Infrasonic Gas Piping Evaluation Network (PIGPEN) system would increase the safe operation of a pipeline by proactively warning an operator that a third party is encroaching on the pipeline. Ultimately, this will lead to reducing the number of hits to the pipe. Undamaged pipelines will save lives and reduce system downtime and customer disruption. As a result, customers and industry could realize lower operating costs and a longer service life with improved integrity of the pipeline infrastructure.

### BACKGROUND

Third-party damage is a leading cause of compromise to pipeline safety. Nationwide, the number of third party damage incidents reported for 2009 on gas pipelines was 46,549.<sup>1</sup> Systems to detect and notify of encroachment would enable gas companies to take action to avoid damage incidents.

PIGPEN applies seismic principles to detect and locate origins of sound energy from typical excavation equipment. Data from earlier PIGPEN phases has demonstrated the feasibility of using algorithms to locate the origin of the sound based on time. However, complex soil interfaces challenged the accuracy of location with time-based methods. PSI developed new power-based algorithms which significantly overcame these accuracy issues. Together with support from PHMSA, PRCI and potential commercializers, NYSEARCH funders restarted the Advanced PIGPEN program.

### TECHNICAL APPROACH

NYSEARCH contracted with Physical Sciences, Inc. (PSI) to develop and test a complete PIGPEN prototype system that includes smart

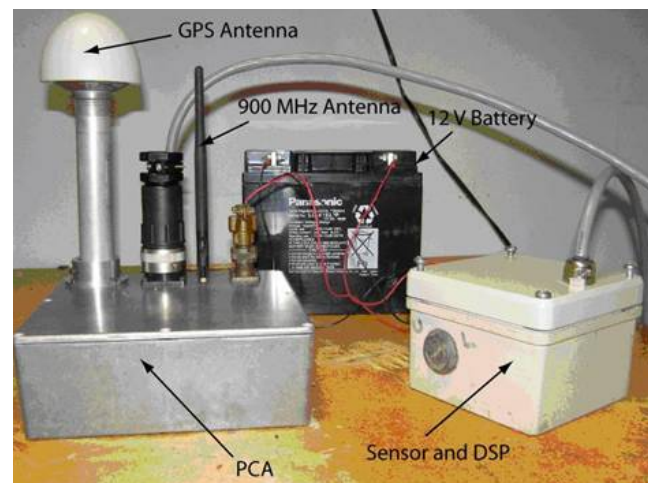


Figure 1: Advanced PIGPEN Prototype System

sensors, network interface, algorithms, software and telemetry interface (Figure 1).

The monitoring network consists of an array of

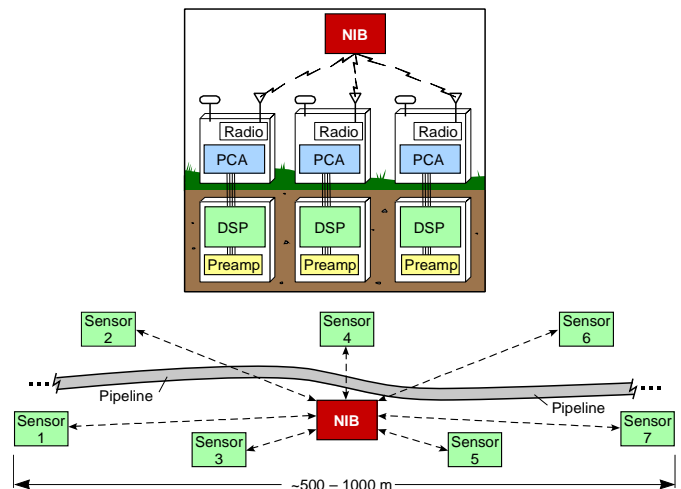


Figure 2: Conceptual Installation of PIGPEN's Seismic Sensors

smart sensors installed near a pipeline, a network interface system, and a communication system (Figure 2). At the core of each smart sensor is a piezoelectric sensor coupled with local processing software and an on-board threat database of seismic signatures from typical threats (Figure 3). The software allows the sensors to ‘sleep’, and filters false alarms. More specifically, the software references the threat database to identify the signal before allowing the entire system to ‘wake’ and locate its origin.

If the system deems the activity to be a potential threat, the smart sensors report the seismic signal intensity to the network interface. The network interface then locates the potential threat by triangulating the intensity of the signal received by each sensor (Figure 4).

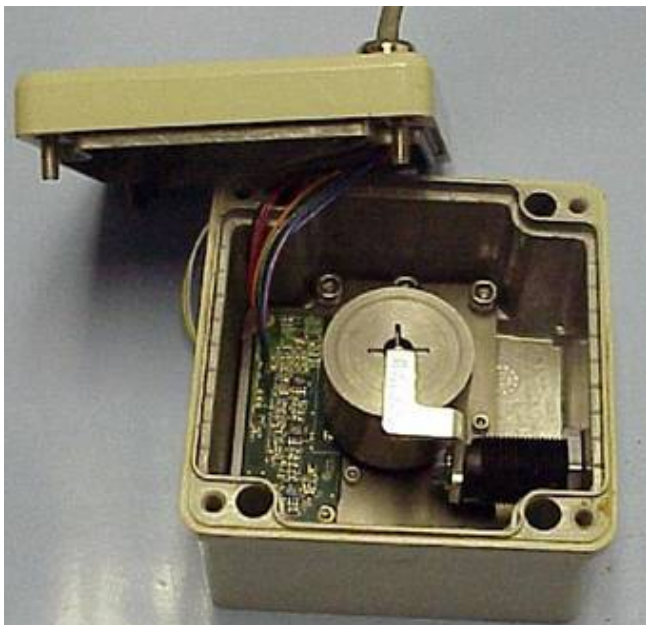


Figure 3: PIGPEN Smart Sensor

### PROGRAM STATUS

The Advanced PIGPEN system was constructed by PSI and programmed with new power localization algorithms. The advanced prototype system has been tested on live pipelines in Cushing, OK (BP) and Woodbridge, NJ (PSE&G). The system demonstrated a significant increase in threat localization accuracy and precision with the elimination of false alarms. Work is underway with a seasoned commercializer to transfer the technology and offer commercial units. Several potential customers have been identified to demonstrate the system.

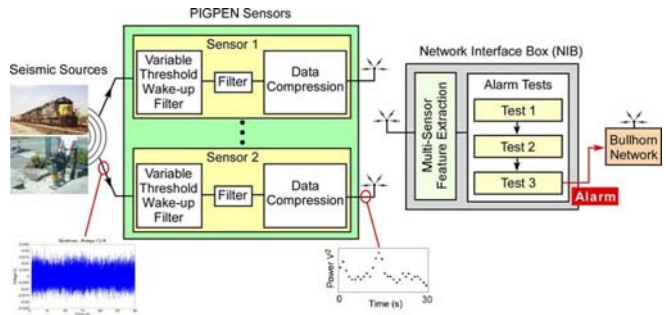


Figure 4: Concept of Operation Illustrating Potential Threat, Data Processing, Alarm Notification

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### Highlights

- Detect threats before damage to pipelines occur
- Low cost per mile protection envisioned \$10-\$15K/mile

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