November 2006

NYSEARCH's PIGPEN Field Tested in Kansas

In early November, a multi-day field test was performed in Kansas for PIGPEN – a low frequency third party damage sensing technology (infrasonic) that is being funded by NYSEARCH and U.S. DOT/PHMSA. PIGPEN has been designed and developed by Physical Sciences Inc. (PSI) of Andover, MA and is used to locate threats leading to potential third party damage to natural gas pipelines. The November field test was conducted in Lawrence, Kansas. This site was chosen due to its known complex soil conditions which challenge the ability to accurately locate threats as a result of refraction caused by changing ground media.

Dr. Don Steeples provided this site. Dr. Steeples is a leading geophysicist from the University of Kansas who is contracted by NYSEARCH to provide independent consulting advice on surface wave physics in the ground as it applies to sensor perception and diffraction within changing soil, rock, and elevations. Dr. Steeples has extensive geophysical research experience and has considerable knowledge regarding the soil and seismic conditions that impact sensing.

The Kansas field test location consisted of a multi-crop agricultural field between a rocky ridge and the Kansas River. The north side of the field has a dirt road, a highly used railroad, and the river. The south side of the field is a rocky ridge consisting of a wooded limestone and slate rock formation rising approximately 100 feet above the field. While these conditions are specific to this site, they represent a "complex soil" condition which has been an area of much discussion among the PIGPEN project advisors since proactive damage prevention requires accurate location of the threat in a range of complex and diverse soil conditions in our members' territories.

North Side of Field & Test Camp

South Side of Field

PSI carefully surveyed the site to correspond with the details in their test plan. Impacts into the ground were accomplished with a variety of devices: a sledgehammer hitting a steel plate on the ground, a '3006 rifle in the ground hole tool', a 12 gauge shotgun, and the pounding bucket of an excavator. Data from freight trains, automobiles, and footsteps were collected in order to identify background noises.

3006 Rifle in the Ground Hole Tool

Freight Train

All impact devices were used in all of the test configurations; however, the shot gun seemed to be the least useful to provide surface wave data (partly due to the sound waves from the shot confusing the data of the surface waves in the soil). Sensors were initially deployed separately in the field and in the rocky ridge. Impact tests were performed in each location separately to develop a soil characterization for each area.

The sensors were re-deployed so that they lay in both the field and the rocky ridge; impacts were conducted in both areas. Time lag studies for each sensor to triangulate the locations of the impacts will be conducted at PSI's headquarters. These will be subjected to a validation model performed by Dr. George McMeekam of the University of Texas. The model will ascertain the accuracy of the technology and the algorithms used to interpret the threat locations.

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