Surveyor Ron Siney initiates a location survey with GNSS and the SPAR 300. Wires connected to the gas meter induce a current into the underground pipeline

GOING UNDERGROUND

THERE ARE MORE THAN THREE MILLION KILOMETRES OF GAS PIPELINES IN THE US. EXCEPT NO ONE'S SURE WHERE THEY ALL ARE. ERIK DAHLBERG REPORTS ON NEW TECHNOLOGY BEING USED TO LOCATE UNDERGROUND PIPELINES – WITHOUT MASSIVE EXCAVATION PROJECTS

As the US works to improve and rebuild its infrastructure, a major concern is to gain accurate knowledge on the locations and conditions of existing assets. In addition to identifying and planning needed repairs, critical assets must be protected against accidental damage. One of the most important needs is the location of underground natural gas pipelines.

According to the US Pipeline and Hazardous Materials Safety Administration, the country has more than 2.9 million kilometres of gas distribution mains and service pipelines. In addition, roughly 480,000km of large collection and transmission lines carry gas from production fields to distribution centre.

Some of the most vulnerable pipelines are in developed and municipal areas including commercial, residential and industrial settings. In these regions, miles of gas pipelines are not located with any degree of accuracy, or the locations are not recorded in an easily retrievable and shareable format. For example, outdated paper maps often are not tied to accurate coordinate systems. They rely on 'tribal knowledge' that comes from an aging workforce – workers nearing retirement age may be the only ones who know the (often approximate) location of the lines.

There are enormous hazards related to not knowing where and how deep these gas pipelines are located. Without accurate, readily-available location data, pipeline operators, construction companies, farmers, land owners and other stakeholders will continue to face the risk of accidental and potentially catastrophic damage to a buried gas pipeline.

The US 2016 PIPES Act calls for increased use of data and technology to improve pipeline safety. Supported by industry players, it includes efforts to prevent damage by third parties, such as accidental contact with a buried line.

The problem is being addressed from two directions. First, a new technology has emerged that can accurately detect the location depth of buried pipelines. Second, locating technologies can combine with geospatial solutions to produce accurate position information tied to known coordinate systems. The resulting survey-quality data forms the basis for GIS-based approaches for planning, asset management, operations and emergency response.

Locating invisible assets

Surveyors from Woolpert, a major US architecture, engineering and geospatial firm, use a SPAR 300 subsurface utility locating system in conjunction with survey-grade GNSS to locate and georeference underground utility lines. One of their first projects took place on a client's property in northern Ohio.

"We used the SPAR unit coupled with Trimble R10 GNSS receivers to detect buried gas lines," says Dave Kuxhausen, Woolpert discipline leader for surveying and geomatics. "The scale of the project was sufficient to demonstrate that we had the capabilities to perform this type of work."

The SPAR 300 uses magnetic field sensors to determine the distance to a buried pipe or other asset capable of carrying an electric current. The sensors can be integrated with Trimble GNSS receivers or total stations connected to Trimble Access software running on a Trimble TSC3 or other field controller.

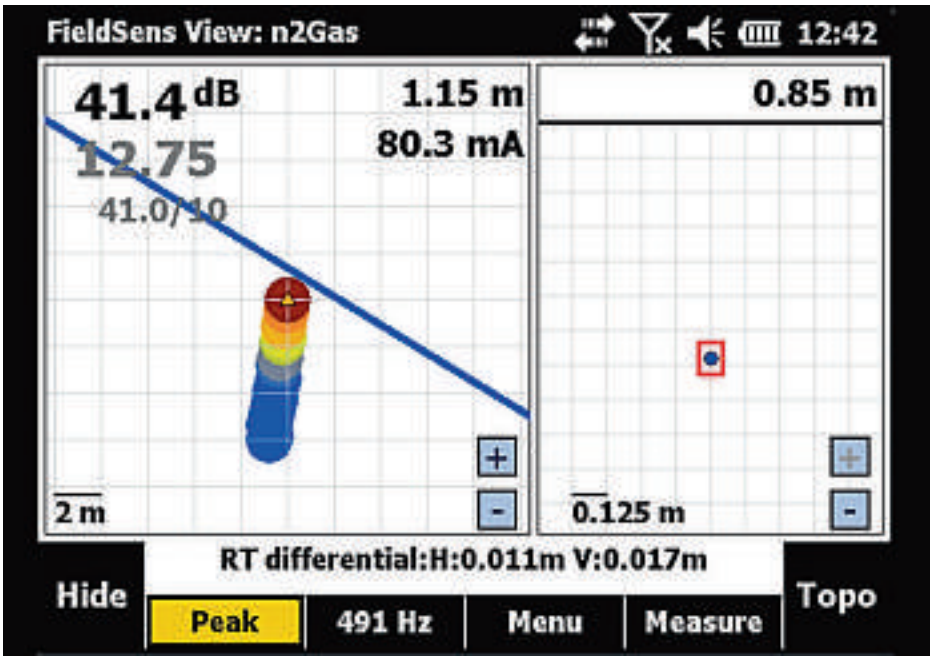
The system locates buried pipes in three dimensions. The Trimble controller indicates when the SPAR has located a pipe and aids the crew in following the pipe. The system provides horizontal and vertical offsets from the sensor to the pipe while the GNSS receiver supplies precise geographic positioning.

When the crew wants to capture a measurement, the field software automatically combines the data from the SPAR and GNSS sensors and stores the resulting positions into its database. In addition

to a 3D coordinate on the pipeline itself, the solution also produces coordinates for points on the surface directly above the pipe.

In a single pass, the survey crew can detect and mark the pipe as well as capture survey-grade positions. The resulting locations approach the accuracy of Level A excavations. Kuxhausen says that the system enables his crews to capture pipe depths accurate to roughly 8cm, depending on the integrity of the tracer wire while working with the speed and flexibility associated with handheld electromagnetic sensors not capable of determining a pipe's depth.

The field data is transferred to Trimble Business Center software. "We run the data through a QA/QC process and then export the data and look at them in an Esri-type environment to check for gaps or overlaps," Kuxhausen explains. "We take advantage of the fact that the data comes with a depth and a surface elevation. In many instances, we'll turn it into a profile view to make sure that the depths look consistent and there are no spikes or obvious issues."



Information from the SPAR 300 is shown on the display of the Trimble TSC3 field controller. Operation and output from the locator is integrated into the standard surveying workflow

A map of major pipelines in the US. Recent legislation calls for greater information about the locations of buried pipes and utilities

Vincent Johnson collects data above a gas pipeline. The system uses GNSS to produce georeferenced location and depth for the buried pipe

Markings on pavement typical of common electromagnetic locations. Survey crews locate the marks for use in GIS, planning, construction and asset management

In demand

Woolpert has had no trouble keeping its SPAR systems busy. Kuxhausen says that his clients quickly recognise the value of the mapping solution. In addition to mapping mandated by the PIPES Act, demand for their mapping services is coming from large and small construction companies. The work includes locating utilities for new construction as well as maintenance and update projects.

In many projects engineers don't have a lot of leeway so the accurate locations are important for efficient design and construction. "In a lot of places clients are forced to do Level A excavation just to locate a pipe," Kuxhausen says. (Level A locations require the pipe to be exposed, usually by digging or hydro excavation.) "They may need data every 3m along the road. We are able to use this system to reduce the frequency of the Level A excavations to say, every 15m. It's a faster and more cost-efficient approach."

Airports represent another source of business for utility locations. Airfield operators need accurate data on the complex web of underground pipes, wires and conduits. "We repeatedly receive requests to perform mapping and subsurface utility engineering services to support the redesign or relocation of navigation equipment," Kuxhausen says. "For instance, we've completed work for airports where they might be deconstructing a control tower or some other site. Our crews will go out and locate the existing utilities, both active and decommissioned so that no lines are damaged when the deconstruction takes place."

Additional opportunities come from roads departments that need to see existing utilities in their transport corridors for design mapping. The information enables the departments to develop comprehensive GIS datasets on the myriad structures and facilities that lay beneath the roadways. While the efforts may not be connected to any imminent construction plans, they provide significant value in support of long-term planning.

New opportunities

At the end of the day, Kuxhausen's goal is productivity and the ability to meet the needs of Woolpert's clients. "It comes down to how can we streamline our processes," he says. "We can quickly, safely and accurately locate utility data and add it into the larger infrastructure mass. Coupling the information from the SPAR/GNSS system with the GIS database can be invaluable for clients that with have large inventories of underground assets."

WE CAN QUICKLY, SAFELY AND ACCURATELY LOCATE UTILITY DATA

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