Mapping to the Meter

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Electric cooperatives own millions of dollars in assets, poles and wires, stretching for thousands of miles across open country and along country roads.

Unfortunately the maps that lead to this gold mine of utility infrastructure are often inaccurate, incomplete and out of date.

To solve this problem, electric co-ops can take advantage of geographic information systems (GIS) and global positioning systems (GPS) to quickly overhaul and computerize outdated paper maps. GIS is more than just a replacement for paper maps. A GIS system is a map with brains.

Eighty percent of the information managed by an electric co-op is connected to a specific place on earth-a street address, a highway intersection or a simple x-y coordinate. That's why a GIS database is a revolutionary technology that cuts across every industry. The technology is changing the way we farm, fight wars and even the way we deliver pizza.

Jeff Lee, Vice President of Lee Inspection, a pole inspection company, first learned how impressive GPS technology was on his way to a Dallas Cowboys football game. Lee says, "We rented a car that had GPS on it. It could tell you how to get to the stadium. If you missed a turn, it would recalculate and tell you where to go next with a voice. I thought this was great. Surely all the utilities are going to get this in their vehicles next."

It wasn't very long before Lee Inspection added GPS to the list of services it provides for electric co-ops. "When you are already at the pole doing an inspection you can do other things, and the cost doesn't go up that much," says Lee. In addition to accurately identifying the pole's mapping coordinates with Garmin GPS equipment, Lee's

inspectors can inventory the pole, test grounds, install guy guards and even take a digital photo of the pole and equipment. A report is produced in Microsoft Access and recorded to CD.

The problem is that the computerized map is only as accurate as the paper map it was based on. David Rountree, manager of engineering and operations for Northeast Oklahoma Electric Co-op, Vinita, Oklahoma, says his co-op started digitizing paper maps nearly two decades ago. "The problem that all of us have is our maps are not accurate. If we go out and accurately locate poles with GPS, our poles would show up in the middle of roads on the map."

The question that Router says every engineer has to ask is, how accurate does a GIS map need to be? In a rural area, 50 feet might be close enough. In another area, that level of accuracy might be unacceptable.

"Don't be afraid to start over," says Rountree. "A lot of us think we have the best database already, but maybe you should consider starting over." Since 1980, Northeast Oklahoma has tried three mapping systems. Now Rountree is convinced he's found the right mapping software in Gentry System's AutoCAD-based GenMap. Rountree likes the fact that Gentry Systems is working with billing software vendors Milsoft, Stoner and Associates and other engineering software vendors to tie GIS mapping to other databases and software. "Now we finally have that conduit to bring everything together."

Bud Miller, director of marketing for Gentry Systems, says that using GPS and a laser rangefinder is the best way to get the data for accurate maps. Although some co-ops have been able to inventory their system with summer help, hiring additional staff for a field inventory is a luxury many co-ops can't afford, he says. "Companies that do field inventories like OSMOSE, or companies that prepare mapping systems like Southeastern Reprographic, they are the experts." Miller also advises co-ops not to start a GPS field inventory if the commitment isn't there to keep it current. Otherwise, the system will lose its value."

Phil Halsch, manager of GIS services for OSMOSE, has seen the frustration co-ops experience when they don't keep their maps current. "They bought the software because they had a perception of what it would do for them, but then they never did anything with it," he says. "It could be they didn't get the training and support, or they

didn't have accurate data, but whatever it is, we see it sitting on the shelf in a lot of places.

"Let's face it," adds Halsch, "to make all of this stuff really work you need data. You need good data, and then you need the right applications." To create a turnkey GIS system, OSMOSE has partnered with Chapel Mapping. Chapel's suite of GIS software is AutoCAD and Microsoft Access-based and will work with industry-standard software like WindMil.

Chapel's software suite includes staking software that can help keep GIS data current. "This software works with a Trimble Navigation GPS unit," says Halsch. "When you come back in from the field after doing the data collection, it automatically draws the map for you. You just download it. It does all of the connectivity, it places all of the symbols, places all of the text, everything is automatically done."

The cost of bad data is high says Halsch. "I've heard too many customers say, 'We have the applications, but we don't trust them because our data is no good. When we get an answer out of the system, we still go out in the field to check because we don't trust our data.'"

Halsch says that sometimes it is cheaper to start over. After two previous tries at GIS, Delaware Electric Co-op in Greenwood, Delaware, is contracting with OSMOSE to remap their system, he says.

Halsch recommends mapping the entire system all the way to the meter. "Most of your line loss is on the secondary and you don't even know it because you don't know what you've got out there. Trace the connectivity right out to the meter. You will find you have a model that allows you to do accurate engineering. You will find opportunities to improve the performance of your system in ways you never could before."

A good and inexpensive starting point is to purchase U.S. Geological Survey quad maps, says Halsch. "Then go out and drive all of the roads with GPS and improve the road accuracy down to the meter level. Taking those USGS digital quad maps we can actually correct them. Jeff Chapel has written a set of algorithms that are amazing, and we can dramatically improve the road accuracy. When we do the facility inventory and mapping we can use GPS, and it carries that data into the map very accurately and poles end up next to the road very

accurately. You will have a much improved land-base map for a very reasonable price."

Chuck Peterson, cartographic technician and customer service representative for the USGS Mid-continent Mapping Center in Rolla, Mo., suggests digital orthorectified quarter-quad (DOQ) maps. Although many rural water systems and electric cooperatives use digital raster graphic (DRG) maps, Peterson says the accuracy of DOQ maps is better. Accuracy falls within the two-to-three-meter range.

"DOQ maps are gong to be invaluable to them," says Peterson. "They will have a general idea of where their power lines reside and they will be able to see those lines. In a lot of cases they will be able to see the power pole. Orthorectified means the photograph has been corrected for tip and tilt." DRG maps are less accurate with 90 percent of the features falling within 40 feet of actual locations. However, DRG maps are very cheap, just $1 per map file. Each map covers 35 to 45 square miles. Unfortunately, the more accurate DOQ maps are not available for all areas, but the cost at $7.50 per quarter quad is still a very inexpensive starting point for a GIS project.

Digital line-graph (DLG) maps are available for some areas. DLGs are layer-separated maps with layers for hydro, roads, vegetation and transportation. Power lines are included in the transportation layer. Digital elevation model (DEM) maps have x-y-z coordinates in ASCII format and create a shaded relief map. DEM maps and DLG maps are free to download over the Internet.

To find out more about USGS maps and the availability of different formats, visit Mid-Continent Mapping Center's Web site at mcmcweb.er.usgs.gov.