

By **John Lowrey**

Data-Driven Maintenance

With a reliable flow of accurate system data, a co-op can extend the life of equipment and save money

Jim Borden was getting pulled in two different directions. “We had pressure on our budgets to reduce cost, reduce the number of employees. But on the flip side, we have more assets to install and maintain. We had to look for more cost-effective ways to meet the needs of our customers, protect the integrity of our assets and ultimately meet the expectations of management,” says the manager of maintenance at Chugach Electric Association in Anchorage, Alaska.

Borden balanced the competing demands with an infrared camera mounted on a helicopter, a sophisticated database and mapping system and a new approach to asset maintenance called “condition-based management.” That combination, he says, has gone a long way toward making life better for Borden and his colleagues.

“It lets you sleep at night, assured there’s not something that’s going to blow up,” he says. “It’s a giant step forward in being able to focus our maintenance efforts.”

Co-op boards are always reluctant to raise rates, and as they face rising costs almost everywhere they turn—from wholesale power to payrolls to fuel for trucks—they often look to system maintenance as one area where they can cut back. But that’s a first step down a dangerous road, according to NRECA engineer Robert Saint.

“When you look at the budget, maintenance expenses stand out,” he says. “But cutting maintenance and trying to catch up later is never a good plan.”

Distribution networks that can’t withstand catastrophes like ice storms and hurricanes, not to mention substation transformer failures, have taught too many co-ops that painful lesson, Saint says. And with new management programs emerging to take the place of the old time-based maintenance approach, he adds, it’s a course that co-ops don’t have to take.

Condition-based maintenance, as Chugach’s Borden found, is one way to go. Reliability-centered maintenance offers another alternative. Still another, asset management, is a more comprehensive approach that seeks to balance cost, reliability and risk, drawing on input from finance, engineering and information technology departments to

set and reach strategic maintenance objectives.

The trick, Saint says, is to hold on to the right information while keeping an eye on assets in the field. “With proper data archiving and condition monitoring,” he explains, “a



co-op can optimize reliability indices most important to its system.”

Co-op maintenance chiefs have plenty of resources to draw upon, Saint continues. For example, NRECA members can download a new report from the Power Systems Engineering Research Center (pserc.wisc.edu) called *Risk-Based Maintenance Resource Allocation for Distribution System Reliability Enhancement* to review a variation of reliability-centered maintenance.

The center is also developing software that analyzes reliability improvements against the costs of certain types of maintenance. That work is being done by Wichita State University and Iowa State University, with the help of co-ops in Iowa and Oklahoma.

Ward Jewell, a professor of electrical engineering at Wichita State University, says “run to failure”—simply waiting until a device fails—is the lowest-cost maintenance op-

tion, at least in terms of money spent on hardware and labor. But that approach comes at a price of a different kind, he adds. “Most failures are not catastrophic, and repair costs can be about the same as maintenance costs. But if you consider reliability, run to failure can be disastrous.”

Time-based maintenance, Jewell says, is the most conservative and predictable, since following manufacturers’ recommendations and standard maintenance cycles is safe. But it’s also the most expensive, Jewell adds: “The problem is you work on stuff that doesn’t need it and miss some that does.”

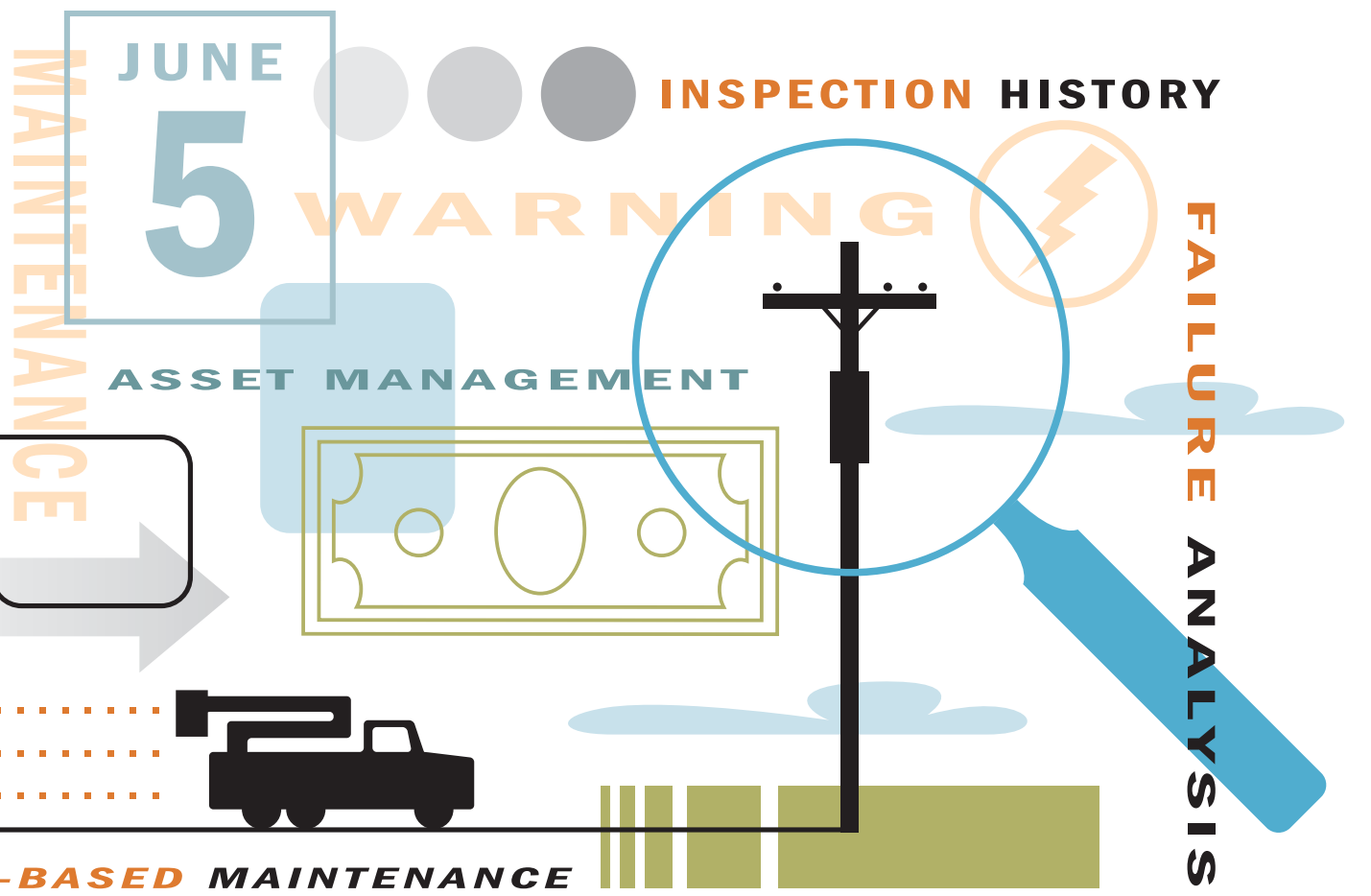
Time-based maintenance can be enhanced with new tools such as data management and geographic information systems. But a move to reliability-centered maintenance or asset management pretty much requires an array of new programs—from monitoring to testing to software—to handle

the additional analyses.

Substation transformers, reclosers, relays, regulators and load tap changers are all high-value assets that deserve more attention. “These are big-ticket items with long lead times to manufacture,” explains Rich Ladroga, manager of business development for Doble Engineering (doble.com). “The key is to be proactive rather than reactive.”

Wayne Bishop, a colleague of Ladroga’s at Doble, says that’s happening in the co-op sector. “It seems that they’re moving slowly toward condition-based maintenance but not throwing out time-based maintenance management.” That shift, Ladroga says, should help extend the life of expensive utility equipment.

That’s the hope, anyway, at Northeast Missouri Electric Power Cooperative, which calls on Doble for annual testing to keep its 50-year-old transformers in service. “Who



knows how many miles we have left in them?” wonders Kevin White, the G&T’s substation and metering manager. “But we don’t typically make a practice of overloading them.”

He compares his rigorous testing regime to hanging on to an old but serviceable car. “It may not impress the neighbors, but it’s still running. If we see anything alarming with the oil test we do a full Doble test. I don’t think people should replace aging transformers simply because they’ve gotten old. It ought to be an economic decision coupled with a loading decision.”

The same thinking went into the decision by San Miguel Electric Cooperative, a Texas G&T, to have Doble assess five older transformers. “Our unit auxiliary transformer is at the top of its rating, sometimes over its rating,” says Ted Mahar, electrical supervisor. “Our testing showed it was in pretty good condition, but it’s an oddball transformer.” With Doble’s help, Mahar says, the co-op can extend the life of the transformers while taking bids on replacements. And when the new models come in, he adds, the older but well-maintained transformers can serve as backups.

Chugach’s revamped maintenance program illustrates the need for a wide-ranging technology package to support condition-based management techniques: the helicopter-mounted infrared camera, for example. “The camera’s videotape is GPS-synchronized with our mapping system,” Borden says, “so if there are any problems we know precisely what structure we’re looking at.”

The mapping system is an important ele-

ment of the co-op’s maintenance management program, which Chugach has been computerizing for the past 12 years. “We moved a long ways down the path toward asset management,” Borden says. “That includes the entire life cycle of an asset, from acquisition all the way to salvage and disposal.”

A program called Cascade, from Digital Inspections, a KEMA Company (digitalinspections.com), provides additional support, he says. Cascade is a complete asset management system with databases that include maintenance history, inspection logs and failure analyses. It provides automatic reminders for reliability-centered, condition-based or predictive maintenance, along with forecasting and prioritization. It also includes reporting and analysis functions, and it ties in with financial, work management and GIS systems.

“We use Cascade to ultimately collect all of our data,” says Borden. “It has a tool we can use to configure our reliability-centered maintenance into a work management system. We have laptops synchronized to the consolidated database. People can take those laptops out and review their work orders.”

That flexibility overcomes a common co-op problem, according to John Lane, sales manager for Digital Inspections. “If you have data sitting in three different filing cabinets, or on computers in three different people’s offices, you don’t have useable data,” he says. “With Cascade, all of that data is stored in one place and you have algorithms monitoring the data in real time.”

Cascade can also gather information for calculating reliability performance, but Borden says Chugach uses a program from the Electric Power Research Institute called Maintenance Management Workstation for that part of the job.

Borden also stresses the importance of managing a co-op’s most important asset—its employees—especially during the transition to a new maintenance program. “Our primary focus is to have our people qualified and familiar in running the equipment,” he says. “There was a fair amount of white-knuckle fear as we moved away from time-based maintenance into reliability-centered maintenance. But over the last three years I think we’ve proven to ourselves that it works. We’re satisfied that we’re on the right path.”

A similar program has been in place at Alabama Electric Cooperative, which has used Cascade for five years. “It’s like a giant database,” says Terry Wilson, technical services superintendent. “You can put just about anything you want in there.” The G&T has set up time-based maintenance triggers for much of its system. But it takes another tack with its regulators, which are monitored for a number of operations.

Wilson says AEC starts the process by testing some equipment before it ever goes into the field. New three-phase protection relays, for example, are checked under a system from OMICRON (omicronusa.com). “We use OMICRON for commissioning tests and routine maintenance,” he says.

AEC also uses an infrared camera to scan the system for hot spots. “We just had a substation with about six hot switches,” says Wilson. “Because we have our own infrared camera, we were able to go back out after repairs were made. In this case three switches were still hot.”

Richard Strmiska, a certified infrared thermographer for Sumter Electric Cooperative in Florida, says he has been using cameras from Flir Systems (flirthermography.com) for the past 10 years. “Our co-op is proactive about maintenance,” he says. “And we showed we could save money and improve reliability with infrared cameras.”

Strmiska even scans the IOU transmission line serving his system. “If they have problems, we have problems,” he points out. “And we can’t afford that.”

He’s also found additional uses for the cameras. “We have six people doing energy audits for our members with infrared. We scan substations every two months. By having it in-house we can scan the system when the load is up. Some say you get a four-to-one payback with infrared, but I think it’s higher. We see close to a 20-to-one payback.”

Strmiska continues, “We’re improving reliability, and that improves customer satisfac-

INFO TO GO

Four things you need to know about maintenance management:

- 1.** *Slashing the maintenance budget during times of rising operations costs usually turns out to be penny-wise and pound-foolish.*
- 2.** *New approaches to maintenance can keep costs down while boosting reliability.*
- 3.** *Traditional time-based maintenance is the most expensive approach.*
- 4.** *Plenty of resources are available to help guide co-op maintenance managers to the next level.*

tion—especially with the key accounts. We find little things, between 500 and 800 hot spots each year, and every one could have caused an outage.”

Steve Erickson, operations supervisor at Iowa Lakes Electric Cooperative in Estherville, found another way to justify the cost of a strong maintenance effort. “A real good indicator your maintenance program is making progress is the overtime the crews are putting in,” he says. “Before we started doing a better job on right-of-way and other maintenance, all the crews were averaging 300 hours of overtime. Now it is well under 100 hours of overtime.”

Erickson’s co-op records pole inspections with the Utility Support Platform from Powel-MiniMax (powelminimax.com), a package that includes StakeOut and GIS to provide field-to-office work order integration and close the gap between information collected in the field and decisions made in the office.

“We like the fact that the platform gives us the option to expand our functionality one step at a time,” says Erickson.

A solid system maintenance program requires “a holistic approach,” says Ed Bevers, manager of engineering and operations at Rural Electric Cooperative in Lindsay, Okla. For example, “adding lightning protection will cut down on the number of OCR operations, lengthening the service intervals on OCRs, and it cuts down on the stresses on connections because you don’t have to carry all that fault current, and so on.”

A good, integrated plan should be the first step, Bevers believes.

“Don’t do things in a scattered fashion,” he says. “Remember that spraying is cheaper than chainsawing every tree. Use infrared. Listen to your linecrews. Listen to your customers. Communicate daily that maintenance benefits everyone. You’ll have fewer complaints, less time working at night.”

All of that, he concludes, will persuade a co-op’s board not to put maintenance on the chopping block when the budget gets tight.

“Less money spent on repairs,” Bevers says, “means better trucks, a better dental plan and better rates for members.” n

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