

Look, Ma! No (New) Wires!

Network Your Cellar Through Existing Power Lines



By Marne Coggan

MOST WINERIES have temperature controllers on their cellar tanks. Some wineries have wired those temperature controllers together in a network so software

can centralize their tank management and recordkeeping. But many wineries, while appreciating the potential benefits of a networked cellar control system, have been stymied by the high cost of installing one.

Well, the cost just dropped significantly.

The savings come from eliminating the need to install new wiring to network the tank controllers. Instead, temperature and other data is transmitted over wires you already have—the existing power lines in your cellar.

TankNET debuted in the 2000 crush

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season, and now controls about 3,000 tanks in 20 wineries. Paul Egidio, Acrolon's President and CTO developed it. In his four years as the IT director and network technology honcho at Chalone Wine Group, Egidio saw that the harsh environment of the cellar made existing temperature probes and controllers finicky and unreliable, and their wiring requirements created a jungle of cables. Says Egidio, "While building from scratch a complete network and computing infrastructure for Chalone's six wineries and corporate offices, I saw firsthand what was being used for temperature control. After learning how these systems were being used, I began to think of ways they could be improved. I knew that new network and sensor

technologies could do a better job of helping winemakers more effectively and reliably manage their fermentations during crush."

With input from winemaker Michael Terrien of Acacia Vineyards and others, he designed the TankNET model TC-1 controller and patent-pending digital temperature probes. Egidio recalls, "From the start, the TankNET controllers were over-engineered. They were rugged

for intensive cellar use, waterproof, chemical-proof and lightning-proof. They included an expansion slot for additional future capabilities. And they were designed so the internal software could be easily upgraded through the network without servicing the controllers themselves."

The heart of the TankNET system is a tank-mounted TC-1 temperature controller. Beyond simply monitoring and controlling tank temperatures, the controller allows cellar staff to enter Brix measurements and pump-over events directly at the tank. The temperature, Brix and pump-over data can be viewed at the tank, or displayed in tables, cellar maps and fermentation graphs on TankNET's web-accessible software. Updates, enhancements and custom features can be downloaded directly to the controller's flash memory via the Internet. An optional I/O expansion card allows the TC-1 controller to interact with a wide variety of additional sensors, or with cellar equip-





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Digital Sensors

To further enhance the performance of TankNET, the temperature probes themselves were modernized. Says Egidio, "Reliability and simplicity were the primary design criteria for our temperature probes. That meant abandoning traditional Resistive Temperature Device (RTD) technology. RTDs can be unreliable over time, especially in wet and caustic environments such as cellars. Minor corrosion of critical probe connections can obliterate temperature accuracy. Thermostats using RTDs must be calibrated periodically to compensate for this. Plus, each RTD requires its own separate shielded cable and at least three, and usually four, contact points. All of those wires from every probe must route back to the controller, which increases wiring costs and complexity."

"So instead of using RTDs, we developed a digital temperature probe, which is accurate to $\pm 0.5^{\circ}\text{C}$. It is completely immune to changes in wiring and contact resistance, which eliminates the need for periodic calibration. And, the probes themselves are networkable. This allows multiple temperature sensors to be clipped in a daisy-chain fashion onto the TankNET controller."

Wired Networking

The TC-1 controllers are networked through a simple, two-wire cable usually run in daisy-chained fashion from controller-to-controller-to-server. Besides being robust, the network technology used by TankNET is polarity insensitive, making it quicker to install and virtually impossible to wire incorrectly.

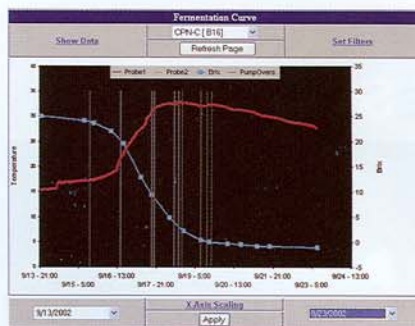
The TankNET server is a small hardware box with no keyboard, mouse or monitor. It typically is installed in the winery's network closet. However, it could just as easily be located in some other part of the winery, in an adjacent building, or at another site across the street, across the state, or across the country. The server usually is connected to the winery's local area network (LAN), and the winery's Internet connection provides secure access to the TankNET system by remote users.

Several larger wineries with multiple programs and multiple cellar facilities use the Enterprise version of TankNET to control all of their tanks from a single server located at the corporate headquarters. The Enterprise version

of TankNET organizes users and data by location so that only authorized winery personnel can view or manipulate particular tanks or tank groups.

Cellar Management from Anywhere

While the controllers can be used manually at the tank, the real power of the TankNET system is realized when the controllers are networked and managed by its web-based software. Powerful and easy to use, the



TankNet fermentation graph with temperature changes shown in red, Brix in blue and pump-overs in gray.

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TankNET software allows winemakers to monitor and control fermentations from anywhere on the planet using their favorite web browser. That browser could be on a desktop computer, PC, Mac or Linux, or on a web-enabled handheld device like a Palm or Pocket PC.

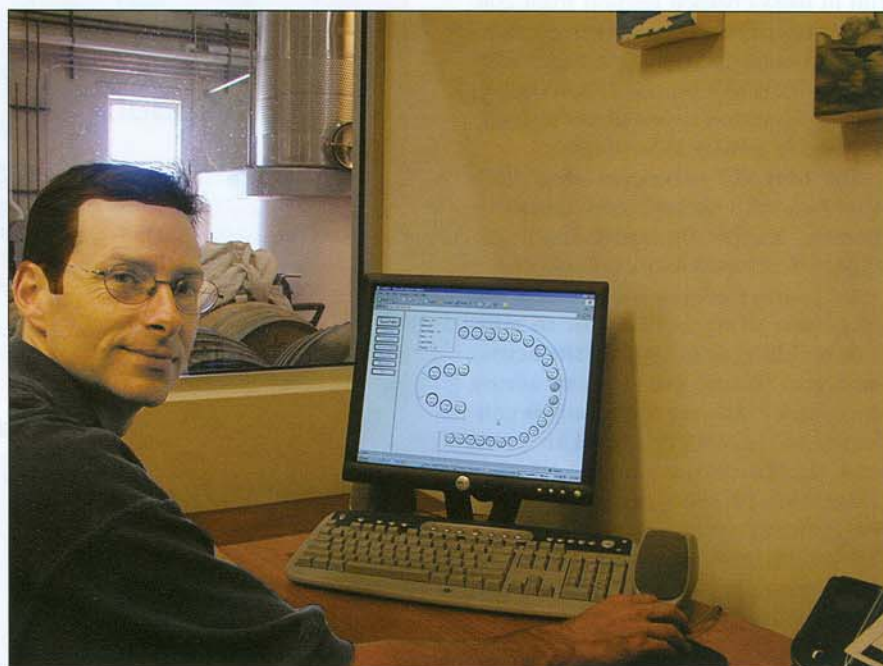
The TankNET software displays data in real-time; temperature measurements, pump-overs and Brix entries made at the tank appear instantly on the software in graphic plots, data tables or on animated cellar maps. Similarly, data entries such as set-point changes made via the web are instantly transmitted to the appropriate tank. The fermentation history of every unique tank/lot code combination is displayed in an easy to read graph showing the change in temperature and Brix over time, plus temperature set points and pump-over events. When data is viewed or edited in tables, it can be color-coded by status, cold soak, fermenting, extended maceration, etc. Each individual user can create his or her own custom tables and selection criteria without affecting anyone else's views.

A custom cellar map shows a winery's cellar configuration and tank locations. Color graphics depict each tank's status: empty, cooling, heating or alarming. Detailed information about lot code, Brix, set point, etc., can be viewed by simply resting the mouse cursor over a tank icon. Clicking on a tank icon on the cellar map or on the

tank ID in any table produces an interactive control panel—a detailed picture of the tank's status and data, which can be used to access tank control functions. The TankNET software maintains a history of measurements of temperature and Brix, and of actions like filling or pump-overs. Logged data, which includes time and date, lot code, tank ID and more, can easily be accessed in real-time from software such as Microsoft Excel, Microsoft Access and Crystal Reports.

Says Michael McNeill, winemaker at the Keller Estate Winery, "I totally love TankNET. It was really great for me to have it last year. It helped me to keep things straight and to keep track of all of my fermentation data. The data retrieval capabilities are so easy, and the graphs are extremely intuitive. It's great being able to enter the Brix right at the tank where you're performing it instead of having to go back to the office to enter it, and having a real record of when punch downs actually were performed. Of course, you have to get your staff and crush help to enter the punch-down event—we're going to work on that this year."

"I can change temperature settings on the tanks themselves, or from the computer in my office or via the web if I was somewhere else. And any changes show up instantly everywhere. If there's a problem with a tank, it shows up everywhere in the software—on the tank icon in the map, on the cellar icon and also on the tank



From the PC at Michael McNeill's desk, this cellar map screen precisely shows the locations of all tanks in the Keller Estate cellar.

controller itself. It's very cool. Last year we hadn't set up alarms on our cell phones, but we will set that up for this harvest. I know that there are many more things that I could be doing with the software. But just the parts I am using make the system really helpful to me."

TankNET at Korbel

Rebekah Richardson, winemaker at Korbel Champagne Cellars, says that all 150 of their tanks are on TankNET. "The system has been brilliant. We are incredibly pleased with the benefits that it has given us. It gives us a lot of flexibility, visibility, and allows us to closely monitor the fermentation process. I'm a very hands-on winemaker and I want to see everything, all the time. With access to the software from home or in the office via the web, I can keep close tabs on all of our processes, even if I am not at work."

"In the harvest season, we record all of our Brix measurements through the TankNET system. I can look at a tank in the software and see a graph of the Brix decrease in relation to temperature just by clicking on a link. Being able to view this information in a graphical manner means that I can see immediately whether or not a fermentation is going well."

Richardson continues, "During the off-season, we're using TankNET primarily as a temperature control system. While our smaller tanks have just a single temperature probe, the larger tanks use a double probe. That's a really handy thing because we can see temperature differentiation between the upper and lower parts of the tank. We've also just started using TankNET to monitor the temperatures on our triage tanks, which are the secondary fermentation yeast tanks. As this is one of the most critical steps in sparkling wine production, we hope, in the future, to add inline Brix measurement to help us improve our visibility in this area."

"In addition to all of the benefits I've already mentioned, we put all of our lot codes, gallon data and analysis in the software on a tank-by-tank basis, so it's almost a secondary system for wine tracking."

Aaron Bader, associate winemaker at Monterey Wine Company in King City, California, a custom crush facility with a strong focus on customer service, thinks TankNET is a handy tool. "We use TankNET for easy access to infor-



Rebekah Richardson at Korbel Champagne Cellars. The TankNET controller is displaying a just-entered Brix measurement.

mation on the tanks. It gives us the real-time temperature and Brix data on our desk-based PCs. Besides getting real-time temperature data and the ability to change the temperature control on

a particular tank from the PCs at our workstations, TankNET also eliminates that whole job of distributing Brix data on paper. When the lab techs go around in the mornings during harvest

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for Brix sampling, TankNET lets them actually input the data at the tank. This immediately becomes data that we can all look at from our PCs. And if we're tasting at the tanks, we can go to the tank itself and punch up on the TankNET controller what today's Brix was."

"The data management is quite useful. We can use the cellar map function of TankNET to provide a visual reminder of what lots are in what tanks. We've grouped the tanks in the software by size. That lets our winemakers sort the tanks by group to see the rundown of empty tanks, full tanks and settings on tanks that are a similar size. And our general manager can access the software from the web when he's working away from the winery."

Acrolon recently introduced the Strati-Probe(tm), a portable temperature probe up to 12 feet long, for readings of cap, sub-cap and juice temperatures at up to eight different depths. Bader has been experimenting with Strati-Probes at Monterey Wine Company. Notes Bader, "We have two different Strati-Probes, one for what we call the 'one-truck' tank with about 25 tons of fermentation capacity, and a longer model that we use in a 'two-truck' tank with roughly 50 tons of fermentation capacity. The Strati-Probes give us an interesting way to look at different tank mixing techniques during red fermentations, pulse-air versus standard pump-overs. We can see what quality of mixing we're getting. They need a bit of tuning, but we're getting some really interesting and educational data from them."

"We're also looking at temperature stratification. Our first job is to discover what's going on in the cap and to find out what the data means. You might think, for example, that a cap temperature of 100° means you should start a pump-over. But what if juice temperature at 85° and a temperature of 100° in the heart of the cap leads you to a great, nicely extracted, deeply colored wine? So we're using the Strati-Probe to find out how hot it gets in the hottest part of the cap during our standard winemaking regime and temperature settings."

Strati-Probes are customized for each winery's tanks. This model has six temperature sensors, and the tank itself has two.

Got Brix?

The TankNET platform allows

Acrolon to respond quickly to winemakers' needs. Software upgrades and customized features are developed and then easily downloaded over the web. For example, a year after they installed 100 TankNET controllers, the winemakers at the Monterey Wine Company wanted to test a Brix probe on a few tanks. Acrolon quickly developed software to interface with the Brix probes, and then downloaded the new software directly to the selected tank controllers via the Internet. Meanwhile, cellar staff installed the Brix probes in the tanks and connected them to the optional I/O expansion cards inside TankNET controllers. The result was automatic Brix measurements charted in the TankNET software. TankNET even controlled the pneumatics used to draw wine samples into the Brix probe and to flush out the wine after a measurement was taken. (For more information on the Brix fermentation probe project, see the article Monitoring Fermentations in the July-August 2004 issue of *Vineyard & Winery Management*.)

Egidio notes, "Integrating the Brix probe is just one sample of what we can do with TankNET. The TankNET platform could just as easily monitor CO₂ or SO₂ concentrations, or even tank levels using a radar or ultrasonic detector. This kind of flexibility allows wineries to easily expand their systems as needed."

At Last, Power Line Networking

Despite the benefits, the cost of installing tank controller networks has been a stumbling block for many wineries. The wire itself isn't all that expensive—the unshielded two-wire network cable used by TankNET is about \$80 per 1,000 feet. The big cost of networking is in the labor and other materials required for installing the wiring in conduit from controller-to-controller-to-server.

Wouldn't networking cost less if you could eliminate the wires? Sure! You might try networking your tank controllers using Wi-Fi (officially known as 802.11a, b and g), the radio-based wireless system often used in homes. But Wi-Fi transmission can be disrupted by large metal and wooden objects. Even without obstructions, its effective range is smaller than many cellars. Further, as of summer 2004 when this article is being written, there are no suitable thermostats on the market with built-in Wi-Fi.

There's a better way to save money on networking. Don't eliminate the wires—eliminate the wiring you have to pay to install. Transmit the network signals using wires you already have in your cellar. What wires, you ask?

Electric power wires. Happily, standard electric outlet boxes in your cellar also can serve as network connections with a system called power line networking. Power line networking uses regular electric wiring for the transmission of digital data. The presence of the data signal on electrical lines has absolutely no effect on the electrical service in the cellar. If you have a thermostat of any kind on your tank, you have all the wiring needed for power line networking.

Power line networking is not a new concept. It's been used successfully in industrial sites in Europe. In the US, however, its acceptance had been slow due to interference with data signals from "noise" on the electric lines and a general lack of available network products like routers and bridges. Updated semiconductor technology is quickly eliminating these problems.

Power line networks can be very robust and affordable. Specifications and performance can vary widely from technology to technology, but broadband power line technologies have a

range of about 1,000 feet, which covers most cellars.

The one downside of power line networking is a slower speed. Its theoretical broadband data transfer limit is 14 megabits per second (Mbps). That makes it unusable for high-bandwidth transmissions like video. However, 14Mbps is perfectly suited for low-bandwidth uses like tank temperature data and automatic control devices where millisecond timing is not needed.

Tank Control Through Electric Outlets

Acrolon Technologies will offer its TC-1 controller in a power line version in 2005. In addition, they will be introducing the new, less expensive PL-1 power line controller. Their power line networking products will be demonstrated at Acrolon Technologies' booth at the 2005 Unified Wine & Grape Symposium.

"To ensure that our power line networking products would work in real-world cellars," says Egidio, "we visited several typical wineries and tested

the networking hardware. It worked superbly, even under the worst possible conditions where variable-frequency pumps were on the same circuit phase as the tank thermostats. In fact, the technology worked so well that we had to reduce our transmitter's power by 12dB—to a mere 6% of normal power—before we began to lose data. So we have a very good margin of safety. And with Acrolon's three-phase power line router, even large tank farms will be excellent candidates for our power line system."

Like the original TC-1 controller, the new PL-1 will perform temperature control and allows the direct input of Brix measurements and pump-over events. The new PL-1 won't accept



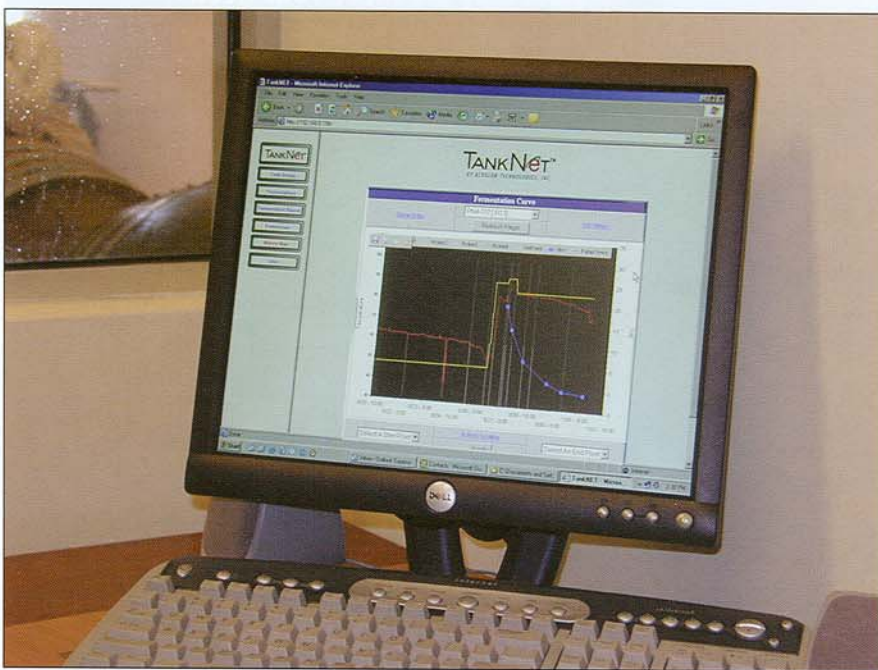
Smaller and less expensive, TankNET's new PL-1 Power Line controller is networked through cellar power lines using a cable that looks just like a standard power cord.

Acrolon's I/O expansion card, but it will interact with the same TankNET web software when networked over cellar power lines.

Egidio notes, "The PL-1 is a smaller, more affordable temperature controller that provides true plug-and-play network capabilities. It offers wineries an easy and affordable migration path to a full TankNET control system. Customers can purchase PL-1 controllers for stand-alone temperature control. And, when they're ready to network, Acrolon will install a TankNET server and a power line router. Then the software will be accessible right from their browsers."

The PL-1's lower price coupled with the elimination of the network wiring expense means that wineries now can have an installed TankNET system for significantly less than many wired systems.

For information on the TankNET controllers and software, contact Paul B. Egidio at Acrolon Technologies, phone (707) 938-1300, e-mail paul@acrolon.com, or on the web at www.acrolon.com



A fermentation profile on TankNET software: The temperature graph in red shows the long initial cold soak followed by the fermentation temperature profile. The Brix measurements are the falling graph points in blue. Punch down sequences in white, and the tank temperature set point in yellow also are shown.