

CONTROL

PROMOTING EXCELLENCE IN PROCESS AUTOMATION • CONTROLGLOBAL.COM

BEST CASES:

POWER SUPPLIES AND USERS GET SMART

Three recent feature articles in *Control* by Jim Montague show how power supplies are evolving to gain intelligence and perform more complex tasks—and how users can employ them to improve operating reliability.

BEGIN



Table of Contents

Brain power for power supplies	3
Power supplies take sophisticated paths	5
Power supplies get in on reliability act	8



Brain power for power supplies

If controllers and field devices already have diagnostics tool power, why can't power supply devices have that too?

Jim Montague, executive editor, *Control*

Everything is getting “smart,” and this trend appears to be holding true for power supplies as well. Devices that used to only deliver power, convert it and maybe offer surge protection are now monitoring and measuring current and voltage profiles, implementing alerts and alarms for predefined operating ranges, and sending data on power supply performance up to higher-level systems and users for analysis and optimization efforts.

For instance, Richard Anderson, senior automation specialist at [Solid State Automation and Controls](#) in Houston, Texas, reports in a whitepaper, “How to Develop Cost-Effective, Ruggedized, Skid-Based Applications for Remote Deployments,” that SSAC recently designed and built a viscosity-reducing, skid-based, oil-mixing system for an unmanned production platform in the Gulf of Mexico, and employed Siemens Industry’s Siplus S7-1200 PLCs, ET200M I/O modules, MP377 HMIs and two power supplies in an explosion-proof, NEMA 7 enclosure and intrinsically safe track pad.

Everything is getting “smart,” and this trend appears to be holding true for power supplies as well. Devices that used to only deliver power, convert it and maybe offer surge protection are now monitoring and measuring current and voltage profiles, implementing alerts and alarms for predefined operating ranges, and sending data on power supply performance up to higher-level systems and users for analysis and optimization efforts.

For instance, Richard Anderson, senior automation specialist at [Solid State Automation and Controls](#) in Houston, Texas, reports in a whitepaper, “How to Develop Cost-Effective, Ruggedized, Skid-Based Applications for Remote Deployments,” that SSAC recently designed and built a viscosity-reducing, skid-based, oil-mixing system for an unmanned production platform in the Gulf of Mexico, and employed Siemens Industry’s Siplus S7-1200 PLCs, ET200M I/O modules, MP377 HMIs and two power supplies in an explosion-proof, NEMA 7 enclosure and intrinsically safe track pad.

The two power supplies consist of two Sitop units, both capable of 24 Vdc and 120 Vac with a redundancy module between them. They support and maintain high availability on the skid’s equally redundant PLCs, which pull data from a flow sensor, and use 4-40 mA analog wiring, HART, Profibus and Profinet communications protocols and Siemens’ Scalance wireless modules to transmit it to the user’s onshore DCS. Likewise, S7-1200 PLCs can also use Modbus RTU and Modbus TCP for communicating between legacy RS-232 and RS-485 systems and industrial Ethernet, while Sitop 1600 DC uninterruptible power supplies have two Ethernet ports for integrating with Profinet and reporting to users’ higher-level networks. [The whitepaper is available here.](#)

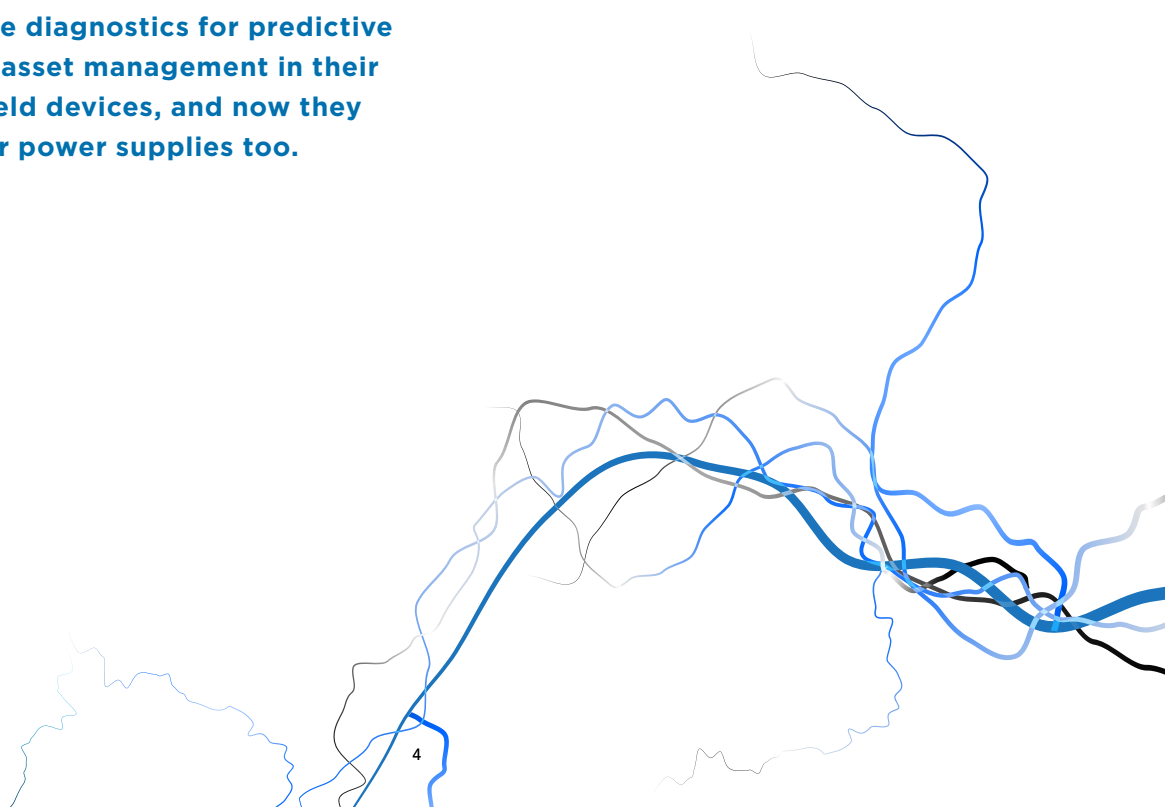
I’d add not to take my word that power supplies are getting smarter, but I can’t because when I researched this topic, I



ran across two articles I wrote on it last year and the year before. In the earlier article, “[Power Supplies Take Sophisticated Paths](#)”, Roolf Wessels, business unit manager for monitoring and protection at Pepperl+Fuchs, said, “Power supplies have always been a bit of a stepchild compared to other process control devices, but users are recognizing that power is the most critical element in their applications. You can lose a few I/O points and networking nodes and still run an application, but losing power means losing your whole application, so it’s worthwhile investing in high-reliability, high-efficiency power. As a result, users want more diagnostics in their power supplies. They already have diagnostics for predictive maintenance and asset management in their controllers and field devices, and now they want it in their power supplies, too.”

Users already have diagnostics for predictive maintenance and asset management in their controllers and field devices, and now they want them in their power supplies too.

In the more recent article, “[Power Supplies Get in on the Reliability Act](#),” Mike Garrick, power supply manager at Phoenix Contact, added, “Applications become more robust when a power supply can report when its connected field devices are drawing too much current, while the integrity of the DC bus is intact. For example, if the system is designed for 10 amps, it’s become a reasonable expectation for the power supply to provide a signal to the process controller when the load starts to draw more than 10 amps. This signal is an early warning that the load is drawing too much current, and maintenance should be scheduled. When this early warning is received, the controller knows the process is running at the proper voltage at a current beyond the nominal rating of the supply. The reason for this could be a field device that’s getting old and requires service.”





Power supplies take sophisticated paths

Using many of the same data processing tools and software as process controllers, power supplies are diversifying their capabilities and serving in many new and different applications

Jim Montague, executive editor, *Control*

We've gone way beyond "on" and "off." Yes, [power supplies](#) always had to convert and deliver appropriate volts, watts, amps and other power levels, and meet quality measures to run their machines and applications. But once configuration was done and harmonics were tested, most power supplies operated continuously—at least until an interruption or outage happened.

Well, those set-it-and-forget-it days are long gone. Digital monitoring devices enabled by microprocessors and software are pulling power supplies up to the same awareness level as so many other process control components.

For instance, [Boliden](#) recently spent \$790 million to renovate its Aitik open-pit copper mine in Gällivare, Sweden, and it used [ABB's](#) control systems and power equipment to increase Aitik's efficiency and double capacity to 36 million tons of ore per year, even though its initial ore is only 0.25% copper (Figure 1). The mine installed 650 motors ranging from 4 kilowatts (kW) to 5 megawatts (MW); 230 drives and variable-speed drives; and two 22.5-MW gearless mill drives (GMDs). These are powered by ABB's 23 distribution transformers and gas-insulated switchgear and controlled by its System 800xA DCS.

Of course, extracting metal from the 106,000 tons of ore that's crushed and chemically concentrated to 25%

copper at Aitik each day requires lots of stable, high-quality power for its 7 km of conveyors, the GMDs and other equipment, which must often run 24/7/365 in very dusty conditions that can get down to -45 °C in winter. So, ABB implemented a 179-kV substation with its gas-insulated UniGear switchgear that's protected by its Relion relay protection equipment, and distributes 24-kV power throughout the mine's operations. Also, a harmonic filter



Courtesy of ABB and Boliden/Lars Deval

MANAGING MINE POWER

Figure 1. The Aitik copper mine uses ABB's 800xA process controls to coordinate its 179-kV substation, gas-insulated switchgear and power supplies.



and power-factor correction system help Boliden prevent damage to its own equipment and avoid disturbing the local power grid.

In addition, Aitik uses the IEC 61850 standard that defines communications within and between electrical components, which enables 800xA to provide one environment for supervising and controlling process automation equipment, [power automation devices](#), switchgear, and transmission and distribution equipment. Boliden reports that integrating Aitik's electrical controls with its [process controls](#) increases productivity and reduces stoppages.

Custom-Made Monitoring

While most process applications aren't as big as the Aitik mine, many similar methods of monitoring and proactively maintaining electricity are being adopted by smaller power supplies in diverse applications.

"Power supplies have always been a bit of a stepchild compared to other process control devices, but users in applications from power generation to food and beverage are recognizing that power is the most critical element in their applications," says Roelf Wessels, business unit manager for monitoring and protection at [Pepperl+Fuchs](#). "You can lose a few [I/O](#) points and networking nodes and still run an application, but losing power means losing your whole application, so it's worthwhile investing in high-reliability, high-efficiency power. As a result, users want more diagnostics in their power supplies. They already have diagnostics for predictive maintenance and asset management in their controllers and field devices, and now they want it in their power supplies, too."

As a result, Pepperl+Fuchs redesigned its PS 3500 power supply in 2009, and is scheduled to introduce its PS 3500-DM diagnostic module in January 2013. "It plugs into the power supply's backplane and monitors incoming current quality and generated dc outputs, checks for brownouts

and spikes, time-stamps any events, correlates them with data from other sources, and provides alerts and alarms," says Wessels. "We even added a display on the DM module itself, so users see all their parameters locally too."

Similarly, [Emerson Network Power](#) is integrating its uninterruptible power supplies (UPSs) with [Asset Management Suite \(AMS\)](#) software to monitor UPS performance. "In many cases, power systems and their backups have been reliable for decades, so users tend to forget about them after commissioning, and no longer know what to do when alerts and emergency calls eventually come in," says David Vasselin, market and business development vice president for Emerson Network Power's industrial systems division. "Now users want UPSs that are easier to understand and maintain, and this is why we've integrated them with AMS in electronic device description (EDD) software and human-centered design principles. We ran through all the UPS alert situations and added them to the EDDs to give users a hierarchy of alerts and how to troubleshoot them."

Standard Pieces for Specific Puzzles

To help reduce the time it takes to integrate power supplies with their control-based counterparts, Mark Wilkins, chief engineer at [Acopian](#), reports his company is building IP addresses, Ethernet and USB interfaces and some control functions directly into its 0-30 kV power supplies "There's a lot more fluctuating inputs these days, typically between 90 V and 265 V, so we designed a universal input to handle them without having to flip a switch," says Wilkins. "In general, we now have more programming and communications options for applying power more efficiently, and these are allowing power supplies to interface with other equipment, talk to each other and synchronize efforts. For example, in a water ionizing application to purify water for plating, a controller can tell a power supply to



turn on; it can report back in a few hundred milliseconds; and be adjusted much faster than manually for more consistent plating with less feathering.”

Likewise, some power supplies are adding intelligence that allows them to be more easily monitored and managed, according to Kai-Uwe Bronzel, product consultant for U.S. power supplies and power security at [Siemens Industry](#). “We recently built a relay contactor module into our Sitop power supplies that can bring a signal back to upper-level control systems,” says Bronzel. “This lets users check on their input and output voltages, observe trends in their 24-Vdc supplies, and prevent more interruptions and potential failures.”

Sharonda Wamer, Siemens’ product marketing manager for U.S. power supplies and power security, adds that many power supplies and related systems are following the lead of Europe’s suppliers, and moving from 230 Vac or 120 Vac to 24 Vdc. “More customers have applications that depend on critical 24 Vdc power, so we provide solutions to maintain it,” says Wamer. “These include our ‘dc ups’ with battery backup, redundant solutions with two power supplies for load sharing, and switched-mode power supplies. These use an electronic method that draws less current than regular mechanical supplies when reacting to short circuits, and this means fewer trips, more and better identification of potential overloads, and fewer lost circuits.”

Merging Power and Control

To combine control and power even more tightly, [National Instruments](#) and the National Renewable Energy Lab have combined NI’s single-board Reconfigurable I/O (RIO) and added its standard General Purpose Inverter Controller (GPIC) board for 50-kW and up power supplies, which primarily use custom circuit boards.

In fact, [Dynampower Corp.](#) has developed power converters for grid-tied energy storage based on NI’s LabView



Courtesy of National Instruments

MERGING POWER

Figure 2. Dynampower’s 50 kVA dc-to-dc power converter and the SmartPowerStack Consortium’s 100 kVA power inverter (bottom right) are based on National Instruments’ General Purpose Inverter Controller (GPIC).

RIO architecture and RIO GPIC (Figure 2). Advanced carbon batteries are useful for grid storage because they have a long lifecycle, fast charge/discharge and deep-cycling capability, but they require a unique power conversion and inverter system such as Dynampower’s to stabilize performance and provide these benefits.

“LabView and GPIC development platforms reduced our development cost and risk compared to a full-custom controller design,” says Kyle Clark, Dynampower’s advanced systems engineering manager. “We were able to reduce development time for our power converters from 72 weeks to 24 weeks. FPGA devices in particular, which now include embedded DSP cores inside the fabric, are a real game changer. We can precisely control the flow of power, run multiple control loops in parallel and reconfigure the hardware at a silicon level even after it’s deployed to the grid.”



Power supplies get in on reliability act

The demand for increased reliability and global application for process control is driving evolution of power supply design

Jim Montague, executive editor, *Control*

Just as large electricity producers and consumers are using smart devices and software to improve power quality and operating efficiency, developers of device-level power supplies are employing many of the same strategies.

Mike Garrick, power supply manager at [Phoenix Contact](#), reports that demand for increased reliability and global application for process control is driving evolution of power supply design. “Process designers are looking for power supplies with increased diagnostic/monitoring ability,” says Garrick. “The application becomes more robust when a power supply can report when its connected field devices are drawing too much current, while the integrity of the DC bus is still intact.

“For example, if the system is designed for 10 amps, it’s become a reasonable expectation for the power supply to provide a signal to the process controller when the load starts to draw more than 10 amps. This signal is an early warning indication that the load is drawing too much current, and maintenance should be scheduled. When this early warning signal is received, the process controller knows the process is still running at the proper voltage at a current beyond the nominal rating of the supply. The reason for this could be a field device, such as a pump, that’s getting old and requires service.”

If this hypothetical application continues to draw more and more current, Garrick explains, then its power supply voltage will eventually start to drop (load down). “The process controller should expect to receive a second indication when the voltage has dropped 10% down from the adjusted/required application voltage,” he adds. “At 10% down in voltage, the application should be tolerant, and continue to maintain the process, but this second indica-

tion is the final warning. Any further reduction in voltage will threaten the fidelity of the process. With the reception of the second warning, maintenance must be considered. Depending on what’s at stake with the application, an organized safe shutdown or an acceptable idling point should be considered.”

Garrick adds that global process applications must consider various other dynamics to meet all requirements for power supply installation, and these firms will standardize on power supplies that meet these needs. “Approvals for hazardous location are the first step to determine the suitability of a power supply to be applied anywhere in the world,” he explains. “Power supplies listed for use in Class I Division 2, ATEX and IEC Ex suit the need for most installations worldwide. Temperature is the next consideration for an application. Temperature can vary greatly depending on the location of the installation. Global process integration companies need power supplies rated for -40 °C to 70 °C to meet their design specifications.

“Finally, the last important, but commonly overlooked factor is choosing a power supply with printed circuit boards (PCBs) that have been dipped in conformal coating. Conformal-coated power supplies provide resistance from moisture, such as salt spray, corrosive gases, conductive dust and other contaminants that could influence the life of the power supply. Please know that all coated supplies are not created equal. Techniques range from hand painting, spray and dip coating the PCB. Perfect coverage can only be obtained by dipping the entire PCB in conformation coating. When evaluating the supplies, the extent of the coverage can be determined by analyzing the PCBs under an ultraviolet light source.”