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System integrator designs and implements a furnace control system upgrade

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BACKGROUND

Founded in 1994, Malisko Engineering (www.malisko.com) is a design and implementation company focused on automation system engineering and programming. The company's expertise spans several industries, including brewing, packaging, pharmaceuticals, chemicals, industrial heating and cooling, and food processing.

In 2009, Malisko Engineering was contracted to upgrade a thermal processing furnace control system for Advanced Energy, a manufacturer of gas and liquid flow management systems, thermal instruments, and other power systems and components. With temperature ranges reaching more than 850 °C, this Radiant Technology Corporation (RTC) furnace is used to fire components before they are integrated into larger systems and machines.

"Ensuring that this furnace is running the correct thermal profile and executing it precisely as components are fired is absolutely critical," says Dan Malyszko, Senior Systems Engineer at Malisko Engineering. "Any malfunctions or imprecision can result in compromised components, which can be very costly."

Advanced Energy's RTC furnace had been operating perfectly since the mid-1990s. The unit included an Opto 22 G4LC32 controller remotely communicating to distributed I/O.

While this control system had been reliable, the aging Windows 95-based PC, which was connected via ARCnet and was hosting the system's human-machine interface, suffered a catastrophic system failure. Advanced Energy rebuilt the PC, but a new problem surfaced.

In the years since the furnace had first been designed and built, Opto 22 (www.opto22.com), had developed a new generation of faster and more powerful controllers, I/O and software. Advanced Energy knew they could realize major improvements in performance and gain other advantages by moving to this new hardware. Additionally, although Advanced Energy had never had a single problem with the old control system hardware in more than 10 years, there was no guarantee that replacement parts and spare inventory would continue to be available.

Advanced Energy's RTC furnace

Advanced Energy therefore sought out an engineering firm to help them upgrade their furnace controls by designing a system based on the newest generation of Opto 22 hardware and software.

"The customer wanted to stick with the Opto 22 hardware because it had performed effectively and reliably, but they needed assistance with the upgrade and the programming," says Malyszko.

An Opto 22 representative accompanied Malisko Engineering on a visit to Advanced Energy to identify which new components were needed and develop a migration strategy. Malyszko himself had recently completed a long-term project at the nearby New Belgium Brewery, assisting the company's chief automation engineer in upgrading the brewery's numerous Opto 22-based control systems.

I/O

Advanced Energy was pleased to hear of Malisko Engineering's considerable experience with Opto 22 hardware. The upgrade began with the removal of the old I/O processor in favor of Opto 22's newer SNAP-PAC-EB1 brain.

This brain serves as an intelligent communications and I/O processor capable of functions like latching, counting, pulsing, and event/reactions. Perhaps most significantly, the EB1 can also perform thermocouple linearization and PID control, two functions that are essential in many heating-related processes, such as the ones performed by Advanced Energy's furnace. [1]

"We reconfigured temperature-zone PID control for the furnace in a way that utilized the built-in PID capabilities of the new SNAP brain," explains Malyszko.

"The old control hardware executed PID control—about four loops per rack—via custom commands. Also, there was more limited space on the I/O rack, so handling all the inputs and outputs needed for PID was an issue. With the new system, however, PID control can be programmed more easily and the EB1 can handle up to 96 loops simultaneously."

I/O in the furnace control system included analog output modules to control the speed and intensity of current and voltage powering the furnace, digital output modules to switch that power, and thermocouple modules that accept temperature input from the furnace's type K thermocouples.

Critical to the success of this upgrade project was the fact that Opto 22 had designed its SNAP line to be backwards

Advanced Energy's furnace I/O upgrade utilized the SNAP-PAC-EB1 brain.

compatible, which meant that swapping out the controller and I/O processor wouldn't necessitate massive changes to the I/O. Indeed, Malisko Engineering was able to integrate the existing wiring from all the furnace's internal devices and thermocouples into a new modular I/O backplane.

By utilizing existing field devices and wiring this way, the upgrade was completed more quickly and furnace downtime was minimized.

The I/O backplane built by Malisko Engineering also included the EB1 brain, which communicated back to a new controller, a SNAP-PAC-S1. This standalone controller was chosen for its powerful processing (roughly 16 times faster than its predecessor) as well as its compact size.

"With this furnace project, we had a limited amount of space to work with," says Malyszko. "It was important for us to design a control solution and retrofit with a small footprint appropriate for the existing enclosure."

SOFTWARE & PROGRAMMING

The SNAP-PAC-S1 controller was programmed with PAC Project, which retains the same look and feel as the old software, while supporting the more powerful features of the S1.

Programming the system was quite demanding, as many of the furnace processes relied on numerous custom commands that were developed using the Forth programming language. These external commands could

1. Thermocouple linearization refers to the conversion of a thermocouple millivolt readings into temperature values. PID control corrects the disparity between a measured process variable and a desired setpoint by continuously calculating and then outputting a corrective action that adjusts the process.

"Having control software that lets you program with both flowcharts and a flexible scripting tool really gives you the best of both worlds."

- Dan Malyszko, Malisko Engineering

not be imported into PAC Project, which meant they had to be reverse-engineered and reproduced.

Malisko Engineering's prior experience on similarly configured systems at New Belgium helped the project move forward swiftly and successfully. Malyszko was able to recover the external command library and replicate its functionality with equivalent commands he programmed in OptoScript code.

OptoScript is a programming tool, similar to scripting languages like Visual Basic, C, and C++, that can be used to augment Opto 22's standard flowchart-based programming when there is a need for control functions involving "if-then-else" processes, complex math, or string handling.

"Having control software that lets you program with both flowcharts and a flexible scripting tool really gives you the best of both worlds," says Malyszko.

Advanced Energy's HMI also required an upgrade. OptoDisplay (part of the old software suite) communicated via ARCnet to a PC, providing recipe management and process visualization. This HMI was upgraded to PAC Display, which communicates over Ethernet to any networked PC. (This communication is facilitated by OptoOPCServer software, used to integrate Opto 22 controller systems with OPC clients.)

Opto 22's newer hardware and software combined with the programming and modular backplane built by Malisko Engineering to form a custom solution that maintained the same look and feel of the original control system. Malisko Engineering fully simulated the new furnace control system off site before presenting it to Advanced Energy for on-site factory acceptance testing of existing recipe files.

After successfully testing the recipes, the new system was demonstrated on site before formal startup and commissioning. Through every phase of the project, Malyszko utilized Opto 22's free product support, which proved invaluable.

"Opto's tech support was tremendous," says Malyszko. "This project took about a month and a half, counting system build and programming, and Opto was there every step of the way providing assistance.

"When it finally came time for system installation at the customer site, we were able to minimize downtime, run thermal profiles, and make everything operational in just two days."

The quick and successful completion of this project was extremely pleasing to Advanced Energy, largely because of the cost savings associated with upgrading the furnace versus buying a new one. And because Malisko Engineering was able to design and complete an upgrade in such a relatively short time, Advanced Energy saved a good deal of time and money.

"There are tremendously high volumes of product pushed through these furnaces and any down time at all adversely impacts production throughput," Malyszko explains. "Across all types of industrial manufacturing industries, there are tons more of these furnaces out there. We feel that our experience makes us the company best suited to assist customers who might need similar upgrades to their control systems."

ABOUT OPTO 22

Started in 1974 by a co-inventor of the solid-state relay (SSR), Opto 22 has always built products on open standards, not proprietary technologies.

Famous worldwide for its reliable industrial I/O, the company in 2018 introduced *groov* EPIC® (edge programmable industrial controller). EPIC has an open-source Linux® OS and provides connectivity to PLCs, software, and online services, plus data handling and visualization, in addition to real-time control.

All Opto 22 products are manufactured and supported in the U.S.A. Most SSRs and I/O modules are guaranteed for life.

MADE IN THE USA

For more information, visit opto22.com or contact **Opto 22 Pre-Sales Engineering**:

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