



Boiler Control System Uses Advanced PID Algorithm

System integrator Diverse Devices uses an IDEC automation system to control complex boiler installations used in hotels, hospitals and other large facilities.

Byline: Jack Heiser, President of Diverse Devices

Founded in Los Angeles in 1946, Parker Boiler manufactures hot water and steam boilers used in manufacturing, wastewater treatment, heating large buildings ranging from hospitals to hotels, and other facilities worldwide.

In 2017, Parker Boiler worked with system integrator Diverse Devices to develop a PLC-based control system using an advanced PID algorithm to sequence multiple boilers. Rather than implementing one large boiler to service the needs of their clients, one or more smaller boilers are often used to minimize downtime, simplify maintenance, and provide regulatory compliance (Figure 1). These and other boiler control applications often require remote access for alerts, adjustments, maintenance and troubleshooting.

Diverse Devices chose an IDEC MicroSmart FC6A PLC and a 10" HG3G HMI to fulfill the needs of Parker Boiler. Diverse Devices migrated from the IDEC FC5A to the MicroSmart FC6A PLC in 2017 because the newer IDEC product had all the features they needed at an attractive price/performance ratio.

Some of the most important new features for this and other applications include a built-in, real-time clock and calendar; Modbus RTU and Modbus TCP IP communication protocols, embedded Ethernet, and data logging capabilities. Other key features needed in this application were data and alarm logging onto a removable SD card, the ability to download logged data via a USB flash drive, and a small footprint for the PLC and HMI.

Advanced PID Algorithm Improves Control

The IDEC PLC is not involved in the safety controls for the boiler, but is instead used to modulate the firing rate of the boilers, along with control of other functions. If one boiler is not sufficient to meet the heat demand, additional boilers are brought online, and their firing rates are controlled and coordinated by the PLC.

This is accomplished either through Modbus RTU communication or by a 4-20mA analog output signal, depending upon the Parker boiler type. Water temperature (or steam pressure) is measured by the PLC, and then using the PID algorithm, the firing rate is adjusted up or down as required to keep the temperature (pressure) constant. Water temperature is typically the process variable of interest in hydronic heating applications, and steam pressure typically the process variable of interest in industrial processes. Hydronic heating systems use tubing to run a hot liquid beneath floor, along base board heaters, or through radiators to heat commercial buildings and other facilities.

"Setting up the PID function in the PLC using IDEC's PID with Derivative Decay (PIDD) instruction is very easy, and the PIDD controller has a very fast reaction time," says Noel Shamoan, chief programmer at Diverse Devices. "Tuning is quick and intuitive, and multiple changes can simultaneously be made to the PIDD parameters. This new PIDD function has helped eliminate undershoot and overshoot of set points in this and other systems."

Remote Access and Operator Interface

Through the HMI interface, the control system is connected to the internet, providing browser-based access to the boiler system from any internet-connected device such as a laptop, PC, tablet or smartphone. This access allows alarms and alerts to be sent to local or remote personnel via text or email.

Another provision is the ability to remotely monitor, diagnose and upgrade the PLC program—accomplished primarily over a cellular network for purposes of convenience and security. Program maintenance, troubleshooting assistance, and feature upgrades are all handled remotely by connecting a cellular modem installed inside the enclosure.

Cellular was chosen over a wired internet connection to improve security, and to eliminate reliance on the end user's IT network. Alarms generated by the built-in functions of the PLC and HMI are pushed out as e-mails over the cellular network. "We have systems deployed all over the United States, and in a few foreign countries, and we never have to leave the office to support the controller," says Shamoon. "IDEC has made it easy for us to connect remotely, and the ability to connect to a faraway system saves us and our customers substantial amounts of money, while also providing much quicker response."

The HMI was programmed with accessible graphics and menus to make the Parker system easy to setup and monitor, with virtually no operator training required (Figure 2). The screens are self-explanatory, and Parker keeps certain screens password-protected so an operator does not inadvertently change a critical setting. The alarm log, data log and trend display features of the HMI are all utilized to provide information needed for troubleshooting and preventive maintenance. The entire automation system for control of up to eight boilers is housed in a 16"H x 16" W x 8" D enclosure (Figure 3).

Conclusion

Diverse Devices has had extremely good reliability with IDEC PLCs and HMIs, finding them to be compact and simple to use, but with the advanced programming features they need. The company has used IDEC PLCs and HMIs for machine and motion control applications. They like the straightforward interface provided by the Automation Organizer suite of programming tools, and appreciate that the tools are maintained and upgraded frequently at no charge.

Parker Boiler has sent a number of their employees to IDEC training classes to become familiar with PLC and HMI programming so they can support the control systems. "The nearby classes have provided tremendous value for us," says Greg Danenhauer, VP of Engineering for Parker Boiler. "We are now supporting our control systems and doing our own programming in-house. The ability to connect remotely has saved us thousands of dollars by minimizing the need to fly technical personnel to job locations."

The end result is a simple yet powerful control system that can be maintained and supported by Parker Boiler.

Figures

Figure 1, picture of four boilers in a Parker Boiler system. *Modular systems from Parker Boiler provide improved performance as compared to one larger boiler, as with these four small boilers.*



Figure 2, Control Panel Exterior. *The HMI interface provides intuitive control and monitoring of the boiler system.*



Figure 3, Control Panel Interior. *The entire control system including the PLC, the HMI and other ancillary components is housed in a small enclosure, saving money and space.*



Author Bio

Jack Heiser is the President of Diverse Devices, a system integrator located in Orange County, California and specializing in the design of solutions for connecting machines and processes to the internet. Prior to founding Diverse Devices, Jack worked for various industrial firms in a variety of engineering and management roles. He holds a Bachelor's Degree in Environmental/Environmental Health Engineering from the University of California Irvine, and has also done graduate studies in Lighting at Rensselaer Polytechnic Institute.