Boiler Facts

Smart controls for your hydronic heating system

by George Carey

Over the past decade or so, the hydronic heating industry has been using what are known as "stand alone" type controls. These controls were intended to moderate a specific application or purpose. Such applications would include resetting a single boiler with and without domestic hot water (DHW), controlling the firing and staging of a multiple boiler system, controlling a mixing device for a radiant system and providing control for the snow melt system.

All of these controls were designed for independent operation, but in larger residential and light commercial properties it has become commonplace—and often necessary—to have two or more of these "boxes" on the wall. In designing such a control package, it requires great detail to make sure that all of the controls are "rowing" in the same direction, not fighting with each other (even though they really don't "know" the others exist!).

These systems can be viewed as somewhat complex, and because of that, many frustrating hours have been spent in wiring, setting up the individual controls, troubleshooting them when an error message pops up and so on. This is not to say that these larger, more complex systems should not be designed or installed. In fact, these systems are becoming more prevalent in the higher-end residential homes. It's just that the controls need to be improved in order to better coordinate smooth operation of all the functions necessary for a properly operating heating and cooling system.

Recently, there has been an influx of new controls from various manufacturers in the industry that offer some very intriguing features—features that will lend themselves very favorably to these complex heating and cooling systems. Some of the controls will actually allow the service technicians to monitor the heating system, as well as make adjustments to temperature settings remotely from the customer's home. This is accomplished by the use of some form of a digital signal to communicate over phone lines with a modem or over the Internet with specific IP addresses, or by some other means of communication.

Of course, not all of this is that new. In fact, in larger commercial and institutional types of facilities (ie; hospitals, schools, etc.), maintenance personnel have been able to monitor and adjust hundreds of set point temperatures from a PC based operating system, either on the premises or remotely off-site for years. With such systems, it is quite common to control the fire sprinkler systems, security and lighting as well as running the heating and cooling systems.

What makes all of this possible in "our world" of high-end residential and light commercial mechanical systems are the technological advances that have occurred in the microprocessing arena. The increase in speed, size, power requirements and memory capabilities have all improved so that we can economically provide a control system that is very close to the more expensive Direct Digital Control (DDC) systems that operate in the institutional markets.

The communication that takes place between the controllers, the zoning managers and sensors is very different with these new controls. With the older "stand alone" controls, you would set a heating curve for each control. This heating curve would then be

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responsible for calculating the required water temperature for that given control under specific conditions. Each one of these controls would operate independently of the others.

The newer communicating controls operate differently. The water temperatures operate on individual "buses". For example, a larger system may have some high temperature baseboard or fan coil zones, a DHW load, a pool heating set point load and three differently designed radiant water temperatures. Each one of these water temperatures represents a "bus". On each "bus" there may be one or several dozen zones of that specific water temperature. This communication "bus" consists of a two-wire connection that runs between the devices on each bus. Each of these buses then terminates at the main controller whose function is to respond to the requests it has received from these buses. It may have to increase the water temperature coming from the boiler or speed up an injection pump to satisfy a call from a radiant zone or perform any number of functions it is capable of handling. But the response is coordinated, because all of these buses, though independent from each other because of different design water temperatures, are all on the network.

Also, each device on each bus has its own digital address. This is necessary for communication to take place in an orderly and integrated manner. When a particular device, for example, a communicating thermostat, calls for heat, the main controller receives this information over the two-wire bus; it needs to know which device the request is coming from. Then it acknowledges the request and sends out a signal letting the device know it has received its information and is responding. This two-way communication takes place all the time with the various devices on the heating and cooling network. In this manner, there is constant feedback occurring among the zones, so from the homeowner's point of view, every zone is maintaining its desired setting.

The information that flows back and forth through the communicating lines (buses) passes at a very high rate of speed. You can have some devices looking at information hundreds of times a second. Based upon how most heating and cooling systems work, this speed of communication is more than adequate to make sure all space temperatures are maintained.

Of course for all of this to work properly, every device must be a "communicating capable" device. This means the mixing devices, boiler controls, zoning devices and thermostats must have microprocessors aboard to support the necessary hardware and software needed to perform their functions. All of these components now exist in the marketplace.

[Editor's note: New wireless systems, including thermostats and steam valve sensors (to automatically detect leaks), can be retrofitted to older buildings to instantly convert them to digital control, without the need to rewire. Some wireless controls use so little energy they can be powered by ambient light and don't even need batteries.]

One of the many benefits of using this technology is the removal of redundant components. With a multi-control "stand-alone" application, it was not only common but necessary to run individual supply sensors, return sensors and outdoor air sensors back to each "stand-alone" control for these devices to function properly. But with these new communicating controls, because everything is on a network, they can all share the information provided, for example, by one outdoor air sensor. It is no longer necessary to run multiple redundant sensors throughout the house.

Another nice feature with some of these new controls is the ability to wire the outdoor air sensor to a thermostat that is located closest to the northern exposure, instead of having to run the two wires all the way back to the boiler room. Once the sensor is connected to a thermostat on the network, every other "smart device" can share it.

Another feature that is available with many of these newer controls is the ability to access the system over a "gateway". This could take the form of a home automation system where the gateway would allow the home automation people access to the heating and cooling system. A homeowner could then view temperatures and make adjustments through the touch screen pads provided by the home automation system.

Or maybe the people want to access their system over the Internet. This type of "gateway" can provide a unique URL address that could be accessed through any Web browser. Typically, a username and password would be required to gain access to the system. Once in, you would be able to view, adjust and monitor any of the temperature settings the system is controlling. Eventually, emails could be directed to service companies indicating system problems, perhaps even before the homeowners are aware of them.

These types of smart controls will become the "norm" over the next few years, so it would be wise to stay ahead of the curve regarding your knowledge and comfort level with this technology. If you have any questions or comments please call me at 1-800-423-7187 or email me at gcarey@fiainc.com.