Winter 2005

ARGUS CONTROLS

ARGUS ADVISOR

News for Argus Control System Owners

Argus After-Hours Support

Argus provides free emergency technical support 365 days a year, 24 hours a day. To ensure prompt support, first call:

1. Your Argus reseller/installer
2. Argus factory support

Our business hours are 8 AM to 4:30 PM, Monday to Friday, Pacific Time (a 3-hour time difference from the Eastern US).

Whenever you call outside of these times, or on a designated Canadian national holiday, you can either leave a message for non-urgent matters, or have an on-call Argus technician paged in an emergency. **After hours paging should only be used in an emergency.**

To have an Argus technician paged, call 1-888-667-2091 and follow the prompts. **When leaving a message, please state your name and contact number, and if possible, a brief explanation of the problem**. **An Argus service technician will return your call as soon as possible.** If parts are required, we try to forward them the next day or as soon as couriers are available.

At Argus, we are dedicated to providing the best customer support possible. So that we can continue to offer this level of round-the-clock support as a free service, we ask that you use after hours paging only for true emergencies.

Heating Control - Heat Distribution

Lucas Greenhouses

In the last Argus Advisor we discussed heat sources. Continuing our heating theme, this newsletter outlines methods and options for distributing heat.

Heat distribution is all about getting heat to where you want it in your process. In greenhouse production, this may include providing heat for both the above ground and below ground parts of crops as well as using heat to manage humidity. You may well require different temperatures in each production area, and different temperatures within a heated zone. Therefore, in determining which heat distribution mechanisms to use, you must first determine where you want the heat, and how critical it is to manage the temperature in these areas.

Take Control With Argus

Matching the Distribution Method to the Heating Requirement

To a large extent, heat distribution options are determined by the source of the heat and the medium that is used for heat exchange. Selecting the right distribution strategy for your needs depends on where and when you need the heat. For example, hot air distribution systems are good for general air heating while hot water heat distribution systems can deliver selective amounts of heat energy to a variety of sub-regions such as the root zone, plant canopy, and gutters. Both have their uses and limitations.

Hot Air Distribution Systems

US Botanic Gardens Production Facility

In most greenhouse operations it is not practical to have central distribution of heated air, so distributed unit heaters are used as heat sources. Poly tube duct systems are often used to help distribute the heat throughout the heating zone. These systems are simple, fast reacting, and relatively inexpensive. However, they may lack the ability to focus heat exactly where you want it, such as in a dense crop canopy or the root zone. Gas fired unit heaters are generally operated as ON/OFF devices since they usually only have the two control states: full heat and no heat. Multiple unit heaters in a zone are often operated as a single device. Occasionally they can be staged for variable heat output, providing they share common distribution paths. Otherwise, the heat distribution may be uneven.

Within the limitations of your equipment, the best way to achieve steady climate temperatures when using unit heaters is to cycle them on an off in sync with the natural process lags of the environment.

What do we mean by process lags? They are the delays between measuring the need for heat and actually getting it. All controlled systems have some process lag. In unit heater systems these include the time it takes to warm the heat exchanger, the time to move the heated air to the sensor, and the time for the sensor and control system to respond.

Once the target temperature has been achieved, there are additional delays in shutting off the flow of heat due to residual heat in the exchanger and distribution duct work. In systems that rely exclusively on feedback loops, such as simple controllers and mechanical thermostats, these delays can result in an unacceptable drop in the zone temperature before the heat is delivered, and an overshoot of the heating setpoint after the heaters turn off.

To minimize the temperature oscillations caused by process lags, your Argus system contains tuning settings to compensate for and even take advantage of these delays by operating the equipment cyclically, using the natural process time as a heating buffer. This can greatly improve the accuracy and uniformity of these on/off type systems, while saving energy and improving crop quality.

Hot Water Distribution Systems

Hot water is an excellent medium for storing and transporting heat. Compared to hot air ducts, you can move a lot of heat in relatively small pipes. With suitable piping and control equipment, heat can be delivered to precise sub-regions such as floors, benches, and beneath gutters for snow melting. For all this to work properly, you need a well designed distribution system. You also need good control coordination.

Unlike on/off heat systems such as gas-fired unit heaters, hot water heat energy can be proportioned to precisely match the current heat requirement. However, hot water systems tend to be much more complex, having inherently longer process lag times and thermal inertia. They also require higher capital investment.

Good design is critical for efficient operation. Water temperatures need to be managed at every stage of the system to achieve the best heating results, and to protect your equipment. Most boilers have a specified range of inlet temperatures for optimum safe operation. Too cold, and the boiler may be damaged by sudden temperature changes (resulting in warped or cracked heat exchanger components). Chronic low return temperatures can also corrode boiler components by producing unwanted combustion condensates.

Although some energy savings can be realized by condensing flue gases to recover the latent heat in the water vapor exhaust, sustained return temperatures below 60°C are generally to be avoided unless you have equipment that is specifically designed for this purpose.

Conversely, if the inlet water is too hot, the heat exchanging efficiency inside the boiler will be decreased. You may also run into problems with short cycling of the boiler. This can almost always be avoided with proper system design and appropriate automated control strategies.

Metrolina Greenhouses

You can use your Argus system to dynamically maintain hotter temperatures in the transport lines than the highest pipe temperatures currently required in the zones. Likewise, by modulating the pipe temperatures in the heated zones, it is possible to precisely match the amount of heat delivered to a zone with the amount of heat that is currently being lost. Sometimes the maximum pipe temperatures in the heating zones must also be limited to avoid damage to nearby crops or plastic piping.

In recirculating hot water systems, you also need to manage the return water. At the start of the evening, the heating zones may begin requesting heat when all they have to return is cold water. To protect your boiler, you can use the **Boiler Return Temperature Limiting** settings on the mixing valve that controls the boiler loop (see the last page of this newsletter for more details).

From a cold start, it can take a relatively long time to change the temperature of the water in the boiler, header, transport, and zone pipes. To overcome this problem, many well engineered hot water systems use buffering. Buffer tanks help decouple the making of the heat from transporting and delivering it to the zones. The buffer tank provides a reserve of available hot water for the distribution system, allowing the heating system time to catch up. This enables more effective and efficient operation of both the heating source and the distribution equipment.

Condensing flue gas recovery systems have an opposite requirement for return water temperature. They need inlet water that is *cold enough* to provide condensation of the water in the flue gases. Special design engineering and control is needed for these types of systems.

In a busy hot water heating system, the control equipment has a lot to do to manage the sometimes competing requirements of the crops and the equipment. In addition, mechanical provisions for alternate pathways and buffer storage must often be made in the system design. The challenge is to keep the design as simple as possible when including these features.

Steam Heating Systems

Hot water systems have now largely replaced steam systems in new installations. Steam distribution systems are more complicated to engineer since the condensate must be gathered by gravity and pumped back to the boiler. Steam is also more difficult to proportion compared to hot water. Whenever you try to restrict the amount of steam entering the zone distribution pipes, the smaller volume of steam will tend to condense and deliver most of it’s heat in the first few feet of piping. Therefore, steam is often best controlled by pulsing the control valves on and off.

Monitoring and Control

With any heating strategy, it is essential to understand the specific capabilities and limitations of your heating system. Depending on the complexity of the system, this can take a considerable amount of time to fully comprehend. An excellent way to help understand the dynamics of your heating system is to make full use of the **Alarm, Event Recording,** and **Data Recording** features of your Argus system. Not only can you monitor how your system is responding over time, but you may detect critical problems. This effort almost always pays handsome dividends through better crop quality and uniformity, more reliable equipment operation, and reduced fuel consumption.

Using Boiler Return Temperature Limiting

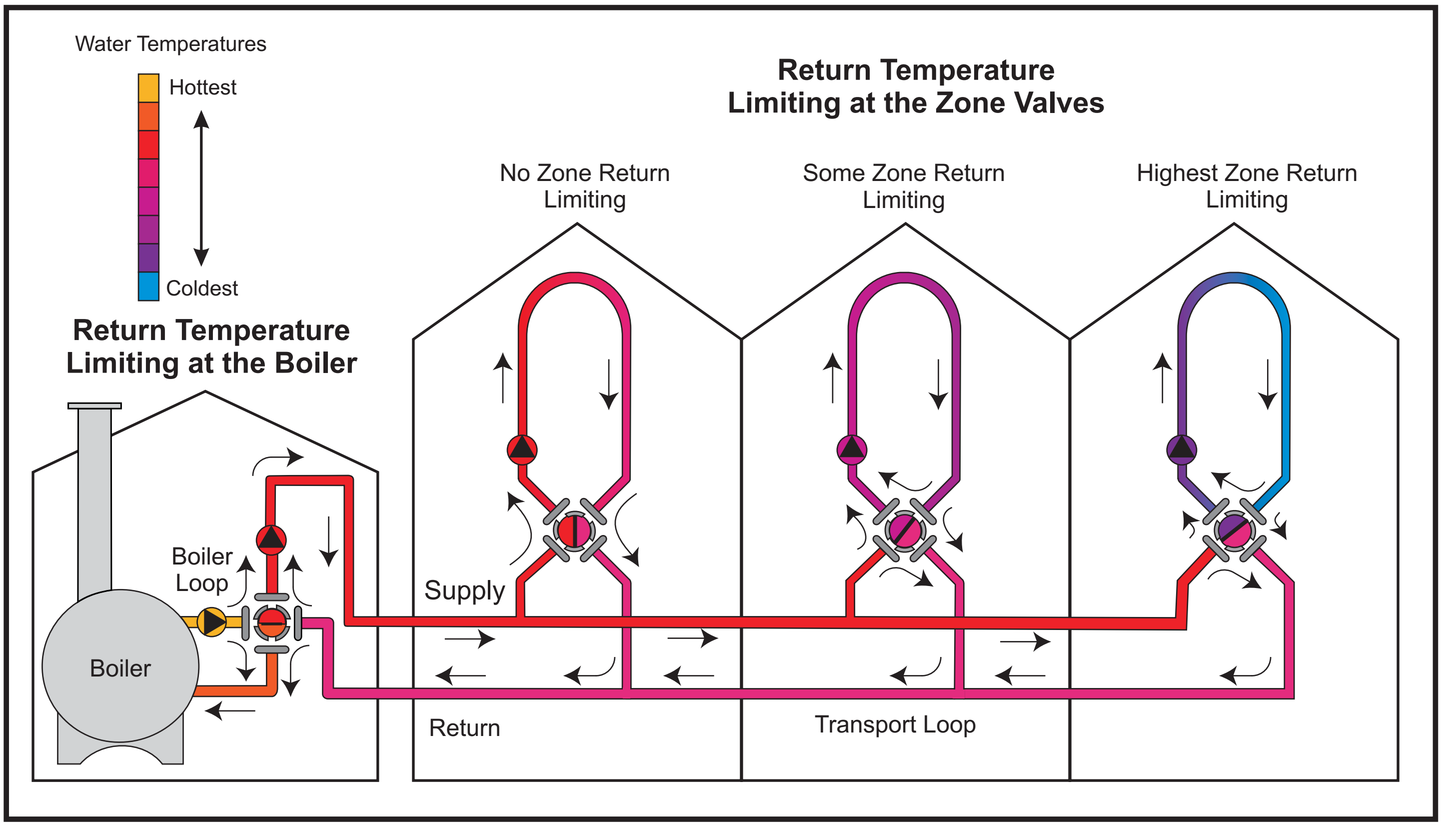
The Boiler Return Temperature Limit settings found in Argus **Mixing Valve** programs are used to restrict the volume of water returning to the boiler whenever the measured return temperature falls below a designated value. You can use them in two ways:

1. **Boiler Protection** - the Argus system will automatically limit the volume of water returning to the boiler whenever the return temperature falls below a designated value. A reduced amount return water will help prevent boiler shock and unwanted condensation on the heat exchanger surfaces. For this type of protection, return temperature limiting is used on a mixing valve that is installed between the recirculating boiler loop and the distribution header or transport line. It's important to note that for this feature to work as intended, proper design of the heating system is necessary, including adequately sized boiler recirculation pumps.

2. **Zone Heating Priority** - Sometimes the heating system may get behind on the heat demand. This often happens at the start of the evening, when the water in the zone piping is relatively cold, and all of the zones begin requesting heat at the same time. To get heat, they have to return all that cold water back to the boiler.

Since it will take the heating system some time to catch up, you can use the return temperature limit settings to temporarily divert limited heating resources to zones that need it the most. To do this, **set the lowest return limit temperatures (or no limits at all) for the zones that need the most heat**, and higher return limit temperatures for lower priority zones.

As the heating system recovers, the limits are automatically relaxed so that all of the zones receive the heat they need. By using return limits at each zone, you'll also help reduce the volume of cold water that is returned to the boiler. However, it's important to remember that for full boiler protection, you need to use return limits on a recirculating boiler loop that is isolated by a transport mixing valve as shown in the diagram below.



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