C.E.R. TECH NOTES

Controlled Environment Room Technical Application Newsletter

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Design and Application Issue:
Limit Control Application In Controlled Environment Room Design

Product loss and unrecoverable schedule delays are certainly damaging to any enterprise, be it private or public. Proper design and application of limiting devices in the CER control system can reduce your risk of loss from equipment or device failure.

The job of the controlled environment room (CER) is to protect what's inside the room from the prevailing conditions outside the room. In order to perform as intended the CER has substantial capacity to change the room conditions. Under normal operation this works to your advantage, but if uncontrolled, as in the case of a malfunction or other failure, the same capacity that normally protects the stored materials can act quickly to destroy them. Secondary hazards from uncontrolled equipment activity include flooding (bursting of frozen water lines, activated sprinkler heads), fire, and self destruction of the CER conditioning system. Only a small portion of the costs associated with equipment malfunction will normally be attributable to CER equipment repair. The major cost will be in lost product and schedule setbacks.

A limit control is not an alarm. An alarm alerts you that something has already happened. Limit controls are designed to take action, preventing abnormal activity and preventing or limiting damage and loss. A limit control may provide an alarm as an ancillary function, but is primarily a safety device.

In determining the appropriate scope of limit control activity, the design professional must examine the intended function of the CER and identify the range of potential failure modes. Next, evaluate the effect of each possible failure on CER equipment operation and the product within the controlled space. Advise the client about the range of limit control functions available for the proposed system and the benefits and risk reduction achieved by each function. Once the required level of protection has been mutually established, search for a manufacturer that can provide what is needed. There is a wide array of safety device implementations in the CER marketplace, with each manufacturer offering its own mix of functions and price points. It is incumbent upon the design professional to determine what arrangement of safety devices and functions will best serve the needs of the client.

Here are some basic principles to use in developing and evaluating a suitable limit control strategy:

(1)Always use a separate device dedicated solely to limit control activity. Do not use the same device which controls the process, such as the room temperature, as the limiting device for that process. A failure in the controlling device may prevent the limit activity from executing at a critical moment.

(2)Limit controls should have their setpoint dials or buttons protected from tampering by inexperienced or uninformed operators. The limiting device should be properly set when the system is commissioned, or when a process condition, like the room temperature, is changed. An improperly adjusted limit control will not provide the desired protection.

(3)Each limit control should have its own sensor, independent of all others. The sensor should be located at the point which will provide the earliest indication of the condition the limit control is designed to protect against. A simple illustration of this is locating the high temperature limit sensor at the warmest part of the chamber.

(4)The limit control should use a different method from the primary controller to stop a process that is no

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More on applying limit controls to controlled environment rooms.

longer under control. There may be a malfunction or failure in the primary controller device train that will also prevent the limit control from stopping the runaway process.

This last principle is often violated in CER design in an effort to reduce cost, and can produce some notable results. Consider a cold room at +4°C which utilizes a refrigerant solenoid valve to start and stop flow in the liquid line (the cooling function). A simple way to incorporate a freeze protection limit control would be inserting a limit controlled relay in series with the solenoid control signal. If room temperature gets too low, the limit controller will open the relay, de-energizing and closing the valve. This scheme initially appears acceptable. It is simple and inexpensive to implement. However, merely opening (turning off) the control signal to the valve is not a dependable method to stop a cooling system which is not responding to the main controller. This is because the failure of the main controller to maintain the room temperature could be due to a mechanical failure of the control valve that prevents it from closing. This limit control arrangement will protect against failure of the main temperature controller, but not the more common mechanical failure of the control valve. A more effective implementation of a limiting device to stop out-of-control cooling is to circuit the limit controlled relay in series with the compressor contactor coil. The limit controller can then open (break) the control signal to the compressor contactor, stopping the machinery which provides cooling.

Technical details aside, the time invested by the design professional and client in evaluating the proposed limit control strategy will pay dividends throughout the life of the equipment. Take time to understand what the limit control scheme will accomplish, and more important, what it will not. Knowing where the risks are, which situations and events can result in damage or loss, will allow you to develop response strategies for emergency situations not effectively handled by the CER control system.

How do you wade through all the technical detail involved with a solid analysis of a limit control scheme? If you are unfamiliar with control technology and application, communicate your concerns regarding safety and product protection to a prospective vendor. Ask for a presentation of the strategy the vendor will use to minimize your risk of loss. Make it incumbent upon the prospective vendor to explain any proposal in language you can understand. Make sure you are satisfied before you proceed with implementation.

Hopefully, you will never need your limit control action but, if correctly designed and installed, it will be in place, ready to save your product and your time.

Insert this document in your Climate Technologies Design Guide binder for future reference. Need a binder? Call our office. We will send you a registered binder that will assure that you receive our latest information.

Future Topics:

The Case For Tighter Temperature Control, Part 2

Documentation Requirements For Controlled Environment Rooms

Risk Management: Refrigerated Storage of Critical Materials