C.E.R. TECH NOTES

Controlled Environment Room Technical Application Newsletter

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Design and Application Issue:

The Benefits Of Enhanced Control Design For Systems With Redundant Cooling

There are many instances where the material to be stored in a new walk-in freezer or cold room is so valuable that a redundant cooling system must be included in the design. Beyond the basic premise that the design will include "two of everything that cools" , what features should be included in the control and mechanical system specification to get the maximum benefit from the additional cost of a redundant cooling system? The table below can serve as a guide.

FEATURE	BENEFITS
Equipment monitoring by analog sensing devices that provide a continuous signal corresponding to a primary indicator of unit performance. Switch type devices with integral setpoints are not as desirable since they only indicate two conditions (above setpoint or below setpoint). Analog devices provide a continuous signal that varies with the condition being monitored. The use of analog input devices allows alarm setpoints to be adjusted at the operator interface instead of the switch device which is installed remotely on each piece of equipment.	Earliest detection of equipment malfunction or failure that will precede room temperature rise. Detection of events that are precursors to a temperature rise allows for maximum response time to potentially damaging condition. Indicate need to service equipment by detecting equipment performance or operation outside of established "normal" range. Multiple alarms or devices can utilize the same input signal for indication of different conditions.
Operator selectable alarm parameters that can be related to any input to the control system. Parameters include high and low setpoint, time delay prior to annunciation, and automatic predetermined responses to be executed without operator intervention to minimize the risk to the stored materials.	Automatic responses executed within a limited time period after alarm detection reduce the incidence of human error in detecting and responding to alarms. More types of alarms for temperature and equipment performance can be utilized, each with a different trigger and response level.
Selectable automatic alarm responses that include changeover to back-up cooling unit, terminate active defrost cycle, sound audio alarm, transfer remote relay contact, change state of any system output, and/or activate back-up controller circuit.	Allows operator to customize the alarm response to best meet changing application or procedural requirements. Provide a means to quickly avert a loss due to equipment malfunction or failure.
Sequential defrosting of multiple evaporators on a single cooling system.	Drastically reduces room temperature rise associated with heat gain from defrost activity, minimizing product risk.
Monitoring defrost cycle performance and indicating abnormal cycle progression. Indication should provide identification of the evaporator that did not properly execute the defrost cycle.	Provide indication of defrost scheduling or setup that does not match the usage of the room. Provide indication of defrost control device failures.
Flexible *defrost cycle scheduling*. Control should include ability to initiate defrosting at preselected real times, fixed time intervals between cycles, cooling system changeover, or in response to an operator command.	Allows the operator to schedule defrost cycles in a manner which best accommodates the way the room is utilized. Cycles can be scheduled around times of heavy usage. Manual initiation provides direct control.

more on.....Benefits Of Enhanced Control Design For Systems With Redundant Cooling

FEATURE	BENEFITS
Fully coordinated defrosting that will be automatically executed in the correct sequence, regardless of the current equipment operating mode. Defrost control adjusts to accommodate automatic system changes.	Operator intervention not required to maintain the benefits derived from enhanced system capabilities. System maintains normally expected performance, even if one cooling unit has failed or both are operating simultaneously.
Multiple defrost termination events, including elapsed cycle time, evaporator temperature, alarm occurrence, maximum allowable room temperature, or operator command.	Provides back-up control for the normal termination sequence. Reduces the heat gain to the room if alarm occurs. Strictly limits temperature rise in room during defrost. Allows operator to manually control defrost.
Redundant temperature control circuit with its own input and output devices that can be automatically switched to the primary control position in response to an alarm or operator command.	Provides a solution for several possible control circuit failures, including sensor break, processor malfunction, output switching device failure, or improperly adjusted setpoint on the primary.
Well configured *operator interface* with text display of alarm conditions and current operating mode of equipment.	Provides clear information about system status. Reduces need to review printed manual. Reduces complexity of control panel face. Fewer switches and pilot lights.
Separate electrical circuit protection for each cooling system and the equipment elements within each system. Each evaporator has its own circuit with disconnecting means and supplemental circuit protection.	Reduce the probability of an electrical fault in an element of one system from disabling the operation of the otherwise functional backup unit. Provide a means to disconnect one system, or part thereof, for service while maintaining the balance of the equipment in operation.
Robust, flexible *cooling system operation scheduling and selection*, with automatic system selection coordinated with defrost and operational status of all units. Provide ability to manually initiate system changeover at the operator interface.	Automatically alternates operation of cooling units to maintain same total operation hours on each unit. Back-up unit is regularly and fully tested. Avoid temperature failure due to incorrect detection of cooling system equipment failure.

While some of the items in the table may appear overly technical in nature, keep in mind that each has a direct impact on long term maintenance of a stable temperature for the stored materials. Each of the listed features included in the design will have an identifiable element of risk reduction which directly relates to product or equipment protection. A control system incorporating the features described above will help maximize the benefits attained from a redundant cooling system. The highest level of product protection is achieved through implementation of enhanced control functions, and risk reduction provided by such a system delivers a payback every day it is in operation .

Effective implementation of the features listed in the table requires careful coordination of the various control system functions . The designer must take care to insure that control activity associated with one operational aspect does not negate benefits to be derived from another system function. When considering vendors for this type of system, a list of previously completed projects *employing the system proposed for the current project* can be a good indicator of successful design implementation. Avoid special, custom, or "first time" designs which have no proven track record.
