

Case History: Enhanced Monitoring Averts Freezer Meltdown

Everybody can benefit from the experience of others. CERTS strives to help manufacturers and owners of controlled environment rooms create a better industry by sharing their stories of how things went well, or not so well. In either case, there is always something to learn and apply to our own endeavors. If you have a story to share, contact tom@CERTS-US.com.

A biotechnology company purchased a walk-in freezer to be utilized as a repository for its client's temperature sensitive material. The repository was part of a high profile services contract involving clinical trials in pursuit of FDA approval for the client's product. The stored material must be maintained below -18°C at all times. Due to this sensitive nature of the stored product, as well as the potential for enormous loss of time and money in the case of equipment failure, the company indicated that backup mechanical refrigeration was to be part of the design.

During the design phase of the project, it was recommended that enhanced equipment performance monitoring be added to the minimum essential requirement to expand on the potential benefits derived from the backup mechanical refrigeration system. The company, after assessing the potential reduction in risk that could be achieved with the added hardware, agreed to the modification. The final purchase included the enhanced monitoring and the system was put into operation. The full advantage of

the computerized system was utilized to minimize the defrost temperature rise and provide a wide range of detection and responses to various forms of system malfunction.

The monitored items included freezer temperature, primary controller setpoint, compressor motor current, fan motor current, suction pressure, and discharge pressure. Several of the items monitored had multiple alarm points with differing setpoints, time delay filtering, and predetermined response.

The freezer environmental profile exceeded the requirements, with temperature uniformity of 1.0°C measured with 32 thermocouples placed throughout the room. Temperature control at any single point in the room varied by less than 1.0°C from highest to lowest measured value over a 24 hour period. Temperature increase in the room during defrost cycles was almost undetectable. The end-user was pleased.

During the first 3 months of operation, the client indicated that there was a loud noise emanating from somewhere inside the freezer at regular intervals. Several visits by a warranty service technician failed to identify the problem because the sound never occurred while the technician was present. There was no apparent evidence of malfunction and the temperature performance equaled the original test results. At a later time, the monitoring system began to generate an alarm indicating fan motor current was measured outside its normal

operating range. The freezer room had 6 evaporators, each with its own fan motor. The client reported the alarm under the warranty service agreement, and this information allowed the service technician to focus on the fans as a possible source of the noise problem. Now there were two pieces of information, noise and high motor current, which may have a connection. In the end, through some follow-up research, it was determined that the fan motor manufacturer had changed lubricants. The new lubricant was not suitable for use on a motor in the low temperature environment unless the motor remained warm, as it would in a more standard walk-in freezer application without redundant cooling. When the control system executed a changeover from one cooling system to its twin, the motors that had been idle for several hours at -20°C had cooled sufficiently to harden the lubricant and retard its lubricity. When the cold motors were started, they would often screech and rotate slowly until the lubricant heated enough to start flowing. The motors were replaced with a different type and the problem has not recurred.

The previous example illustrates how enhanced monitoring can assist in maintenance by alerting the operator when major components operate outside of their commissioned values. This same freezer experienced another malfunction that could have had a devastating impact on the company's contracted work, had it not been for



the early detection of failure by the enhanced monitoring system.

During the ninth month of operation the client reported the annunciation of a warning message on the system related to low refrigerant suction pressure. This particular alarm was intended to alert the operator if the suction pressure fell slightly below the design point. The system design provided only a small fluctuation in suction pressure, so the alert point was set very close to the operating point.

The responding technician indicated, as did the client at the time of the originating call, that the room temperature was as it always had been. There was no indication of trouble evidenced by the freezer temperature. The cooling system seemed to be operating normally, with pressures within the expected range. Suspicion turned on the suction pressure sensor. Lacking any obvious sign of malfunction, it was thought that the sensor might need calibration and was providing a false reading. The technician did not have the means on hand to calibrate the pressure sensor, so the alarm was reset and the client was told to reset the alarm if it occurred again and call if any alarm messages other than the original one for suction pressure appeared. A new pressure sensor was ordered for installation, to see if a newly calibrated unit would cure the problem.

A few days later the end-user called and indicated that the *second* layer of suction pressure alarm was annunciating. This second alarm was intended to alert the operator of a suction pressure level too low to provide adequate cooling capacity, likely due to loss of refrigerant. The automatic system response to this alarm was to changeover to the backup refrigeration system and

prevent the failed system from being called into service until it was repaired. There was still no problem evidenced by the temperature of the room. Displays and recorder charts indicated that the room performance was the same as always.

The service response team found a small refrigerant leak in a very unusual location, but a leak nonetheless. The leak was repaired, the alarms reset, and the held out cooling system put back online without shutting down the freezer, disturbing or moving any stored product, or generating any events that would endanger the stored product.

This case shows how properly investing in some control enhancements can reduce your risk of loss by calling attention to problems with the equipment before they may even be evident to the end-user. There are other articles available from CERTS that provide additional guidance on how to incorporate these enhancements into your controlled environment room project.

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