



Energy Efficiency & Customer Research & Development Technology Brief...CoolTrol®

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Background

Here is a riddle for you: They work 24 hours a day, 7 days per week, 365 days per year. They never sleep or take a vacation. Their performance is critical to the survival of the businesses they serve, and yet they are often overlooked or taken for granted. What are they? Walk-in coolers and freezers! These 'silent servants' can account for a whopping 50 percent of the overall electrical energy consumption for small food and liquor stores.

This technology brief focuses on the National Resource Management's (NRM) refrigeration control system known as CoolTrol®. Local testing has shown that CoolTrol may reduce overall electrical energy costs by as much as 24 percent.

What is CoolTrol?

CoolTrol series control systems are designed to reduce energy costs by optimizing the operation of walk-in coolers and freezers. Although CoolTrol is relatively new to the West Coast, NRM states that over 3,000 systems are in use throughout the country at more than 2,500 locations. For more information, please visit NRM's website at: <http://nrminc.com/products.html>. According to NRM, CoolTrol offers the following:

- ❑ **Cooler & fan control:** Walk-in coolers and freezers usually have multiple evaporator fan motors that run continuously. CoolTrol can shut off the fans when the refrigeration system is off and has a setback feature. Result: Reduces evaporator fan energy consumption by 25 to 60 percent and reduces refrigeration compressor run time.
- ❑ **Door and frame heater optimization:** Most systems use electric resistance heaters within the doors and around the doorframes to prevent doors from sticking shut and problems from condensation. These electric

strip heaters typically operate continuously. CoolTrol measures the dew point within the store and adjusts the amount of heater power needed. Result: CoolTrol reduces run time of the heaters by 60 to 90 percent

- ❑ **Smarter defrost cycles:** Refrigeration systems often use time clocks to initiate defrost cycles. These cycles are often more than what is needed and result in wasted energy. CoolTrol uses evaporator coil temperatures and compressor run time to determine when and how long defrosting is required.
- ❑ **Energy efficient evaporator fan motors:** NRM's evaporator fan replacement motors use ECM (electronically commutated motor) technology and are up to 70 percent more energy efficient than the shaded-pole and PSC motors typically used in walk-in coolers and freezers.



Evaporator fans

- ❑ **Cooler shut down during loading and stocking:** A push-button control allows the refrigeration system to be shut off for 20 minutes during deliveries and while employees are stocking shelves. This saves energy and provides a more comfortable work environment.
- ❑ **Alarms:** A strobe light flashes when high or low temperature limits are exceeded in the cooler. This helps prevent product spoilage by alerting the storeowner of problems with the refrigeration system.
- ❑ **Novelty cooler shut-off:** CoolTrol has a scheduler that may be programmed to turn off freestanding 'Visi Coolers' with non-perishable products (such as soft drinks) when the store is closed.
- ❑ **Data logging:** System tracks the temperatures and equipment run times. This information may be used to assess performance and energy consumption.
- ❑ **Service bypass:** Users and technicians may bypass the CoolTrol system while servicing the cooler. This feature also prohibits technicians from disabling the system.

Demonstration Project Results

SMUD provided research grants for six CoolTrol demonstration projects in 2005 - three food and liquor stores, a health food store, an independent grocery store and an agricultural warehouse. A summary of six months of billing data for the first four sites is shown in Table 1 below. Since the latter two sites were installed in November 2005, usage and savings data is not yet available. A follow up report for these two sites is tentatively planned for October 2006.

Table 1: Summary of six months of billing data for four CoolTrol sites

Project site	kWh consumption*		Total kWh savings	Reduction in kWh consumption (%)
	2004	2005		
Food & Liquor Store #1	58,613	44,332	14,281	24.4%
Food & Liquor Store #2	67,740	56,280	11,460	16.9%
Food & Liquor Store #3	67,761	65,224	2,537	3.7%
Health Food Store	86,760	78,000	8,760	10.1%
Totals	280,874	243,836	37,038	13.2%

*Total kWh consumption for May through November. Source: billing data

It should be noted that the kWh reductions shown above are for the *entire site* – not just the refrigeration system!

The refrigeration system at Food & Liquor Store #3 was malfunctioning during at least four months of the monitoring period. The problem was not related to CoolTrol and has been corrected. In fact performance data collected by the CoolTrol system was used to help diagnose and correct the problem. Afterwards, CoolTrol was programmed to run in the bypass mode every other day for fourteen days (October 24 to November 6, 2005). CoolTrol's on-board data collection system was used to collect run-time data for various refrigeration system components. The results of the monitoring are shown in Table 2.

Table 2: Results for fourteen-day on/off test at Food & Liquor Store #3

Operating mode	Evaporator Fan Run Time	Compressor Run Time	Door Heater Run Time
CoolTrol in Run	67%	51%	42%
CoolTrol in Bypass	100%	56%	100%
Reduction in run time	33%	5%	58%

This same type of test was performed at the other two food and liquor stores and the health food store during the month of August. Results:

Component	Reduction in run time
Refrigeration compressors	5 to 19%
Evaporator fan motors	22 to 44%
Door and frame heaters	35 to 73%

Financial Summary

The calculations below are based on the average monthly savings during the past six months and assume no rebates or financing costs. Once again, the savings for Food & Liquor Store #3 appear to be quite low due to the malfunction discussed earlier.

Table 3: Financial summary for four CoolTrol sites

Project site	Project cost (\$)	Estimated annual savings (\$)	Simple payback (yrs)
Food & Liquor Store #1	\$5,304	\$2,685	2.0
Food & Liquor Store #2	\$8,141	\$2,294	3.5
Food & Liquor Store #3	\$3,593	\$467	7.7
Health Food Store	\$6,893	\$1,638	4.2

Estimated annual savings = average actual monthly savings x 12

Recommendations

Based on the information collected during this demonstration project, CoolTrol has the potential to save significant amounts of energy (and money) for customers who use walk-in coolers and freezers, such as food and liquor stores. However, CoolTrol may face some challenges:

- Experience has shown that small commercial customers will seldom invest in energy conservation measures that have a payback longer than one year. Significant utility rebates and low interest financing may be required for customers to make the initial investment.
- NRM needs to develop a West Coast presence by establishing relationships with local contractors to handle installation and service.
- California's population is diverse and speaks at least 120 different languages. During the pilot project, we experienced difficulty communicating with several storeowners. NRM's staff will need the ability to effectively communicate with all customers before, during, and after installation.

Addendum (11-7-06): CoolTrol has now been accepted into SMUD's commercial rebate programs.

SMUD's Customer Advanced Technologies program works with customers to encourage the use and evaluation of new and underutilized technologies. For more information, please visit: www.smud.org/education/cat/index.html

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