

*Customer Advanced Technologies Program
Special Report*

Operation: IDEC System Rescue



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Table of Contents

<i>Introduction</i>	1
<i>Abstract</i>	1
<i>Background Information</i>	1
<i>ABC School's Call For Help</i>	2
<i>SMUD's Response</i>	2
<i>The Team's Findings</i>	
□ Air Distribution System.....	3
□ Water Distribution System.....	4
<i>The Solutions</i>	5
<i>The Results</i>	5
<i>A Very Satisfied Customer</i>	5
<i>Final Thoughts</i>	5

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Introduction

SMUD's Customer Advanced Technologies (C.A.T.) program works with customers to encourage the use of and evaluate new or underutilized technologies. The program provides funding for customers in exchange for monitoring rights. Completed demonstration projects include lighting technologies, light emitting diodes (LEDs), residential building shell construction, geothermal heat pumps, indirect / direct evaporative cooling, non-chemical water treatment and a wide variety of other technologies.

Abstract

We all know that proper maintenance of heating, ventilation and air conditioning equipment is important. This is especially true for indirect / direct evaporative cooling (IDEC) systems. In addition, building owners and contractors often overlook other equally important steps: ensuring that designs are correct, inspecting contractors' installation work and commissioning the completed systems. Mistakes that are not found and corrected during design and installation can lead to poor system performance and make maintenance a nightmare. This report focuses on the IDEC system installations at Applied Behavior Consultants (ABC) Inc., which operates a school for children diagnosed with Autism (see insert).

Background Information

When the plans for the ABC School in Sacramento were being developed, Administrators wanted to incorporate technologies that were both innovative and environmentally friendly. This commitment was evident by their decision to use straw-bale construction for the exterior walls of the school.

After carefully considering several air-conditioning system options, they chose to install indirect /direct evaporative cooling (IDEC) units for the classrooms. IDEC systems were deemed to be a good choice, since they are extremely efficient and offer numerous other benefits¹. The plans were finalized, the systems were selected, and the construction phase began.

During the installation of the IDEC systems, the mechanical subcontractor declared bankruptcy and

About ABC

Applied Behavior Consultants (ABC) is a human services agency dedicated to improving the lives of individuals with special needs and developmental disorders by the use of Applied Behavior Analysis principles informed by B.F. Skinner's philosophy of 'Behaviorism.'

ABC specializes in the **Intensive Behavioral Treatment (IBT)** of individuals diagnosed on the Autism Spectrum, in-home and/or in our non-public school (NPS). Our goal for each person is a more effective, independent and improved quality of life.

ABC was founded in 1987 by Joseph E. Morrow, Ph.D., and Brenda J. Terzich, M.A., to provide Applied Behavior Analysis services for persons with special needs. They began by providing in-home behavioral services to the developmental disabled population throughout northern and Central California. This included group parent training and behavior consultation to Community Care Facilities.

ABC has provided behavioral services for over 3000 clients. Along with the continuation of these services, ABC opened its first classroom for children diagnosed on the autism spectrum in 1994. Currently, they provide services for three Regional Centers, over 40 School Districts and 16 Community Care Facilities. Present Autism services include 70 intensive behavioral treatment in-home programs and about 90 students in our two schools. ABC is based in Sacramento and provides services throughout California. For more information, please visit www.abcreal.com

¹To learn more about IDEC systems, please visit the following links: http://www.adobeair.com/coolers/evap_cooling.htm
<http://www.adobeair.com/coolers/mastercool.htm>

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walked off of the job. ABC was ultimately forced to hire another subcontractor to complete the IDEC system installations. Unfortunately, this change may have opened the door for several installation oversights. These mistakes would later contribute to severe operational problems.

ABC School's Call for Help

In late June of 2002, SMUD received a call from Mr. Ron Sandell, Director of Business Services. According to Mr. Sandell, "The classrooms were unbearably hot and humid. Temperatures inside the classrooms were above 85°F and the relative humidity was over 80%. We were forced into actively considering replacing the IDEC units with more conventional systems. I decided to call SMUD for advice."

SMUD's Response

SMUD responded to ABC's request by sending James Mills, an Energy Specialist II in the Commercial Services group, to the site to assess the situation. According to Mr. Mills, "The IDEC systems were in poor shape. The evaporative media were completely covered with scale and Cottonseed tree lint." ABC's staff was very surprised by the condition of the units, since they already had a maintenance contract in place. They immediately directed their contractor to remove the scale and clean up the systems. After the scale and lint were removed, the systems worked somewhat better, but still could not handle the cooling load requirements. Mr. Mills contacted SMUD's Customer Advanced Technologies program staff to discuss the situation and to jointly develop a strategy to assist ABC.

SMUD implemented a team approach to identify and correct the problems:

- ❑ An experienced HVAC contractor was dispatched to assess the physical condition of the IDEC units and make any needed repairs.
- ❑ An engineering firm was hired to:
 - 1) Review the design and specifications
 - 2) Analyze and evaluate the performance of the installed systems
 - 3) Develop a list of recommendations to maximize system performance and efficiency
- ❑ SMUD trained ABC's maintenance staff to perform routine maintenance and oversee any future contracted maintenance activities.

Team Members

Ron Sandell, ABC School
Garth Daniels, ABC School
Jeff Miller, Davis Energy Group
Sherm Grady, ProAir Heating & Air Conditioning
James Mills¹, SMUD
Dave Bisbee, SMUD
¹ Project Team Leader

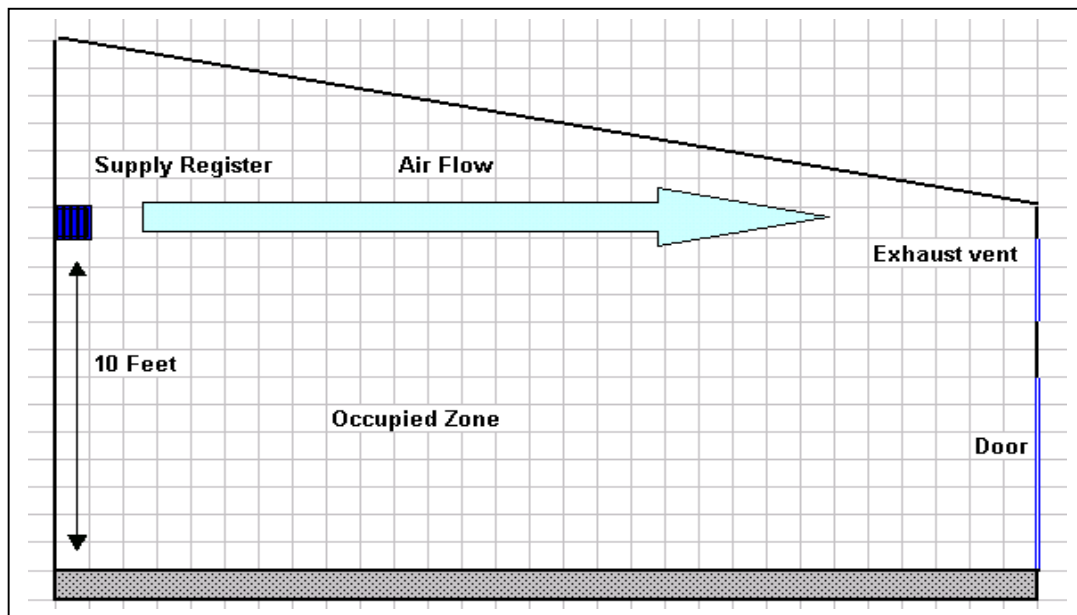
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The Team's Findings

The team identified a wide variety of problems. According to Mr. Mills, "It was like unpeeling the layers of an onion!" Problems included the air distribution system, water distribution system, failed and missing components, and mistakes made during installation. A more detailed summary of the findings is presented below:

Air Distribution System:

- Since the IDEC units were mounted on the roof, most of the ductwork was exposed to direct sunlight. When the outside temperature was 100°F, the measured surface temperature of the ductwork exceeded 150°F. *This added a considerable amount of heat to the air being supplied to the classrooms.*
- The supply air duct registers were located approximately 10 feet above the floor. The exhaust vents were located above the entrances to the classrooms. *Because the supply air was not directed downward, most of it completely bypassed the occupied portions of the classrooms* (refer to the diagram below).



- Several of the exhaust vent damper assemblies were partially or fully closed. Although they were designed to operate automatically (based upon barometric pressure), the airflow was not sufficient to fully open the dampers.
- Although the units were equipped with adjustable sheaves and two speed blower fan motors, the amount of air supplied to the classrooms was insufficient to meet the cooling load requirements.

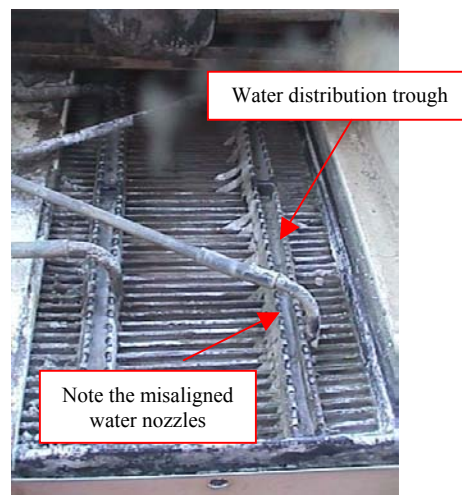
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- The indirect evaporative cooling assemblies were mounted onto the main blower compartments. Unfortunately, there was a 1/2” gap between the indirect and direct stages on several of the units. *These gaps allowed a significant amount of air to completely bypass the indirect cooling stage and greatly reduced the overall cooling capacity of the units.*

Water Distribution System

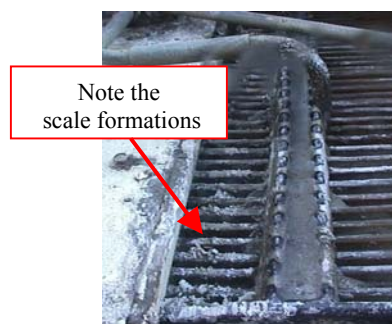
- The water in the indirect cooling stage is pumped from the basin through tubing into two water distribution ‘troughs.’ From there the water is supposed to be evenly distributed over the evaporative cooling media.

Several of the water distribution nozzles were misaligned and were not delivering the water into the water troughs (see photo). Consequently, water was being distributed over an extremely limited portion of the evaporative cooling media. *This dramatically reduced the cooling capacity of these IDEC units. In fact, the water troughs for one IDEC unit were completely missing.*



- One of the IDEC units had a defective circulation pump—and, as a result, *this unit’s indirect evaporative cooling stage was completely inoperative.*
- The IDEC units had significant problems with scale. Most of the scaling was due to the lack of provisions for water bleed or blow down.

Whenever water is evaporated, most of the impurities contained in the water are left behind and fall back into the basin (or sump) of the unit. As this process is repeated, total dissolved solids becomes very high and scale forms easily on the heat-transfer surfaces of the direct and indirect stages.



According to the manufacturer’s installation guidelines, these units are supposed to be equipped with controls to periodically or continuously bleed off water from the sump. The water that is bled off is replaced by incoming water (i.e. make-up water). These controls help reduce the hardness of the water within the sump and reduce the formation of scale. *None of the IDECs were equipped with bleed controls.*

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The Solution

The Team implemented the following corrective actions:

- ❑ IDEC units were thoroughly cleaned
- ❑ The exterior of the exposed ductwork was treated with heat reflective coating
- ❑ Supply registers were adjusted to direct the supply air downward into the occupied zones of the classrooms
- ❑ Blower fan motor sheaves and motor speeds were adjusted to provide optimal airflow
- ❑ The gaps between the indirect and direct evaporative cooling stages were sealed with mastic
- ❑ Exhaust damper linkages were lubricated
- ❑ ABC Staff were trained to periodically check the exhaust dampers to ensure that they are fully open whenever the IDEC units are in operation.
- ❑ Water distribution nozzles were adjusted to deliver the water into the distribution troughs
- ❑ Missing water troughs were replaced.
- ❑ A faulty water circulation pump was replaced
- ❑ Units were equipped with water bleed (i.e. blow down) controls
- ❑ ABC Staff were provided with training regarding basic system operation, routine and seasonal maintenance requirements

The Results

During the month of September, the revamped IDEC units were put to the test when the outside air temperatures in Sacramento reached over 100°F. According to Mr. Sandell, “The comfort level in our classrooms improved dramatically! During this latest heat wave, the average indoor temperature was 74°F and the relative humidity levels were between 55% and 60%.”

A Very Satisfied Customer

Prior to consulting SMUD, three air-conditioning companies had told ABC that the problems with the IDEC units could not be resolved, and that they would need to replace the units at a cost of \$150,000-\$200,000. Today, Mr. Sandell is very satisfied with both the IDEC units and SMUD. “Our company is sincerely appreciative of SMUD’s efforts. We now see SMUD as a very community-service oriented company that has helped our company both eliminate unnecessary air-conditioning unit replacement as well as significantly reduce our electricity usage by fully utilizing the IDEC units.”

“The time, effort and cooperation that were contributed by Mr. Mills have been absolutely outstanding.”

-Ron Sandell, ABC School

Final Thoughts

Recent advances in technology have made IDEC systems an energy efficient alternative to conventional air-conditioning systems for many applications. However, care must be taken to ensure that the units are properly installed and maintained. For more information about this project, please contact James Mills at jmills@smud.org or Dave Bisbee at dbisbee@smud.org

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