UC/CSU Sustainability Conference
Santa Barbara, 2006

Best Practices Awards Program
A program created by the UC/CSU/IOU Energy Efficiency Partnership Program, and funded under the auspices of the California Public Utilities Commission
Best HVAC Design
Sonoma State University
Keith Dunnivant, PE, Regional Sales Manager
Des Champs Technologies
PROJECT DESCRIPTION

Ruben Salazar Hall
PROJECT DESCRIPTION

• In 2001 the Design Team set out to transform and reoccupy the 118,000 ft\(^2\), two story, vacant building (formerly the Ruben Salazar Library) into new Classrooms, Computer Laboratories, and Offices.

• Existing thermal energy storage system did not have the required ton-hr cooling capacity for the renovation.

• It was concluded that indirect/direct (IDEC) evaporative cooling air handlers would be less costly to design and install than the necessary chiller plant expansion.
• 414 cooling tons were required for the renovation

• The IDEC air handlers were estimated to cost $347,400 more than conventional chilled water air handlers (approx $2.0/CFM premium)

• The added cost of the IDEC units was partially offset by the $106,279 in rebates offered by PG&E for an innovative, energy efficient design

• PG&E also awarded the engineering firm $16,000 for pursuing this energy efficient design
PROJECT DESCRIPTION

- The IDEC air handlers were projected to save $30,000 in annual utility costs

- The IDEC units consume only 0.2 kW per ton of cooling provided

- In addition to the energy savings offered by the IDEC units, PV Solar Panels were installed to provide 100% of Electrical Power required to operate the IDEC Air Handlers on Sunny Days
PROJECT DESCRIPTION

One of seven IDEC units, 20,000 to 28,000 CFM

Photo taken immediately following commissioning in 2002
PROJECT DESCRIPTION

Photo taken June 2006
DETAILS OF THE DESIGN PROCESS

• The IDEC units were larger and heavier than the originally designed conventional chilled water air handlers. To minimize the unit weight, the IDEC units were constructed of aluminum.

• The IDEC units were equipped with chilled water coils – just in case they should ever be needed.

• The air handlers and duct system was designed to allow the building to be cooled with 58°F air.

• Campus’ motivation to utilize Best Practices is based on taking the long view of economics … life cycle costs NOT first cost.
2-Stage Evaporative Cooling System

Conventional Cooling System With Full Economizer Capability
Direct-spray heat pipe wets the building return-air side of an air-to-air heat exchanger.
100% OUTDOOR AIR 2-STAGE EVAPORATIVE COOLING SYSTEM REQUIRES LESS REFRIGERATION COOLING THAN 100% RECIRCULATION SYSTEM

\[
\frac{(26.04 - 23.22)}{(29.15 - 23.22)} = 0.476
\]

\(\Rightarrow\) IEC/DEC REDUCES LOAD BY 52.4% RELATIVE TO 100% RECIRCULATION SYSTEM

78/64 R/A
Sprayed Heat Pipe Sump, Pump, and Piping

Adjustable, cooling tower
Spray nozzle

Manual Bleed Valve
BARRIERS TO IMPLEMENTING IDEC

• Increased size and weight of IDEC units compared to conventional air handlers (partially addressed using aluminum Construction)

• Extreme hard water, solved using new water treatment systems currently on the market (electronic pulsed power systems)

• Fears of Legionnaires’ disease

• Added maintenance of IDEC systems
LEGIONNAIRES’ DISEASE

“There have been no known cases of Legionnaires’ disease with air washers, wetted media evaporative air coolers/humidifiers, or steam humidifiers.”

“There has been no positive association of Legionnaires’ disease with indirect evaporative air coolers”
WHY?

• The water in the sump is not warm enough to allow the Legionella bacteria to proliferate.

• Rigid media evaporative coolers do not produce droplets in a size that is conducive to transporting Legionella bacteria.

• Evaporative coolers have their sumps dumped on a regular basis.
DIRECT EVAPORATIVE COOLING … A CONSTANT WET BULB PROCESS

HUMIDIFIES AND COOLS
DEC MEDIA WASHES OUT MUCH OF THE MICROSCOPIC POLLEN & DUST IN THE SUPPLY AIR
$20M Renovation was completed October 2002

Chilled water has never been used to assist the IDEC air handlers cool the building, even during some of California’s hottest summers on record (2002 and 2003)

The renovation has yielded a total cooling load savings of up to 400,000 ton-hours per year

Cooling and solar components combined, the system reduces peak demand by 206 kw, and 477,556 kw-hr per year

The building as a whole is 42 percent below the 1999 Title 24 California Energy Standard
LESSONS LEARNED

• The building’s high thermal mass has been used to advantage, by overcooling the space at night, helping to offset the higher daytime cooling requirements and shifting the peak load to late afternoon.

• Building materials have been observed to sorb, and desorb moisture, helping to reduce space relative humidity levels during periods of high ambient dew point.

• DEC media may be effectively used to humidify the building in winter (stage 1 of DEC only).

• Because the unit provides 100% outdoor air during all but the coldest winter ambient conditions, the IAQ is substantially improved compared to conventional air handling designs.
LESSONS LEARNED

• Controls that automatically drain sumps and dry out evaporative media are key to the long term success of any IDEC system … but are not a substitute for good maintenance practices

• The marriage of IDEC and under floor air distribution may be used to extend the range of application where IDEC may be used without refrigeration backup

• New polymer tube indirect evaporative cooling systems that are more efficient than sprayed heat pipe systems are being considered for future projects. These systems show promise in reducing first cost, air handler weight, and problems associated with hard and corrosive water.
THE TRIPLE DIP SYSTEM ...
IEC, DEC, & EVAP COOLED CONDENSER

Integral DX System Used at the Student Rec Center
Figure 2

Psychrometric Chart for Altitude 0 feet
Pressure: 29.92 in. Hg

Space equilibrium condition on the Stockton, CA 0.4% DP design day with indirect/direct evaporative cooling only (87.1°F DB / 72.3°F WB)

Space equilibrium condition on the Stockton, CA 0.4% DB design day with indirect/direct evaporative cooling only (83.7°F DB / 68.6°F WB)

Mixed air after 2°F fan heat (79.5°F DB / 64.3°F WB)

Mixed air with 10% outdoor air using conventional air conditioning system (77.5°F DB / 63.6°F WB)
TEAM

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CONTACT INFORMATION

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