FläktGroup®
SEMCO®

CAMPBELL JUNIOR HIGH SCHOOL

CASE STUDY

SAVING ENERGY WITH 3FFICIENCY™

WINCHESTER, KENTUCKY

3fficiency®
PINNACLE® + NEUTON® + CHILLED BEAMS

In the wake of its three-year-old high school's nationally renowned sustainability design, Clark County Public Schools has improved upon its chilled beam energy-saving model with the recent HVAC retrofit of a 43-year-old school building.

Robert D. Campbell Junior High School was retrofitted in 2015 from circa 1970's unit ventilators to FläktGroup® SEMCO® IQHC chilled beams and Pinnacle® dedicated outdoor air systems (DOAS), but with a new twist. Chilled beams and DOAS aren't new, but Campbell is the world's first known building to use smart, plug-and-play controlled chilled beam pump modules. The pump modules, better know as NEUTON™, helped save hundreds of thousands of dollars in capital equipment and labor/installation costs. They also combine chilled beam pinpoint indoor air comfort temperature and humidity control with energy efficiency. The combination of Pinnacle, active chilled beams, and NEUTON is better known as 3fficiency, a system that provides occupants with energy efficiency, zone-level climate control, and superior indoor air quality.

Using NEUTON in Campbell's two-phase HVAC retrofit saved the school district $147,000 in labor installation costs versus the alternative of variable refrigerant flow (VRF) technology. The chilled beam/Pinnacle combination also saves $33,000 annually versus the school's former unit ventilator system. The energy savings will lower capital dollars spent on the project by $500,000, which is guaranteed by a performance contract with the Lexington, KY., branch

Pinnacle DOAS at Campbell

of Indianapolis, Ind.-based, Performance Services Inc. (PSI), an integrated design and delivery engineering contractor that led the project.

FläktGroup Semco provided 46 NEUTON controlled chilled beam pump modules, 212 IQHC active chilled beams and two Pinnacle 5,000-cfm DOAS units to meet the school's heating and cooling demands.

PSI's NEUTON specification enabled the reuse of 100-percent of the existing two-pipe loop's piping, the pumps, and the relatively new replacement chiller and boiler installed in the 1990's and 2003, respectively. Another advantage is that NEUTON eliminates the need for heat exchangers.

NEUTON, which includes a powered integrated direct digital controller (ddc), chilled and hot water connections, valves, variable-speed electronically commutated (EC) motor pumps and smart sensors, is superior in temperature and humidity control to the original unit ventilator design especially during season changes. The plug-and-play NEUTON eliminates the guesswork associated with chilled beam system specification, installation, balancing and commissioning. As with most two-pipe designs, the many wildly fluctuating temperatures of spring and fall days resulted previously with uncomfortable indoor temperatures, because of the extensively long periods required to switch from heating to cooling modes.

Conversely, Campbell's design provides pinpoint tempered conditions within a one-degree tolerance, regardless of the season, because its control is based on outdoor dew point, not temperature. If the OA dew point is less than or equal to 45°F, the space latent load is satisfied by the Pinnacles' ventilation air, which is distributed through each chilled beam and controlled via its respective NEUTON. When the dew point surpasses 45°F, the chiller is needed to maintain space conditions.

Installing and Commissioning NEUTONs, Chilled Beams and Pinnacles

Chilled beams in school retrofits offer superior air comfort and lower costs compared to its nearest methodology competitor, VRF systems, according to Gary Sprague, PSI's energy management specialist and Campbell project manager. Furthermore, Clark County School District Superintendent Paul Christy, preferred a hydronic-based system versus VRF systems, because of VRFs potential for refrigeration leaks from line sets and evaporators into classrooms and the environment. Chilled beams have three times the lifecycle expectancy of VRF technology and lower maintenance costs because there are no fans or condensate drain lines.

Donahue Mechanical, Morehead, Ky., the project's sheet metal and piping contractor, executed PSI's design of reusing all hydronic trunk lines and the former unit ventilator taps for the first floor, but needed to extend the second floor unit ventilator taps to the ceiling for the NEUTON and chilled beam connections. Most NEUTONs are mounted above each level's classroom zone's 18-inch high T-bar drop ceilings and typically control four ceiling flush-mounted chilled beams ranging from 2 x 2-foot to 2 x 8-foot sizes. Each NEUTON was centrally positioned in each zone to limit chilled beam piping circuitry and allow its front panel to swing down through a removed 2 x 2-foot ceiling tile for easy access.

"Our project is best described as a three-loop system–the original pipe loop from the central plant, the take-off loop to-and-from each NEUTON, and the loop that connects a series of four to eight chilled beams to its respective NEUTON," said Sprague, who has managed several previous chilled beam projects.

Paul Christy, Superintendent of Clark County Schools advocated for safe and energy efficient technology.

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The third loop is a "game-changer," according to Sprague, because NEUTON blends and re-circulates its return water within its zone to convert typical 42°F (cooling) and 140°F (heating) primary loop supply water temperatures to optimal 58°F (cooling) or 100°F (heating) chilled beam discharge temperatures, respectively. This prevents cooling mode condensation and heating season heat stratification. Campbell is a retrofit, but in new construction projects, a secondary pipe loop with its own dedicated chiller and boiler–which was previously required in chilled beam designs because of a primary loop's extreme temperatures–are no longer necessary, because of NEUTON's water tempering capabilities.

The facility uses a building management system (BMS) by Delta Controls Inc., Surrey, British Columbia, with front-end software by Tridium, Richmond, Va., which monitors the NEUTONs via Ethernet with the BACnet protocol and sends outdoor temperature/humidity information. Sprague receives alarms and periodically reviews real time and historical data from the BMS to spotlight trends and calibrate energy-efficiency improvements.

Cooling season condensation is prevented with the Pinnacles' ducts that supply six-inch-round intakes on each chilled beam with conditioned, dehumidified air above dew point and satisfies outdoor air codes. The small six-inch-diameter air supply ducts easily fit into the restricted ceiling space, which was another impetus for using chilled beams versus other technologies requiring larger outdoor air ductwork.

Christy, who was the catalyst for getting chilled beams

specified with geothermal and Pinnacles in the district's sustainable award-winning new George Rogers Clark high school, also likes the decibel (dB) reduction of chilled beam induction versus the disruptive operational noise of unit ventilator fans for classroom environments. "The two-pipe conventional unit ventilators that preceded the retrofit were noticeably loud and distracting, whereas now I walk into classrooms with the chilled beams and I can't hear any sound from the HVAC system," said Christy.

The new high school's attendance numbers climbed versus the school it replaced–which Christy partially attributes to the comfortable learning environment created by the HVAC. Likewise, the 7th and 8th grade students that came from two other schools are showing an attendance increase during Campbell's first year, which Christy attributes partially to improved IAQ. Rising attendance generally transcends into more productive learning, which will help maintain Clark County Schools' standing as one of the top districts in Kentucky.

IQHC Chilled Beam at Campbell

Detailed Costs of Chilled Beam vs. VRF Installation

Chilled Beam Labor Description	Chilled Beam Installation Cost	VRF Labor Description	VRF Installation Cost
1. Demo of existing equipment and piping (re-using pipe)	$16,000	1. Demo of existing equipment and piping	$25,000
2. Install all chilled beams, valve boxes and ERVs	$142,000	2. Install all VRF equipment, distribution boxes and ERVs	$98,000
3. Provide all ductwork and insulation from the ERVs to the chilled beams	$275,000	3. Provide all ductwork and insulation from the ERVs to the rooms as drawn	$238,000
4. Provide all piping, and insulation from the existing mains and run outs to the chilled beams	$138,000	4. Provide all refrigerant, and insulation for the VRF system	$262,000
5. Provide balancing:	$9,400	5. Provide balancing	$10,000
6. Provide ductless split systems	$17,000	6. Provide ductless split systems	$17,000
N/A		7. Condensate piping- PVC	$96,000
TOTAL	**$599,000**		**$746,000**

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