

CASE STUDY

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Texas school district embraces multi-unit, tankless water heating systems for their ‘sizable’ space-and energy-saving advantages

550,000-square-foot Centennial High School complex is the latest successful tankless project for the Burleson (Texas) Independent School District, with 25 units in three systems delivering hot water to food-service and culinary arts kitchens, locker-room sinks and showers, and plumbing facilities in the field house.

BURLESON, TEXAS — A series of successful installations has made construction manager Cliff Holden a big believer in tankless water heating systems for the school-building projects he oversees. Since 2007, the 15-unit Burleson (Texas) Independent School District (BISD) has erected six new educational facilities under Holden’s direction, and the latest three have all featured multiple-unit, tankless solutions — in no small part because he wholeheartedly championed the idea.

The newest of these projects is also the largest and most complex: the 550,000-square-foot Centennial High School in Burleson, about 12 miles due south of Fort Worth. Centennial’s hot-water delivery strategy features three multi-unit systems, encompassing a total of 25 tankless water heaters from Noritz America. These units feed food-service and culinary kitchens as well as locker-room sinks and showers in the main building; plus locker room facilities in the adjacent, standalone, indoor-practice field house. (See “Project Profile” for more details.)

A commitment to maximizing energy efficiency helped spur BISD’s move to tankless in 2009 with the construction of Clinkscale, one of 10 elementary schools in the district. (The BISD also includes two middle school operations and one other high school besides Centennial.) As Holden notes, that commitment is also why Clinkscale, Centennial and the Academy at Nola



Project manager Chad Kroeker (left) and Cliff Holden, construction manager for the Burleson (Texas) Independent School District, shown with the ten-unit tankless water heater system for the indoor practice facility.

Dunn — the third new-construction project in recent years to use tankless — feature an assortment of green construction materials and methods. Among the most important: ground source heat pump technology from either Florida Heat Pumps (Centennial and Nola Dunn) or Climatemaster (Clinkscale) for space heating and cooling, rather than conventional heating and cooling systems.

“At 97,000 square feet, Clinkscale is identical in size and layout to our Frazier school,” says Holden, offering the district’s economic rationale for sustainability. “But its annual operating costs are nearly \$16,000 less because of its use of tankless water heaters and geothermal HVAC, rather than gas-fired boilers and rooftop air conditioners. That’s a sizable savings, and that’s why we have continued to use these technologies in our building projects.”

Friday Night Lights: But it’s also worth noting that energy efficiency was not the primary driver behind Holden’s first move to tankless in 2007 at the school district’s football stadium. At that juncture, the facility had been using a pair of 400,000 Btu per hour (Btu/h) gas-fired boilers, installed earlier in the decade, to provide hot water to the locker rooms. The big negative with these units involved irritatingly high maintenance costs, recalls Holden: “Half the time, one of the boilers wasn’t working. The annual repair costs were tremendous and ongoing. Besides also having to cope with state inspections, we just weren’t comfortable with this big, 400,000 Btu ‘bomb’ sitting there, waiting to go off if something in the system malfunctioned.”

As a result, BISD began looking for less-costly alternatives, ultimately opting to go tankless. Holden replaced both stadium boilers with 10 Noritz 199,000 Btu/h tankless water heaters, installed in parallel for the sake of system redundancy; that is, never doing without hot water if one or more of them needs maintenance. The switch was definitely an educational experience, Holden admits. “We really didn’t require 10 units to serve peak demand at the stadium; it turned out half that number was enough.”



Student entrance for the main building at Burleson Centennial High School.

But the conversion still convinced BISD management that they had made the right choice — in terms of both performance and energy savings — by switching to a multi-unit tankless solution.

After a second successful install at Clinkscale and with a third project underway at Nola Dunn, the BISD was ready for the challenge of the \$117.5 million Centennial project, whose construction began in June 2008 and finished in the fall of 2010, just in time for the new school year. Situated on a 152-acre site, Centennial has a capacity of 2,000 students at four grade levels.

Fort Worth-based Century Mechanical Contractors, Inc. (CMC) handled the plumbing and HVAC work at Centennial as well as at Clinkscale and the Academy. BISD and general contractor Charter Builders of Dallas chose CMC because of the latter's expertise in geothermal systems, having completed more than 60 such projects in the Dallas-Fort Worth metroplex over the past 16 years. A geothermal solution was especially critical at Centennial because it is a two-story structure, explains project manager Chad Kroeker, P.E.

"A typical DX rooftop system would have involved running duct chases through the building to get air to the first floor. The school district did not want to utilize floor space for this ductwork in its new building."

CMC subsequently was also given the nod to handle the three, 25-unit tankless installations, although the company was not nearly as familiar with this technology as it was with geothermal. Still, Kroeker wasn't worried, and not only because he had managed the successful Clinkscale and Nola Dunn projects:

"Not only do I have a Noritz residential unit in my house, but so does my father-in-law. Both installations were retrofits, and we enjoy the energy-saving way these systems work, providing hot water strictly on demand.

"The multi-unit installations at Centennial and the other two schools were definitely something new to us at CMC," he contin-

PROJECT PROFILE

Project: Burleson Centennial High School, Burleson (Fort Worth), Texas

Description: Newly constructed, secondary education facilities, including the main school building (500,000 square feet) and an indoor practice facility (50,000 square feet).

Applications:

- Main building — (1) prep kitchen for student lunches; (2) culinary arts kitchen for classes; (3) locker rooms for basketball and volleyball teams, as well as restrooms and locker areas for physical education classes.
- Indoor practice facility — (1) locker rooms for varsity and junior varsity football and softball teams; (2) hydrotherapy room; (3) laundry facilities.

Installation: 25 Noritz tankless water heaters in three, multi-unit systems installed indoors. The units in each of the three systems are connected in tandem with one another, and each system is operated by its own controller:

- *Main building/kitchens* — Six N0841MC gas-fired condensing tankless water heaters, with inputs from 12,000 to 199,900 BTUH, capacity range of 0.5 to 11.1 gallons per minute (gpm), and an efficiency rating of 93%. Venting method: 4-inch PVC.
- *Main building/gym facilities* — Nine N1321M-ASME gas-fired tankless water heaters, with inputs from 22,500 to 380,000 BTUH, capacity range of 0.7 to 13.2 gpm and an efficiency rating of 80%. Venting method: 5-inch stainless steel.
- *Indoor practice facility* — Ten N1321M-ASME units. Venting method: 5-inch stainless steel

Time Frame: June – August 2010

Installer: Century Mechanical Contractors, Inc., Fort Worth, Texas

ues, “but because of my previous exposure to the technology, I was totally confident it would work. Cliff Holden felt the same way, thanks to the district’s experiences at the stadium and the elementary school.

One building, three hot-water systems: The size and floor plan of the main structure at Centennial are large and complicated enough to warrant three separate hot-water zones, according to Kroeker.

1. Kitchen facilities: Extending from the building’s circular hub are four different wings. Three house classrooms, and in one of these is the culinary arts kitchen for teaching. Contained within the hub is the cafeteria and food-service kitchen for preparing student meals. Close by — so the hot water need not travel far — are six gas-fired, high-efficiency condensing tankless water heaters with an efficiency rating of 93 percent and gas inputs of 199,000 Btuh. A dedicated system controller, located in the same space, maintains a constant output temperature, independent of the usage. Venting was done with flexible and easy-to-install PVC pipe (four inches in diameter).



Culinary arts kitchen in the main building at Centennial.

2. Gym wing locker rooms: The fourth wing of the main building contains the school gymnasiums and their adjoining locker rooms. These receive hot water from a mechanical room on the mezzanine level of this wing where nine, gas-fired tankless units with inputs up to 380,000 Btuh are linked together and also operated by a single controller. Because the nine tankless heaters are conventional atmospheric units, venting consists of five-inch, Category III Stainless Steel.

The school district understandably wanted to minimize the wait at the tap and shower head by bringing the hot-water lines as close as possible to the outlet. Consequently, a 600-foot loop of three-inch, copper pipe was built to connect the plumbing fixtures to the nine-unit tankless system. The system sits idle until the temperature of the water in the loop drops below a preset level, at which point the controller activates a circulator to begin pumping hot water from the tankless system. The number of units firing at any one time depends on the number of showers and faucets in operation.

Kroeker acknowledges that the system startup involved a learning curve because of the piping circuit’s length and the volume of water it holds: 420 gallons. The system uses a mixing valve to regulate the temperature in the loop. But because of the additional pressure drop through the tankless units, maintaining the preset temperature proved elusive at first.

“When there was little or no demand, the water returning from the locker rooms wanted to stay in the loop rather than returning to the tankless system, so the loop would cool down too far,” explains Kroeker, who says the adjustment of a balancing valve and a few other system “tweaks” ultimately solved the problem.

“We had not encountered this problem on the Clinkscale project or even with the kitchens at Centennial,” he continues. “In both instances, the mixing valves were located at the individual handwashing fixtures, while the dishwashers and other kitchen fixtures generally need hot water only. With the sinks and showers in the locker rooms, however, the water had to be tempered to a greater degree.

“I do not regard our struggles with the locker rooms at Centennial as an argument against this type of multiple-tankless system,” he concludes. “It just took us a little time to diagnose and solve the problem correctly. Once we did, the system operated fine.”

3. Restrooms: Seventy-five, electric point-of-use instantaneous water heaters, made by Stiebel Eltron, serve the various restroom facilities in the other three wings of the school. For the most part, each POU unit is connected to a single sink; however, wherever sinks are positioned back-to-back with a contiguous wall in between, a double-sized unit will be used to generate hot water for both.

Holden made the decision to use POU technology for a couple of reasons, he says: Hot-water demand, which is confined to handwashing at the restroom sinks, would be very light and intermittent. These factors, combined with the fact that the restrooms are dispersed over three separate wings, spurred Holden to find a way to eliminate the hot-water circulating system he had previously relied upon to deliver hot water quickly. “With POU, we still get warm water to the sinks quickly, but without using a lot of energy and copper tubing to circulate it around the building 24/7,” he explains.

“The tankless and the point-of-use systems are a major improvement over the old ways of bringing hot water to wherever it is needed. They don’t take up nearly as much space and they don’t waste energy creating hot water when there is no demand for it.”

Installation — involved, but not difficult: The nearby indoor practice facility is equipped with virtually the same system as was installed in the gym wing of the main building, except that 10 — rather than nine — Noritz, 380,000 Btuh tankless units were used. Once again, five-inch stainless steel was used to build the vent runs.

Project manager Kroeker reports that the overall installation “probably took a little longer than a conventional tank-type system would have required,” but mainly because this was the job superintendent’s first encounter with tankless. “Below each tankless unit are two tees, one for incoming cold water and the second for outgoing hot water. All those pieces and connections weren’t all that difficult for our plumbers to make, but assembling them did take time.

“Fortunately, our service technician, who wired the controllers and programmed the three tankless systems, is a fast study,” he continues. “Having a quick learner like that on the job is vital. The instructions are all spelled out in the manufacturer’s literature, of course,

but you need someone patient enough to read that literature — or to take the relevant training course offered by Noritz — to get the job done right the first time.”

Kroeker anticipates specification of tankless water heaters on commercial projects will grow for the same reasons the technology has been a good fit in residential applications. On-demand operation saves energy, while the elimination of hot-water storage saves space. “The footprint advantage is a big deal in commercial applications,” says Kroeker. “At Clinkscale, the water heaters had to fit inside the janitor’s closet: A tank-type water heater would not have fit into this space.”

Kroeker also regards the multiple-unit strategy as a huge advantage for any application that simply cannot do without hot water for any duration. “You see a lot of commercial applications, especially restaurants and schools, with two tank heaters whose total storage capacity roughly matches the peak demand of the project. As a result, if one goes down, the operation doesn’t have enough hot water.

“A multi-unit tankless job frequently involves more than two or three units, so each water heater contributes a smaller share of the overall demand,” he continues. “If one or even two must be valved off for maintenance, the system output is much closer to maximum building demand.”

Meanwhile, the system sits idle at night, over weekends and holidays — as it should — saving energy by not generating hot water when none is needed. “You can turn a boiler down during the off hours,” says Kroeker. “But when you need it back online, the system will take more time and more fuel to reheat all the water it has stored.”

Construction manager Holden does not yet have comparative figures to determine precisely how cost-effectively the various hot-water systems at Centennial performed during their first-ever school year in 2010-2011. But based on what he can see, the maiden voyage was an unqualified success with “no problems with any of the systems, tankless or point-of-use.

“Everyone — our maintenance director, the administration and the school board — is pleased,” he continues. “We learn a bit more about tankless system sizing and design with each project. But I fully expect the school district will remain supportive of our use of tankless water heating on future projects.”

Kroeker has a rooting interest in BISD’s sticking with tankless, and not just because of the work it brings to CMC. He’s also a resident of Burleson, he says. “As a taxpayer, I like to see lower operating costs, so I definitely like the decision to go tankless.”

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Hi-res versions of photographs to accompany this case study are available for immediate download in .tif format by using this link: <http://noritz.oreilly-depalma.com/2011/cs-centennial-high-school.shtml>

NORITZ CASE STUDY

CENTENNIAL HIGH SCHOOL, BURLESON, TEXAS

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