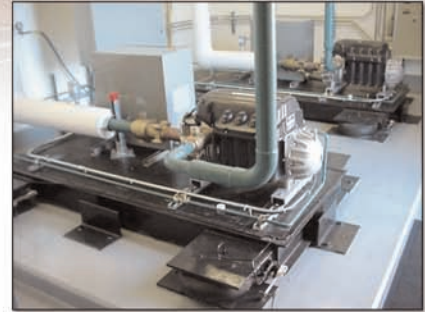


New Compressor Technology Retrofit for Operating Engineers Trust Fund Building



Operating Engineers Trust Fund Building.
View of replacement Turbocor compressors.

If you're a Union Pension Trust Fund that owns real estate and demands the highest level of operating efficiency for your buildings, you need to continually implement cutting-edge energy conservation measures. You do this to maximize the long-term financial performance of the investment. If you work for the Operating Engineers Pension Trust, Local 12 out of Pasadena, CA, you'd better be the best when it comes to HVAC systems optimization and performance. As the Chief Engineer for this Trust Fund, Bruce Manning admits to being obsessed with finding ways to minimize energy use in the buildings for which he is responsible.

One of those sites is the Trust Fund headquarters located at 100 E. Corson St. in Pasadena, California. Manning's obsession is why he is so excited about the performance of the new Danfoss Turbocor technology. The newly installed Turbocor compressors in the building have opened the door to additional cooling savings. He predicts these could be as high as 50 to 70 percent vs. his older compressors.

Compressors Support DX System

The four-story office building was completed in 1988 and encompasses 210,000 gross square feet. The heart of the original cooling system was two 120-ton, open-drive Carrier 5H120 reciprocating compressors connected to a built-up direct-expansion (DX) coil with sixteen expansion valves. Conditioned air is delivered to four (4) floors of VAV boxes from the centralized penthouse air-handling system with dual, side-by-side DX coils and associated face-off dampers, variable-speed driven supply and return-air fans.

The system also features a fully functional 100% outside air (O/A) enthalpy-controlled economizer system. Manning, a 30-year engineering and energy analysis veteran, took over in 1993 and performed extensive maintenance management and energy management evaluations of the entire real estate portfolio, including this facility.

Energy Report Card

Over time, Manning installed VFDs on the supply and return fans, as well as the cooling tower fans to conserve energy by eliminating the previous constant-volume fan operation using inlet-guide vane control. He then retrofitted and overlaid a point-intensive DDC energy management control system on all mechanical equipment and floor VAV boxes. Manning developed his "Energy Report Card," which utilizes kBtu/sq. ft. as the primary benchmark to evaluate and sustain the energy efficiency of his buildings.

After evaluating all possible plant retrofit options for years, he knew that additional efficiency improvements were possible, but not at the right cost/benefit and associated return-on-investment ratios. He became particularly interested in refrigeration compressor improvements and began studying and tracking a new low-friction, oil-free refrigeration compressor. This technology was developed by Danfoss Turbocor and was beginning to appear in California. Manning says, "I had been following the development of this technology since its inception. I waited until a few local jobs were installed and went to look at and evaluate them." He says he then discussed the design and performance of the jobs with various contractors, consulting engineers and on-site property engineering staffs.

Oil-Free Compressor Seen as Opportunity

Manning concluded that the Danfoss Turbocor technology, with its oil-free design, variable-frequency speed control, floating magnetic bearings, centrifugal compression and digital controls was the ideal replacement compressor for his building. He admits, "I was also influenced by the fact that with only one moving part, no need for lubrication and virtually no major service requirements, both maintenance and energy costs could be very significantly reduced."

Manning turned to ACCO Engineered Systems, a design-build contractor with a long history, a solid reputation, and experience with the Danfoss Turbocor product. He worked closely with Jacob Coble and Bill Brown of ACCO to design and install the compressors, while at the same time optimizing his building's HVAC system. He indicates, "We were determined not to leave any energy savings potential on the table. Bill Brown from ACCO was absolutely relentless in looking for energy savings." He notes that this focus on energy savings continued through design, installation and system commissioning.

Trouble-Free Startup

The new compressors are rated at 120 tons each, or 240 tons total. The installation was done in January 2006 and was completed over a few weekends. Manning says the startup went very smoothly. "We did the normal tuning and tweaking to prevent surge conditions on low load and verifying proper motor cooling at the specified compressor amperage at full load."

The HVAC system in this office building has eight electronic expansion valves (EXVs) on each of the two DX cooling coils to ensure the appropriate flow of refrigerant during varying load conditions. According to Manning, he and Brown spent considerable care in the commissioning stage to ensure that these EXVs were utilized properly in a "full face" coil feed control strategy. This strategy is used in conjunction with the building's centralized energy management system and the compressors' on-board intelligence.

Utility Supported Improvements / Perspective

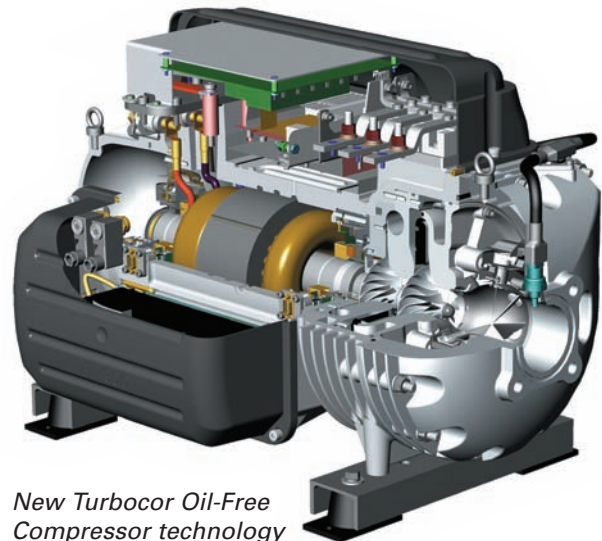
The electric utility, Pasadena Water & Power (PWP), was very supportive of the compressor upgrade, actually providing a rebate for the installation. PWP also worked with the owner to document the efficiency improvements. PWP Account Representative Robert Thompson, who coordinated the rebate process, documented and videotaped the performance tests. He recorded the side-by-side operation of one of the original open-drive reciprocating compressors running simultaneously with one of the new Turbocor compressors. Manning says, "At the time of the test and after balancing the load equally across both compressors at the same time via the DDC control system, we all saw energy reductions approaching 65 to 70 percent for the new compressor."

PWP's Thompson adds, "An ammeter simply doesn't lie." The obvious peak load demand reduction, along with the totalized kWh reduction potential, is one that is of great interest for the utility company. "This technology can possibly revolutionize the compressor industry, while creating a tremendous opportunity for all utility companies to implement and achieve a significant load-reduction strategy in the communities we serve," suggested Thompson.

Manning feels the most important aspects of the new compressors will be their "unparalleled efficiency that will finally enable a properly implemented and optimized system to match exactly the required horsepower and associated kW of the entire plant to the connected real-time air conditioning load."

Impressed by Energy Improvements

He is impressed by the efficiency improvements in the entire system due to the removal of normal DX system effect losses, reciprocating technology friction losses, oil insulating losses and lowered condensing pressures—from 220 psi down to 160 psi. He continues, "For the first time, I have seen a refrigeration system that can be so precisely tuned that there is zero operating slop." He also points out



New Turbocor Oil-Free Compressor technology has high efficiency, low acoustic signature.

continued

that the strength of the DDC controls on the entire system makes a lot of difference. "It's not just the compressors."

Manning also points to the dramatically reduced acoustic signature of the new compressors. He indicates that the system has not been running long enough for him to have specific information on long-term reliability, but the simplicity of the design and the experience of other owners make him confident.

Need for Evaluation, Planning

Asked what he would tell other owners contemplating such a compressor upgrade, he says he would urge them to visit other jobs. He cautions, "There is still a learning curve to all this. You need to develop a full sequence of operation for the entire system, not just the compressors, in order to take full advantage of all the operating-efficiency doors that the Turbocor compressor can open."

He recommends, "Invest in better DDC controls and electronic expansion valves to gain full system control. You don't have to buy it upstairs (i.e., compressor energy) if you don't waste it downstairs (i.e., sloppy or poor zone/VAV control)." He recommends that operators should optimize cooling tower performance to maintain low compressor ΔP (80 psi or less) during hot summer months. "Condenser relief strategies still apply; let your ammeter be your guide," suggested Manning.

An Important Next Step

As with any business, escalating energy and associated maintenance costs are always of concern. Manning feels like "We have killed two birds with one stone." It's little wonder why this Chief Engineer is so enthusiastic about the potential of this new technology and the associated all-around benefits presented by the Danfoss Turbocor technology.

For the Operating Engineers Pension Trust, Local 12, the pursuit of energy savings has been a journey with many steps, but one of the most important appears to be the decision to learn about and confidently install the new Turbocor compressors. Manning says he is willing to share his experiences with owners and facility managers because the opportunities for energy and maintenance savings are so great. For further information on this project, Mr. Manning can be contacted at (760) 899-5053 or bruce@oefi.org.

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