

DAN FOSS VLT DRIVES AND PUMPS HELP GREENHOUSE GROW 'GREENER' -MINNEAPOLIS, MN

Location: Minneapolis, MN
Equipment Supplier: SVL, Inc.



Challenge

Improve the air flow in a large greenhouse to better control temperature and humidity.

Solution

Installation of a Danfoss VLT® AQUA Drive to operate 13 exhaust fans ensuring a more consistent air flow throughout the greenhouse.

Project Details

Water and sunlight are well understood as being essential to plant growth. But, as one of the largest nurseries for cut-stem flowers in the central U.S., Len Busch Roses in Minneapolis knows there is an additional factor: air. In fact, airflow is so important to the growth of Len Busch Roses' flowers that the company recently turned to Danfoss to provide a variable frequency drive (VFD) to power the fans used in its largest greenhouse to maintain the proper air flow rate and underfloor duct static pressure. It also modulates the chilled water valve to control either discharge air temperature or return air temperature.



"As plants grow, they not only consume water; they also expire water," said Rene Vahk, senior technician for Len Busch Roses. "All the water vapor and heat make greenhouse plants very sensitive to rapid changes in humidity and air temperature. In fact, small differences within the plant microclimate throughout the greenhouse will limit the size of blossoms and stems. Air that is too humid can also condense on leaves and petals, causing disease problems."

"That's why we want temperature, humidity, and airflow to stay within a range — so our plants are more uniform and marketable," said Tom Nass, grower at Len Busch Roses. "So,



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when I discovered a Danfoss variable frequency drive could improve airflow, I was very interested.”

Flowing Air and Water

Family-owned and operated, Len Busch Roses has been growing flowers since 1965. Today, their Minneapolis greenhouse complex covers more than a half-million square feet —

about the area of 100 football fields — where they grow roses, lilies, tulips, gerberas, snapdragons, alstroemeria, and more. One of the largest greenhouses, which spans 100 feet by 250 feet, grows snapdragons.

“This particular greenhouse was ventilated with 13 fixed-speed, 42-inch-diameter exhaust fans,” said Vahk. “They were arranged in three banks. A sensor wired into our automation system would turn on one bank of fans, then another, and another until the set point was reached. But, as each bank of fans turned on, it would create a huge difference in airflow. Humidity could fluctuate by as much as 50 percent throughout a single day. On top of that, the fans required a lot of maintenance due to the constant on-off cycling of the equipment. The fan belts would squeak so much that the neighbors in the nearby residential development would complain.”

When Brian Peterson of Schwab, Vollhaber, and Lubratt Inc. (SVL) in Shoreview, Minnesota, heard about these problems, he suggested Danfoss VFD technology could solve the airflow and noise problems.

“Rene was already familiar with the technology of Danfoss VLT® Drives because I had installed some VLT AQUA Drives for pumps on their water wells and irrigation systems,” said Peterson. “Being able to vary pump speed to prevent uneven pressure solved a lot of problems related to water flow. When I heard about the noise with the fixed-speed fans, I thought a Danfoss drive would provide smoother startup and variable-speed fan control to eliminate the airflow issues.”

A Green Solution

“This application is a great example of what a Danfoss VLT Drive can do if you think outside of the box,” Peterson noted. “In a normal fan-control application, I would specify a Danfoss VLT HVAC Drive. But in a greenhouse, water gets sprayed all around. So, we went with a VLT AQUA Drive instead, because it’s washdown-rated IP66/NEMA 4X design.”

A 15-horsepower (hp) VFD was selected to operate the 13 exhaust fans installed in the sidewall of the snapdragon greenhouse. The fans function like a window box fan — fresh air is pulled inside the greenhouse as the fans exhaust air outside. Louvers mounted on the



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fan's exterior housing prevent air from flowing back inside. Each propeller blade is powered by a V-belt connected to a standard, single-speed $\frac{3}{4}$ -hp three-phase motor.

"Operating 13 fans with one drive provides a much smoother and more consistent airflow than you can get by cycling banks of fans on and off," said Peterson. "When more airflow is required, the drive speeds up all the motors together at the same rpm. A minimum speed of 30 Hz is maintained to offset any effect of the wind against the louvers. Then, the rpms can increase in nearly infinite steps to deliver up to 15,000 cfm per fan as needed to meet the temperature and humidity set points."

The snapdragon greenhouse uses an environmental control system to regulate temperature, lights, and humidity. Peterson notes that adding the Danfoss VLT Drive did not require an automation system upgrade. Instead, the greenhouse's analog temperature sensor is wired into the drive, which uses floating point speed control to change motor rpms.

Payback: Less Than A Year

"Variable-speed fan control is making a huge difference," said Vahk. "The fans speed up or slow down together across a wide rpm range to adjust the ventilation rate more precisely. Proper airflow creates a more uniform environment. It pulls out excess water vapor and prevents localized hot or cold spots. It also prevents condensation on plants, which can occur when the dew point drops, to keep pathogens from growing on leaves and petals. The uniform environment ensures consistent growth for all the plants from the center to the perimeter of the greenhouse so all our flowers have higher market values. Plus, we have reduced the number of maintenance hours needed to keep the equipment operational."

On an irrigation system pump, a Danfoss VLT AQUA Drive ensured the water line pressure never exceeded the operating design pressure. That stopped previous pressure problems that had resulted in a blown-out a 4-inch pipe.

The VFDs also proved their value by providing greater energy savings.

For several well pumps, the drives cut power consumption at critical periods to reduce utility demand charges.

"For the fan application, however, saving energy was not the main issue," said Peterson. "The most important goal was to create a quality environment. Nonetheless, it's good to know that improved energy efficiency — and a rebate from the utility — made the payback period for the fan drives very attractive for Len Busch Roses."



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Peterson used free Danfoss VLT Energy Box software to calculate the return on investment.

“This tool gives an accurate calculation according to the greenhouse’s trend log based on the number of fans that were cycled on. I entered in the kilowatt along with the initial cost, installation cost, and the utility rebate to determine the payback.”

The utility, Xcel Energy, offers cash rebates to customers installing variable frequency drives. For Len Busch Roses’ application, the rebate amounted to \$2,000. After the rebate

was plugged in along with a 22 percent reduction in energy costs, the tool calculated a simple payback time of just eight months.

The Energy Box software also calculated a carbon footprint savings of 6.06 tons of CO2 per year.

Vahk is not only happy to be creating an environment inside the greenhouse that enhances the quality of plant growth, but also to be reducing Len Busch Roses’ footprint on the environment outside. “This was a successful experiment,” Vahk said. “We’ve proven that a Danfoss VLT Drive improves airflow in our snapdragon greenhouse. In the future, we’re definitely interested in applying variable frequency drives in our other greenhouses.

You could say the idea of using Danfoss VLT Drives for greenhouse exhaust fan control just kept growing on us.”

PRODUCTS USED

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