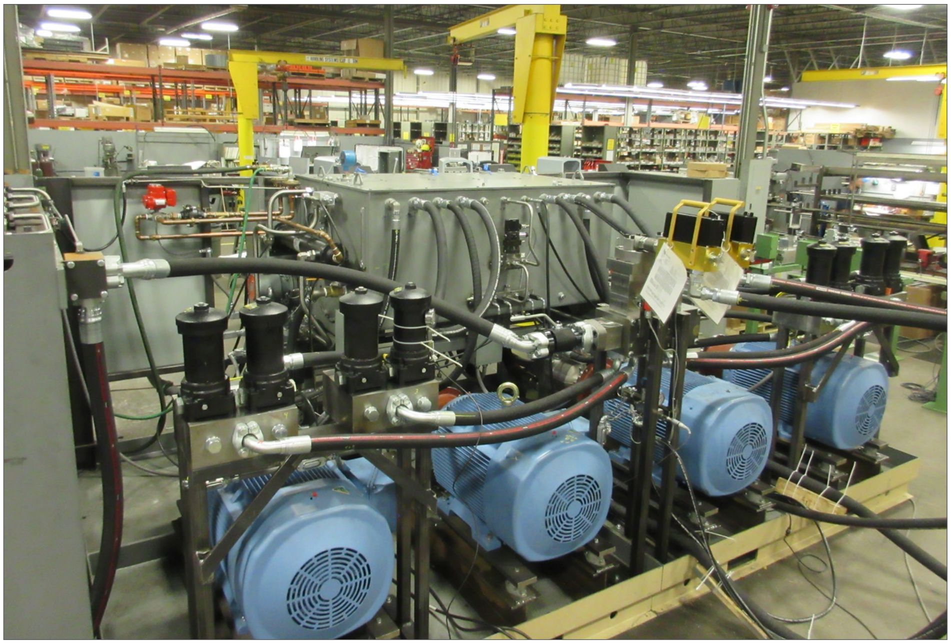
Variable Frequency Drive Technology Solves Need for Power Efficiency at Reduced Cost

Variable speed drives are used in systems to control AC motor speed and torque by varying motor input frequency and voltage. Approximately 25 percent of the world's electrical energy is consumed by electric motors in industrial applications, which makes variable frequency drives (VFD) conducive for energy savings. Over the past 40 years power electronic technology has reduced VFD cost and has improved performance by way of positive changes in conductor switching devices, drive technologies, simulation/control techniques and control hardware/software.

In the United States 60-65 percent of electrical energy is used to supply motors alone, of which 75 percent are on variable torque fan, pump, and compressor loads. Approximately 20 percent of the energy used in 40 million fixed electric motors in the United States could be saved by switching to variable frequency drives.



Moving Large Loads With Precision
A national defense contractor assigned Sorensen Systems the challenge of creating a hydraulic solution to handle large flows at high pressure to actuate a number of linear and rotary devices. The requirement was 400 GPM @ 3,000 psi to satisfy all movements in the correct time. The system had to ramp from zero to 400 GPM in 160 milliseconds.

A major defense contractor presented Sorensen Systems with a challenge to build a powerful and robust power unit for a purpose they would not reveal. The machine presented a significant hydraulic solution opportunity that required large flows at high pressure to actuate a number of linear and rotary devices. The Sorensen team derived a requirement of 400 GPM @ 3000 psi to satisfy all movements in the correct time. The system had to ramp from 0 to 400 GPM in 160 milliseconds. Two options were considered to meet the rigid requirement. The first option considered was to satisfy the instant flow requirement with a bank of over twenty, 10-gallon accumulators and gas bottles.

This method, when coupled with the proper pumps and valve arrangement, would satisfy the requirement; however, the Sorensen team looked beyond the instant gratification. Realizing the sophistication of its customer, the Sorensen team developed a written analysis that addressed the total cost of ownership of the first option versus a second option, which incorporated four 150 horsepower VFD drive electric motors, driving four Parker PV 270 pumps.

Each pump is capable of 105 GPM @ 1500 RPM which when combined with 75 gallons of Parker accumulator/gas bottle capacity, results in an instant 3000 psi pressure, while the pumps come back on flow from dwell. In starting a motor, the VFD initially applies low frequency and voltage, thus avoiding high inrush current. After the start of a VFD, the applied frequency and voltage are increased at a controlled rate or ramped up to accelerate the load. This starting method allows the motor to develop 150 percent of the rated starting torque, while the VFD is drawing less than 50 percent of its rated current in the low speed range. A VFD can also be adjusted to produce a steady 150 percent starting torque from standstill to full speed. All this results in efficiency, response and energy savings.

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VFD Reduces Cost

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Total Cost of Ownership Consideration

There were many things for the customer to consider when weighing one option against the other. However, the second option utilizing the SSD variable speed drive electric motors provided more benefits. The customer quickly grasped the long range total cost of ownership that the real value is not in the initial purchase price alone, but in the overall savings realized through energy efficiency, reduced floor space, environmental protection, increased productivity, and operational dollar savings. The characteristics of the VFD motor drive system will exhibit a smooth acceleration and ramping, providing for a powerful high efficiency package in a smaller envelope. There is also less total system oil required, reduced system noise levels, simpler diagnostics, less chance of troublesome oil leaks, and the best part comes last; the four 150 horsepower motors, running on variable frequency drives, sometimes as low as 400 RPM in the pump compensation mode (dwell) and up to 1500 RPM in the full 400 GPM requirement, result in significant energy savings. The difference between a dwell with the pumps compensating at 400 RPM utilizing VFD's versus a conventional system compensating at 1750 RPM is significant when it comes to energy usage. The customer's run time theoretical energy savings, combined with heat and noise reduction, based on dwell time alone is 300,000 KW/year. Based on a conservative $.06/KW rate, the net result is a savings of $18,000 per year. Many utilities across the United States have rebates to the end user where substantial savings can be attained over age old conventional methods. These savings can sometimes approach 50 percent of the cost of the equipment.

Visual Monitoring an Important Feature

Beyond the pump motor accumulator circuit, the system reveals an Allen Bradley Micrologix PLC along with a Maple systems HMI interface to adjust system operating variables, pressure and VFD speed, as well as to annunciate the status of important devices in the system. Proportional pressure control was accomplished by way of Parker R4V proportional relief valves working in sync with the PV270 pumps. Optimal fluid conditioning was accomplished utilizing Parker 50P pressure filters, a return HDIL8, and a recirculation loop with ILP filters for continuous protection. Because of the critical nature of the system, a number of test points that include gauges and transducers have been installed to enable visual monitoring of the system's circuits for flow and pressure. Optimal reservoir oil temperature is ensured with heaters and also heat exchangers, depending on environmental conditions. In addition, there are a number of safety circuits, warnings, and alarms, both electronic and hydraulic, which are built into the hydraulic power unit and overall system to ensure protection from hazardous conditions. In the unlikely event of a system failure, the power unit is programmed to shut down, an alarm is then displayed on the HMI and processed to remote operator stations. The warning/alarm stays in effect until the condition is remedied.

Like everything else in today's fast paced world, hydraulic solutions for technology savvy customers have been incorporating more electronic interface to provide faster and more accurate results. Companies such as Parker Hannifin and Sorensen Systems continue to leverage the technology developed for markets such as aerospace and transfer it to the industrial market in the form of smart electronic valves and actuators.

VFD Drive Creates Cost Savings

At the suggestion of Sorensen Systems, the design was adapted to use four 150 HP VFD drive electric motors, driving four Parker PV 270 pumps, which allowed a controlled rate of acceleration creating 150 percent of rated starting torque while drawing less than 50 percent of its rated current in the low speed range.

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