powershift by NV Energy

Business Energy Services

VARIABLE FREQUENCY DRIVES

Air, water or refrigerant flow in a fan, pump or compressor system is typically controlled by an automatic valve or damper that restricts the flow. Devices that control flow by imposing a pressure drop are inefficient and result in energy waste. NV Energy offers incentives for equipment that control flow and vary the speed of the device to help you save.

Details

How It Works

The speed of the pump or fan can be controlled by several means including a variable pitch sheave, gearbox or slip clutch, but the most efficient and most common means is controlling the motor speed. Motor speed control is accomplished most commonly by varying the characteristics of the electric power wave supplied to the motor. The electronic devices that accomplish this are referred to as adjustable speed drives (ASDs); however, as frequency is most often the characteristic varied, they are typically referred to as variable frequency drives (VFDs).

VFDs can save considerable power at part-load flow. This process is a result of two "affinity laws".

First, flow varies (approximately) with the rotational speed of a pump or fan. This means that a 10% reduction in speed results in a 10% reduction in flow.

Second, depending on the operating characteristics, the power input to the pump or fan varies with the cube of the rotational speed. So, a 10% reduction in flow can mean a reduction in power input of (1 - 0.9^3) = 27%. The savings increase exponentially, so as the flow rate and pump speed decrease the reduction is even more dramatic.

Equipment Options

Controlling motor speed to control capacity has many cost-effective applications.

Cooling Tower Fans

Cooling towers are great candidates for VFD control because they can operate long hours at part loads, particularly with Nevada's desert climate. Installing multiple towers allows all of the fans to operate in parallel at a low speed controlled by a common speed signal, which results in the greatest savings.

Centrifugal Chillers (Refrigeration Compressors)

Centrifugal refrigerant compressors found in many large chillers respond in a similar manner to fans. Constant-speed compressors typically use inlet vanes to restrict refrigerant flow at the compressor inlet to achieve part-load capacity. Varying the speed of the compressor can achieve partial capacity operation at a much lower power level. VFDs can be retrofitted on most existing chillers (consult the manufacturer) and many manufacturers provide a VFD-driven chiller as a high-efficiency option.

Varying flow on pumps or fans saves significant energy because it accomplishes flow control by varying the speed of the motor driving the pump or fan, rather than using a valve or damper to induce a pressure drop.

Air-Moving Fans or Industrial Blowers

In the past, inlet guide vanes controlled the flow in most variable-flow air-moving systems or, in some cases, it was controlled by a variable-pitch drive sheave. Flow in some industrial systems is controlled using by-pass air or discharge dampers that are even less efficient. For most of these applications, a VFD is more efficient and retrofit is very cost effective.

Pump Systems

Hot or cold water distribution, irrigation or industrial cooling in HVAC applications often is controlled by either cycling on/off, by-passing flow or throttling with a valve in the piping system. Controlling flow by varying the pump speed electronically offers significant energy and cost savings and often more precise operation.

Miscellaneous Equipment & Industrial Process Systems

VFDs offer a cost-effective means of capacity control in many industrial process and support systems. Common cost-effective applications include material conveyor systems, elevators, induction molding machines, process air compressors, wastewater treatment and purification systems.

Application Considerations

VFDs don't save energy when the fan or pump is at or near 100% load. In fact, a VFD-driven system usually uses more power than a comparable constant-speed system at full flow. Unless a system operates partially at part load, retrofitting a drive on a system designed for constant flow won't save energy. This applies to most HVAC applications.

VFDs offer "soft start" capabilities. The VFD allows the motor to "ramp up" to its operating speed by gradually raising the power level. This process reduces wear and tear especially on motors that start and stop often or with a high starting torque. If a "soft start" on a motor is needed for the above reasons, consider a VFD. It adds the potential for dynamic speed control at not much higher cost. If a VFD is used only for "soft start" capabilities and there is no partial-load opportunity, the energy savings may be minimal.

Some older motors may not be suitable for variable speed control due to the way they are wired or internally protected. Confirm the motor compatibility (replace the motor with a premium efficiency motor) prior to retrofitting a drive on an existing motor.

VFDs can produce harmonic "noise" that may be unacceptable on circuits with electronic equipment or controls. Although this effect is minimized with newer VFDs, an isolation transformer may be necessary to ensure this noise does not impact electronic equipment.
Some driven equipment (fans or pumps) may produce excessive noise or may not operate properly at certain speeds. Install controls to ensure that the drive does not operate in this range.

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