US DRIVES, INC.

Made In the U.S.A.

US Drives Inc.
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APPLICATION NOTES

- Centrifugal Pumps - *Energy Savings / VFD Payback Analysis*

The energy savings potential for your pump based system when upgrading to **US Drives Variable Frequency Drives (VFD's)** is dependent upon several factors. Some of which are the original design philosophy of the pump system, the flow modulation method, system duty cycle, and your cost of electricity.

If the original design philosophy was to design for the worst case maximum flow condition for a future requirement or the designer used the usual 20% oversizing criteria, your potential for savings is very good. If, however, expansions have occurred over time and the system is near full flow capacity, your potential for savings may be limited.

The **VFD system curve** is derived by selecting an operating point on the desired **pump curve** and connecting the operating points of the revised pump curve as calculated by the affinity laws through the **static head** point, (SH). If the static head is high, the system curve can approach a **Constant Pressure** design (System C.P.). If the static head is low, the system curve will resemble the VFD system curve shown in Figure 1. **Basically, the lower the static head is, the greater the energy savings that will be achieved by using VFD's**. This does not mean that savings can not be realized by using VFD's on a constant pressure system - each installation must be evaluated on its own merit.

The existing flow modulation method used on the system will also affect the potential for energy savings when using VFD's. If **Bypass** Control is used, the system is always operating at point DP. If the system uses **Outlet Valve** Control, it operates along the pump curve from point DP to point P3. If a VFD is being used for pump speed control, the system operates along the VFD system curve from point DP to point V3.

The savings potential is quite large if there is no modulation present as in the case of **Uncontrolled** or **Constant Flow** systems. **Outlet Valve** controlled systems use less energy than those using constant flow.

The **Duty Cycle** of your system (where the system operates and for how long) is another factor that will affect potential savings. If, for instance, the system tends to operate close to the **Design Point** for the majority of the time, the savings potential through speed control is limited. On the other hand, if the system is operating at reduced flows for extended periods of time, the potential savings by using VFD's is great.

Obviously, the cost of electricity plays a major role in your consideration of whether motor speed control makes economic sense. If the rate of electricity is $0.02 per KWHr, the chances are slim that you'll be able to cost justify a Variable Frequency Drive for your system. However, If the electricity rate is $0.10 per KWHr or higher, you can expect to show fast paybacks for virtually any system.

Table 1 gives an indication of the energy savings realized by applying **US DRIVES VFD's** to centrifugal pumps. Although each system has its own characteristics, (pump curve, static head, pipe losses, pump efficiency, etc.) the typical savings expected on different motors can be estimated.

Table 1

Typical $ Saved Per Year On HVAC Centrifugal Pumps*

	Constant Flow	Outlet Valve Control	With US Drives VFD
30 HP	None	$3,360	$15,500
50 HP	None	$5,600	$25,800
100 HP	None	$11,200	$51,600
250 HP	None	$28,000	$129,200
400 HP	None	$44,800	$206,600

*Based on a conservative $.10 per kilowatt hour, zero static head and 8000 hours of operation per year.

The information necessary to run a VFD Payback Analysis for your pump system is indicated on the "Centrifugal Pumps Energy Savings Program Data" sheet (Doc. # 3011)

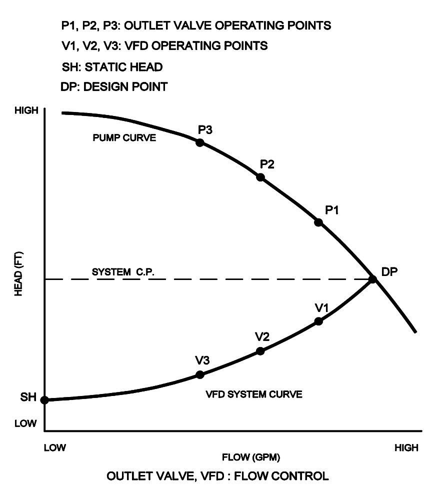

Figure 1

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CUSTOMER DATA:

DATE: ____________

CUSTOMER NAME ____

PROJECT NAME ____

CITY ________________ STATE/PROV _____ ZIP/POSTAL CODE __________

CONTACT ____________________ PHONE _________ #FAX ______________

APPLICATION PARAMETERS: DATA

PUMP EFFICIENCY	________	%
DESIGN FLOW	________	GPM
DESIGN HEAD	________	FEET (WATER)
STATIC HEAD	________	FEET (WATER)
MOTOR HP	________	HP
MOTOR VOLTAGE	________	VOLTS
MOTOR EFFICIENCY	________	%
COST OF ELECTRICITY	________	/KWH
METHOD OF CONTROL (SPECIFY 1 or 2)	________	SELECTION

1: UNCONTROLLED
2: OUTLET VALVE

DUTY CYCLE (SPECIFY 1 or 2)	________	SELECTION

1: USE TYPICAL DUTY CYCLE AND **SPECIFY** TOTAL OPERATING HOURS/YEAR ______ HOURS
2: USER SUPPLIED (SEE BELOW)

DUTY CYCLE DATA:

OPERATING POINT	1	2	3	4	5	6	7	8	TOTALS
% FLOW	___	___	___	___	___	___	___	___	______
HOURS	___	___	___	___	___	___	___	___	______