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Volume 18 Issue 1 October 2003

Identifying the TRUE Cost Savings of Variable Speed Pumping Systems

Some engineers still hesitate to specify variable speed pumping systems (VSPS) because they are under the mistaken impression that VSPS's are very expensive systems, which result in long payback periods.

In reality, the immediate reduction of energy costs often results in positive cash flow that can be used for a variety of reinvestment purposes.

To best demonstrate these results, take the example of a specifying engineer faced with the challenge of remodeling a chiller plant at the local community hospital. He had planned to expand an existing three-way valve constant volume pumped chilled water system.

However, using Bell & Gossett's ESP-PLUS software selection program, the local Bell & Gossett Representative was able to demonstrate to the engineer the clear superiority of variable speed pumping systems.

The step-by-step process they followed was to:

1) Determine the Annual Operating Cost (AOC) of three 6G primary pumps (CS/CV), assuming total on-line time will be two pumps operating at 100% and the third 50% of the time. The AOC equalled $40,287 per pump x 2.5 = $100,718. (Table 1).

Table 1

Pump Selection:	Series 1510
Performance Rank: I	Cost Rank: 2
Pump Size: 6G	Pump speed: 1770 RPM
Total Capacity:	1500 GPM Total Head: 125'
Efficiency: 84.16%	NPSH req: 9.00'
Discharge Size: 6.00"	Velocity: 16.66 FPS
Suction Size: 8.00"	Velocity: 9.62 FPS
Impeller Diameter: 11.625"	
End-of-curve BHP: 66.032	(at design 59.2%)
Pump power, BHP: 56.25	41.945 Kw)
Motor Power, HP: 60.00	(BHP/HP= 0.94)

Motor: SE AC MOTOR 230/460 V 364-17 R 368539
60.00 HP 1779 RPM 4 poles 60 Hz 3 phase
Voltage: 230/460 RPM: 1781.1 Eff: 91.21%
AMP: 137.04/ 68.52 P.F.: 84.24% KVA: 54.593

Annual Operating Cost per Pump = $40,287.00
for 8760 hours annually at $0.10/kwh

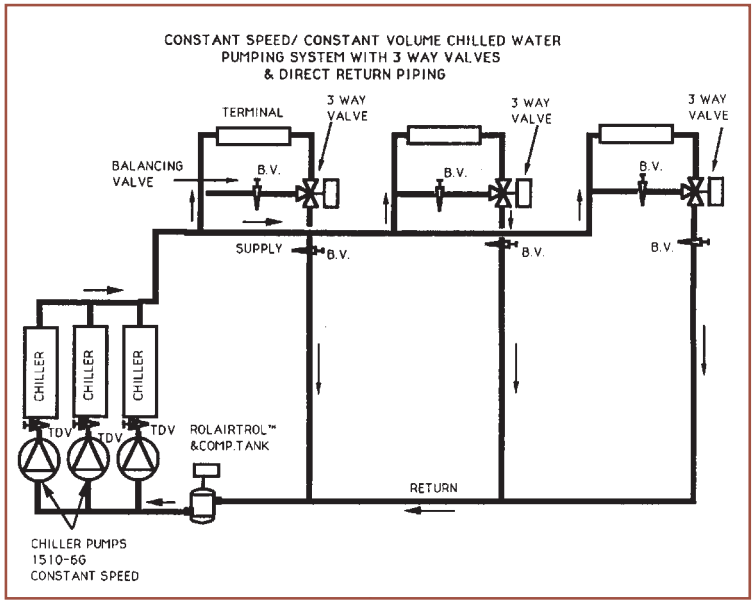

Fig. 1

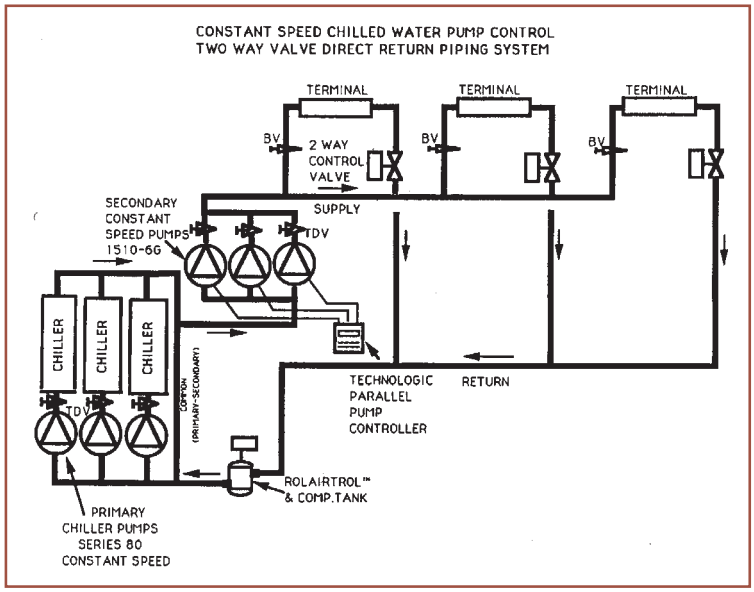

Fig. 2

Instead of operating a constant volume system (Figure 1), the Bell & Gossett Representative suggested a primary/secondary piped system (Figure 2). Although some repiping would be necessary, the two existing 6G pumps could be used as the secondary pumps. Since lower head is required, the impeller could be trimmed and lower horsepower motors used to match the new 6G pump.

2) The next step was to determine the AOC of the constant speed/variable volume system (CS/VV) primary and secondary pumps.

Three series 80 pumps were selected for the new primary pumps for the chillers and were sized for the pressure drop through the chiller and associated valves and piping only. The three Series 80 pumps will run at 1500 GPM, at 25 feet of head. Taking advantage of two-way valves and variable volume characteristics, the chillers can operate in the following manner: one chiller 100% time, one chiller 50% time, and one chiller 25% time, which would average out to be less than two chillers running full-time (175%).

VARIABLE SPEED PUMPING TIPS

True Cost
from pg. 1

This translates into an AOC of $18,566 per year ($10,609 per pump x 1.75). Using ESP-PLUS, it was determined the three Series 1510 6G pumps (1500 gpm at 100 feet) would have an AOC of $52,052.

Please note: By removing the head of the chiller and its associated valves, etc., the non-overloading horsepower has been reduced from 66.8 to 51.2hp and the impeller size reduced by 1/2 inch.

By adding the two operating costs together, we can determine the total AOC $18,566 + $52,052 = $70,618.

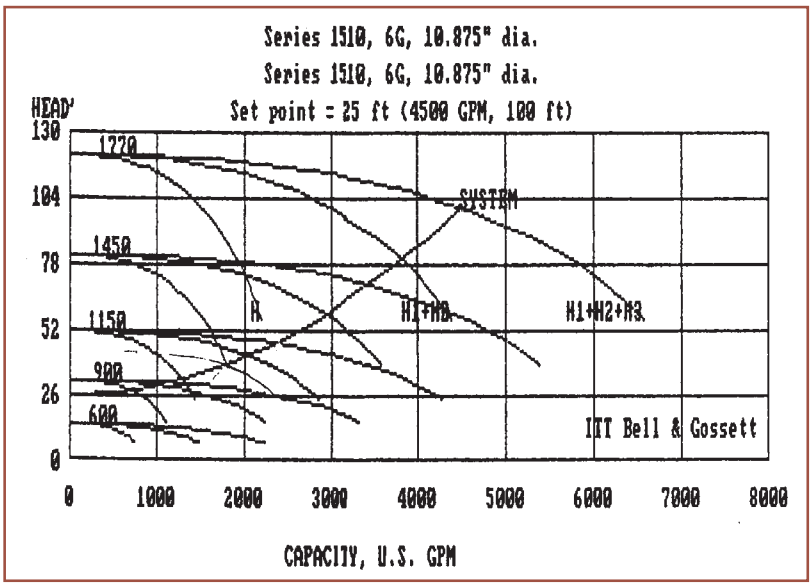

Fig. 4

3) The next step is to determine the AOC of variable volume/variable speed system (VV/VS) (Figure 3). Our ESP-PLUS calculations show us that the three Series 80 pumps still remain at $18,566 per year. But our calculations also show us that we reduced the operation cost of the three Series 1510 pumps from $52,052 to $25,280. That provides us with a total operating cost of $43,846 ($18,566 + $25,280) or a 62% reduction over the constant speed system primary and secondary pumps' AOC.

4) Step four is to review pump curves to make sure the lead pump does not operate in an "end of curve" situation. In this example (Figure 4), end of curve staging is required. Please note that the maximum speed of the lead pump should not exceed 1450 RPM.

5) The fifth step is to determine "first cost" of the equipment installed. The primary/secondary CS/VV system consists of three primary pumps, one secondary pump (lower HP for others desirable), pump staging panel, and piping, which totals approximately $20,000.

Our calculations also show us that the primary/secondary VS/VV system, which includes all the same elements plus the variable speed equipment, is $78,000.

Table 2

Simple Payback Calculation

	First Cost	Operation Cost
CS/CV system	-	$100,718
CS/VV system	$20,000	$70,618
VS/VV system	$78,000	$43,846

Payback equals difference in first operation/cost divided by Difference in AOC

CS/CV vs. CS/VV = $20,000/$30,100 = 0.67 years

CS/CV vs. VS/VV =$78,000/$56,872 = 1.37 years

CS/VV vs. VS/VV =$58,000/$27,772 = 2.17 years

6) The final step is to calculate simple payback (Table 2). After reviewing the computer printout of the payback analysis, the consulting engineer was amazed at the savings. He was equally amazed that a complete analysis of operating cost for a variable speed/variable volume system versus constant speed/constant volume system with performance curves and paybacks could be produced with B&G's ESP-PLUS software in less than 30 minutes.

The representative reminded the engineer that this was only half the story. Only the pump horsepower had been addressed. Yet to be considered was the savings in shutting down the chillers, increasing the delta temperature across the chiller, turning off the tower fans and pumps, etc.

Call your nearest Bell & Gossett Representative for a demonstration of ESP-PLUS software for equipment selection, and see for yourself how simple it is to produce analyses for variable speed pumping systems.

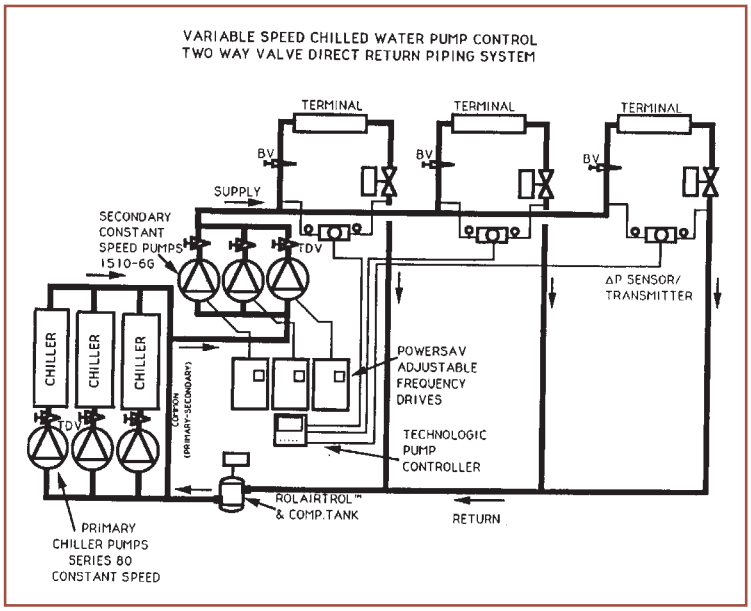

Fig. 3