IPSSA Pool Pump Field Survey for 2008 Title 20 Update

Survey of cost and efficiency of .75 HP (1.25 THP) pumps

Submitted by IPSSA Government Relations Committee

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IPSSA, the Independent Pool and Spa Service Association, initiated a in-field survey to verify data presented to the CEC by PG&E and the Davis Energy Group. The purpose of the study was to compare the energy savings of existing installations of .75 (1.25 THP) single and two-speed pumps of identical design.

* Field data gathered during July 2008.
* Twelve pumps were measured, two were two-speed, nine were single speed.
* To insure a direct comparison of single to two-speed motor performance, all pumps were Pentair Whisperflo, 1.25 THP, a commonly used pump listed in the CEC database in both single and two-speed models.
* Pools are of varying age from less than one year to 40+, in a variety of sizes and plumbing configurations.
* All pools are in-ground, one is indoor
* Pumps are of varying age, from one to nine years. The two-speed pumps were both less than one year old.
* Vacuum readings were measured at the pump pot drain plug. Pressure readings were taken at the pump volute .
* Voltage and amperage measured with Greenlee CM 400A (RMS) meter EI= Volts x amps (apparent power)
* Flow was measured with Blue-White F-300 Flowmeters where possible; if plumbing could not accommodate flow meter installation, flow was calculated using Pentair pump curve and Sta-Rite Engineering Manual. Flow readings in *italics* are measured flow.
* Systems measured in normal operation, without spa, solar or waterfalls/fountains running..

Definitions/ assumptions:

Cost figures for 2 speed upgrade from Davis Energy Group (July 23, 2008)
Comparisons made from field gathered data and CEC database Pool-Pumps.xls dated 5/19/08 (DEG)
LCC = .931 (10 year) (Davis Energy Group)
THP = Total (theoretical) horsepower = Nameplate Horsepower x Service Factor = Max load horsepower
NP = Motor name plate
OHP = operating horsepower = actual horsepower (KW x .746)
PV = Net customer present value
BCR = Benefit cost ratio
Number of pools 12

Analysis of pools surveyed:

Operations that require minimum 2 hour high speed:		
Pool cleaners with booster pumps	9	75%
Automatic erosion chlorine feeders (may need more than 2 hrs high speed)	8	67%
Suction or pressure side cleaners (no booster pump)	3	25%
Functions that require additional high speed operation:		
Pools with sand filters (require 100% high speed operation)	2	17%
Pools with solar (usually 4-6 hour/day)(4.66 field pool average)	3	25%
Pools with auxiliary features such as waterfalls, fountains, heaters and spas	3	25%
Total number of field study pools unable to utilize two-speed	***4***	***33%***

Field gathered sample inventory of pools with WhisperFlo .75 (1.25 THP) pumps:

Total pools	Automatic chlorine feeder	Booster pump cleaner	Suction cleaner	Return line cleaner	Floor system	No cleaner	Spa	W.fall	Aux pumps	DE	Sand	Cart	Solar	multi skimmers
0	**8**	**9**	**1**	**1**	**1**	**0**	**1**	**2**	**2**	**10**	**2**	**0**	**3**	**2**

Conclusions:

In addition to the consistent extra use indicated above, pool owners often run the high speed extra time to handle adverse conditions such as wind, algae or heavy use. The assumption of two hour high speed use is a conservative average. The very low vacuum and pressure created by the low speed of the.75 (1.25 THP) pump is not high enough to adequately run features such as automatic chlorination and pool cleaners. Automatic chlorinators have become very common because floating chlorinators may damage plaster and endanger swimmers. These types of chlorinators depend on the high flow and pressure of single or high speed pumping to dissolve the chlorine tablets. When considering the real world demands of a typical existing swimming pool, low speed, low flow and low pressure conditions are often inadequate. When the pump is run more than 2 hours/day on high speed, the energy savings become almost nil. Because most existing pools are plumbed with 1.5 and 2 inch plumbing, which can not safely accommodate much more flow than the amount a .75 (1.25THP) pump can produce, it is clear that the many larger horsepower pumps when replaced with like sized two-speed motors and pumps under PG&E's recommendation, will continue to be oversized; all while the misinformed pool owner, store counter person or field service technician thinks they will save energy without downsizing. Field data proves that .75 (1.25 THP) single speed pumps/motors remain an important energy saving choice for replacement applications.

1.25 THP Pool Pump Survey Comparisons for 2008 Title 20 Update							July 28,2008				
Assumptions:			Pump: Pentair WhisperFlo .75 (1.25 THP)								
Base Pump Run time		5	hours, 4.6 hours and 4.2 hours								
High Speed Operation		1	hour (inadequate), 2 hours								
Controls Cost		$240	(per DEG)								
LCC (10 year)		0.931	$/kWh	(per DEG)							
Davis Energy Group calculated (per CEC pump data 7-10-08) Two-Speed Savings (theoretical)											
Total HP	WhisperFlo	Flow (gpm)	Power (W)	EF (G/Wh)	Hours	gal/day	Energy (kWh/yr)	Cost	PV	BCR	
1.25	Single-speed	61.0	1550	2.36	5.0	18,300	2829	$485			
	Two-speed High	61.0	1750	2.09	1.0	3,660	639	$695			
	Two-speed Low	33.0	349	5.67	7.4	14,640	942	$240			
	Savings						**1248**	**$450**	**$711.74**	**2.58**	
IPSSA field gathered data July 2008						**Actual savings/costs**					
Assumptions for controls cost and LCC unchanged (per Davis Energy Group) measurements from field gathered data											
Field gathered data: Two-speed cost/savings one turnover/day (average pool volume per field data)											
1.25	Single-speed	66.1	1497	2.65	4.8	18,917	2606	$485			
	Two-speed high	76.0	1754	2.60	2.0	9,120	1280	$695			Actual
	Two-speed low	34.0	557	3.66	4.8	9,797	976	$240	Cost:		kWh/y savings
	Savings						**349**	**$450**	**($125.45)**	**0.72**	**234**
Field gathered data: Two-speed cost/savings: 4.6 hour run time (Davis Energy Group)											
1.25	Single-speed	66.1	1497	2.65	4.6	18,244	2513	$485			
	Two-speed high	76.0	1754	2.60	2.0	9,120	1280	$695			
	Two-speed low	34.0	557	3.66	4.5	9,124	909	$240	Cost:		
	Savings						**323**	**$450**	**($149.33)**	**0.67**	**217**
Field gathered data:Two-speed cost/savings: 2 hour high speed: (actual single speed run time per field data)											
1.25	Single-speed	66.1	1497	2.65	4.2	16,657	2294	$485			
	Two-speed high	76.0	1754	2.60	2.0	9,120	1280	$695			
	Two-speed low	34.0	557	3.66	3.7	7,537	751	$240	Cost:		
	Savings						**263**	**$450**	**($205.58)**	**0.54**	**176**
33% of field study pools would be unable to utilize two-speed pumping; actual kWh/yr savings figures must be reduced by 33%.											

Above are examples of various run times/pool volumes to compare average costs/savings to replace single speed WFE 3 with its two-speed replacemant, WFDS 3. Note that none of the scenarios create a net customer savings in the present. Field data indicates single speed WhisperFlo pumps operate at much higher flows and lower energy consumption than indicated on calculations from PG&E and Davis Energy Group and CEC curve A. **The CEC pump curve A calculations do not appear to be a good predictor of energy savings or pump performance in typical existing pool pump installations.** Actual OHP is significantly lower than (THP) averaging only slightly over 1 HP at **1.12** . If a direct comparison of the .75 (1.25 THP) single and two-speed pumps yield such minimal energy savings, it is clear that there will be much less energy savings when this pump is compared to the higher consumption of the larger horsepower 2-speeds. In the straight replacement scenario, significant savings opportunities will be lost when rather than downsizing, the choice of a same size 2-speed replacement is made. All those oversized pumps will continue to overpump their plumbing, underperform, and most importantly **waste energy**.

IPSSA Field Gathered Data July 2008

Pump model		Nameplate horsepower	S.F (service factor)	THP (nameplate theoretical horsepower)	OHP (Operating horsepower)	Pump run time (actual)	Measured voltage	Measured amperage	Name plate amps	Vacuum gauge reading	Pump Pressure gauge reading	TDH (total dynamic head)	Volume (gallons)	Power measured (EI)	KWh/Y (based on EI)	Flow - Gals per minute	EF = Gal/EI	Suction plumbing	Return plumbing
SingleSpeed																			
WFE 3	1	0.75	1.67	1.25	1.01	4.0	237	5.7	5.6	6.0	27.0	69	15,000	1351	1972	50.0	2.22	1.5	1.5
WFE 3	2	0.75	1.67	1.25	1.06	4.0	230	6.2	5.6	7.0	16.0	45	14,000	1426	2082	75.0	3.16	2	2
WFE 3	3	0.75	1.67	1.25	1.07	2.5	240	6.0	5.6	4.0	25.0	62	20,000	1440	1314	62.0	2.58	2	2
WFE 3	4	0.75	1.67	1.25	1.10	4.0	237	6.2	5.6	5.0	18.0	47	16,000	1469	2145	72.0	2.94	1.5	1.5
WFE 3	5	0.75	1.67	1.25	1.12	6.0	243	6.2	5.6	9.0	21.0	59	18,000	1507	3299	62.0	2.47	2	1.5
WFE 3	6	0.75	1.67	1.25	1.13	4.0	241	6.3	5.6	6.0	20.0	53	23,000	1518	2217	67.0	2.65	2	2
WFE 3	7	0.75	1.67	1.25	1.14	6.0	242	6.3	5.6	7.5	15.0	43	33,000	1525	3339	69.0	2.72	2	2
WFE 3	8	0.75	1.67	1.25	1.13	4.0	237	6.4	5.6	3.5	14.0	36	15,000	1517	2215	75.0	2.97	2	2
WFE 3	9	0.75	1.65	1.24	1.18	4.0	243	6.5	6.3	10.0	21.0	60	22,000	1580	2306	60.0	2.28	2	1.5
WFE 3	10	0.75	1.67	1.25	1.22	3.5	244	6.7	5.6	15.0	14.0	49	16,000	1635	2088	69.0	2.53	1.5	1.5
Totals 1.25 THP		**0.75**	**1.67**	**1.25**	**1.12**	**4.2**	**239**	**6.3**	**5.7**	**7.3**	**19.1**	**52**	**19,200**	**1497**	**2298**	**66.1**	**2.65**		
Two-speed																			
WFDS 3 low	11	0.09	1.67	0.15	0.43	4.0	119	4.8	4.7	2.5	0.5	4	15,000	571	834	33.0	3.47	2	1.5
WFDS 3 low	12	0.09	1.67	0.15	0.41	6.0	118	4.6	4.7	3.0	3.5	11	20,000	543	1189	35.0	3.87	2	1.5
Totals 2 sped low		**0.09**	**1.67**	**0.15**	**0.42**	**5.0**	**119**	**4.7**	**4.7**	**2.8**	**2.0**	**8**	**17,500**	**557**	**1011**	**34.0**	**3.67**		
WFDS 3 high	11	0.75	1.67	1.25	1.36	2.0	119	15.3	14.8	7.5	12.0	36	15,000	1821	1329	77.0	2.54	2	1.5
WFDS 3 high	12	0.75	1.67	1.25	1.26	2.0	118	14.3	14.8	6.5	15.0	42	20,000	1687	1232	75.0	2.67	2	1.5
Totals 2 spd high		**0.75**	**1.67**	**1.25**	**1.31**	**2.0**	**119**	**14.8**	**14.8**	**7.0**	**13.5**	**39**	**17,500**	**1754**	**1280**	**76.0**	**2.60**		
Totals two-speed 1.25 THP																			
Total pools	**12**		**1.67**	**1.25**	**1.15**	**3.8**	**219**	**7.7**	**7.2**	**7.3**	**18.2**	**50**	**18,917**	**1540**	**2128**	**67.8**	**2.6**		

IPSSA Field Gathered Data July 2008

Automatic erosion chlorine feeder	Booster pump cleaner	Suction side cleaner (no booster pump)	Return line cleaner (no booster pump)	Floor system	No cleaner	Spa	W.fall (valved)	Aux pump	DE filter	Sand filter	Cartridge filter	Solar	Heater	multi skimmers	Elevated suction	Flooded suction	Motor replaced less than 1yr	Pump ireplaced less than 1yr	
1	1						1		1										
1	1									1		1		1					
				1					1					1					
	1								1										
1	1					1			1			1	1						
1	1								1				1						
1			1					2		1						1			
	1						1		1			1				1			
1	1								1						1		1		
1	1								1										
7	8	0	1	1	0	1	2	2	8	2	0	3	2	2	1	2	1	0	Single
																		1	
1									1									1	
		1							1						1				
	1																		
1	1	1	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	2	2-speed
8	9	1	1	1	0	1	2	2	10	2	0	3	2	2	2	2	1	2	Totals

Pool Pump Calculations for 2008 Title 20 Update

Leo Rainer

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Assumptions:

Base Pump Run time	5	hours
High Speed Operation	1	hours
Controls Cost	$240	
LCC (10 year)	0.931	$/kWh

Two-Speed Savings

Total HP	Pump	Flow (gpm)	Power (W)	EF	Hours	gal/day	Energy (kW	Cost	PV	BCR
1.25	Single-speed	57.0	1360	2.51	5.0	17100	2482	$485		
	Two-speed High	58.1	1488	2.34	1.0	3489	543	$722		
	Two-speed Low	32.1	334	5.77	7.1	13611	861	$240		
	Savings		**1026**				**1077**	**$477**	**$526**	**2.10**
1.65	Single-speed	60.9	1615	2.26	5.0	18263	2948	$580		
	Two-speed High	61.6	1810	2.04	1.0	3695	661	$740		
	Two-speed Low	32.8	426	4.62	7.4	14568	1152	$240		
	Savings		**1190**				**1135**	**$400**	**$657**	**2.64**
2.2	Single-speed	63.0	1958	1.93	5.0	18900	3573	$629		
	Two-speed High	65.5	1880	2.09	1.0	3930	686	$865		
	Two-speed Low	33.4	405	4.96	7.5	14970	1103	$240		
	Savings		**1553**				**1784**	**$476**	**$1,185**	**3.49**
2.6	Single-speed	67.8	2202	1.85	5.0	20325	4019	$708		
	Two-speed High	69.0	2149	1.93	1.0	4140	784	$1,015		
	Two-speed Low	36.0	468	4.61	7.5	16185	1280	$240		
	Savings		**1734**				**1954**	**$547**	**$1,273**	**3.33**