Program: Residential Pool Pumps

Residential Pool Pumps with Variable Speed Drives

Algorithms:

Calculated Value	**Formula**
Energy Savings (Customer kWh)	= (BSL - (VFD_Lo x (Hrs_Lo / Hrs_Eff)) + (VFD_Hi x (Hrs_Hi / Hrs Eff)) x Days / 1000
Demand Savings (Customer kW)	= (BSL / Hrs_BSL - ((VFD_Lo x (Hrs_Lo / Hrs_Eff)) + (VFD_Hi x (Hrs_Hi / Hrs Eff))) / Hrs_Eff) / 1000
BSL (Wh/Day)	= Baseline condition calculated by deriving the energy use per day for single speed motor; Energy Use per day = Pool Capacity x Number of Turnovers / EF_BSL (Reference 1)
VFD_Lo (Wh/Day)	= Efficient condition calculated by deriving the energy use per day for low speed operation; Energy Use per day = Pool Capacity x Number of Turnovers / EF_VSD_lo (Reference 1)
VFD_Hi (Wh/Day)	= Efficient condition calculated by deriving the energy use per day for high speed operation; Energy Use per day = Pool Capacity x Number of Turnovers / EF_VSD_hi (Reference 1)
Electrical Energy Savings (Gross Generator kWh)	= Customer kWh / (1-TDLF)
Electrical Demand Savings (Gross Generator kW)	= Customer kW x CF / (1-TDLF)
Electrical Energy Savings (Net Generator kWh)	= Gross Generator kWh x NTG
Electrical Demand Savings (Net Generator kW)	= Gross Generator kW x NTG

Variables:

Pool Capacity (gallons)	= 22,000
Turnovers/Day	= 1.5
EF_BSL (gallons/Wh)	= 2.01; average Energy Factor of pump, motor and speed combination for a 2 HP single speed in gallons/ Wh (Reference 6)
EF_VFD_hi (gallons/Wh)	= 1.77; average Energy Factor of pump, motor and speed combination for 3 HP variable speed at high speed in gallons/ Wh (Reference 6)
EF_VFD_lo (gallons/Wh)	= 9.88; average Energy Factor for 3 HP variable speed at low speed in gallons/ Wh (Reference 6)
Hrs_Eff (hours)	= 24 total hours of operation per day for VFD pump (Reference 8)
Hrs_Lo (hours)	= 22.24
Hrs_Hi (hours)	= 1.76

Hrs_BSL (hours)	= 8.25
Days	= 167 per year (Reference 5)
gpm_lo (gpm)	= 19.19 average for 3 HP VSD at high single speed motors (Reference 6)
gpm_hi (gpm)	= 70.10 average for 3 HP VSD at high speed (Reference 6)
gpm_BSL (gpm)	= 66.67 average for 2 HP single speed (Reference 6)
TDLF	Transmission Distribution Loss Factor = 7.70%, the percentage loss of electricity as it flows from the power plant to the customer.
CF	Coincidence Factor = Probability that peak demand of the motor will coincide with peak utility system demand. 0.4 will be used for prescriptive rebates (Reference 4)
NTG	Net-to-Gross Factor = 0.80
Incremental Costs	= $597 (Reference 2)
O&M savings	= 0 value for Operation and Maintenance savings
Measure Life	= 10 years (Reference 3)

Needed from Customer/Vendor/Administrator for Calculations:

Rebate applicants will submit model number for verification

Assumptions:

2 HP standard efficiency motor is replaced by a 3 HP VFD (Reference 4)

New or replacement motors are eligible for rebate

Only pool pumps on the qualified pool pumps list meeting CEE Tier 2 specifications (low speed EF ≥ 6.95, high speed EF ≥ 1.82) are eligible for a rebate (Reference 1)

Rebate applicants will submit model number for confirmation

References:

1. CEE (Consortium for Energy Efficiency) Residential Swimming Pool Initiative - Source for formula to derive daily energy use (p. 10) and source for hours of operation (p. 10)

2. Field-based price survey in Nevada and Arizona

3. EUL/RUL from DEER database (updated 10/12) - Source for measure life, http://www.deeresources.com/deer0911planning/downloads/EUL_Summary_10-1-08.xls

4. Energy Efficient Pools and Spas Program; NV Energy - Sourthern Nevada (NPC); Program Year 2011- source for VFD replacement size and turnovers per day

5. Average response from 3 large Denver area retailers and the largest Distributor in CO of pool season length is 5.5 months
6. California Energy Commission (CEC) Pool Database Tab; CEC appliance search website - http://www.appliances.energy.ca.gov/AdvancedSearch.aspx
7. Measure Guideline: Replacing Single-Speed Pool Pumps with Variable Speed Pumps for Energy Savings; NREL, May 2012