

Proposal Information Template for:

Residential Swimming Pool & Portable Spa Equipment Update

Submitted to:

California Energy Commission

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Please note: all savings estimates and information in this document are preliminary and are based on data available to the authors at the time of the report. If the CEC moves forward with this topic, we anticipate updating our estimates and recommendations based upon additional input from stakeholders.

Proposal Information Template – Residential Swimming Pool & Portable Spa Equipment Update

2011 Appliance Efficiency Standards

Prepared for: Pacific Gas and Electric Company and Southern California Edison.

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Purpose

This document is a report template to be used by researchers who are evaluating proposed changes to the California Energy Commission's (Commission) appliance efficiency regulations (Title 20, Cal. Code Regulations,, §§ 1601 – 1608) This report specifically covers residential swimming pool filtration pumps, new and replacement pump motors, controllers, gas fired pool heaters, and portable electric spas.

Background

California Energy Commission Energy Efficiency Regulations currently cover Residential Swimming Pool Filtration pumps, replacement motors, controllers, and heaters. In the years since these regulations were first proposed and adopted, the range of products available has changed and improved significantly. Also, the Association of Pool and Spa Professionals has recently adopted a voluntary national energy efficiency standard, APSP 15, which was based on California's Title 20 and 24 requirements. An opportunity exists to update California's Regulations with respect to APSP 15, improve clarity considering currently available pumps and controllers, modify the regulatory approach

to new and replacement pool pump motors, add measures addressing gas fired pool heater hydraulic performance and underwater lights, and require marking on portable electric spas so consumers can better determine their likely energy use.

The definition and descriptions of these products is contained in the current regulations; however, further background is provided below on the proposed changes to current regulations.

UPDATING POOL PUMP REGULATIONS:

Present testing, reporting, and listing requirements include several two and variable speed pump performance specifications on CEC Pool System Curves A, B, and C at full and low speed. The terms “high” and “low” are not defined for variable speed (VS) pumps. To better understand VS pump efficiency performance at a variety of operating conditions, we recommend that this information be tested, reported, and listed for 3450 RPM (or the pump’s highest rotational speed, whichever is lower), 1725 RPM (or half speed, whichever is lower), and at the speed that produces 20 GPM of flow on System Curve A. In addition to improving the way performance is characterized in the in testing, reporting, and listing, there are other, minor improvements to the regulatory language that will be proposed and recommended.

POOL PUMP MOTORS:

Pool pump motors are subject to a design regulation in Title 20, which prohibits split phase, shaded-pole, and capacitor-start, induction run designs. Replacement residential pool pump filtration motors with a capacity of 1 Horsepower or over, must also be of 2, multi, or variable speed design, with the lowest speed having a rotational rate no more than $\frac{1}{2}$ the maximum speed.

When the prescriptive motor design regulation was adopted, the Industry stated a preference of an energy efficiency performance specification, but pool pump motor efficiency information was not available on which to base a standards level recommendation. While motor performance information is not presently reported or listed directly, it is reported in conjunction with motors supplied on pumps on an Original Equipment Manufacturer basis. We recommend that pool pump motor performance be tested, reported and listed. We also recommend that the prescriptive design requirement be changed to an energy efficiency performance specification, with a minimum level to be negotiated with Industry, but no lower than 5% better than the current prescriptive design standard presently affords, and no less than 65% on low speed for 2 speed pumps.

POOL PUMP CONTROLLERS:

Pool pump controllers are subject to a design regulation specifying the capability to operate pumps on at least 2 speeds and return to the normal filtration speed within no more than one normal period (24 hours) when set to high speed for cleaning or maintenance. We recommend that these regulations be reworded and clarified with respect to variable speed pump operation.

POOL HEATER HYDRAULIC PERFORMANCE:

Pool heater design and thermal efficiency performance is federally regulated, and reflected in California's regulations. Heater hydraulic performance is not presently regulated. We recommend that gas fired pool heater hydraulic performance (resistance to the flow of water - Total Dynamic Head) be tested, reported, and listed at 10 to 120 GPM flow rates in 10 GPM increments when heaters are firing and not firing. We also recommend that a standard be adopted limiting TDH at all flow rates to less than a 5 feet when not firing. This could be accomplished through multiple pathways, including the manufacturers' provision of an automatic bypass for use when heaters are not firing.

Pool heaters are very commonly permanently plumbed into pool plumbing systems without a bypass. As a result, they present a continuous resistance to the flow of water, whether they are firing or not. With the advent of 2, multi, or variable speed pumps on residential pools, pumping power and energy consumption can be reduced in conjunction with the reduced heater TDH, when heaters are purchased new, or replaced.

Pool heaters feature a heater manifold safety and balancing mechanism that assures adequate minimum flow when the heater fires, and bypasses excessive flow outside the heat exchanger tubes. These functions are currently achieved at 16 feet of head in some products, while through highly cost-effective design changes they could be achieved at the recommended less than 5 feet when heaters are not firing.

POOL UNDERWATER LIGHTING:

Since the adoption of the original pool pump regulations, high performance Light Emitting Diode pool underwater lights have become available. Unlike their Incandescent Reflector Lamp counterparts, manufacturers do not specify the performance of these new integral and replacement lamps.

Adoption of this new, high performance technology and consumer choice in the marketplace will be facilitated by testing, reporting, and listing of the performance of these lamps. Recommended parameters to be included are lumen output, power demand (Watts), efficacy, mean life, lumen depreciation, correlated color temperature, color rendering index, and beam spread distribution. Listing of these parameters in the CEC's Appliance Database will facilitate utility programs which might wish to encourage this efficient technology.

PORTABLE ELECTRIC SPAS LABELING

Portable Electric Spas are currently regulated by Title 20, including testing, reporting, listing, and minimum standby energy consumption standards. We recommend that portable electric spas be required to carry a label specifying their energy efficiency performance (standby power in watts) and compliance with Title 20 requirements. Consumers could then readily determine that products they are considering for purchase are compliant with California's Appliance Efficiency Regulations as well as how they compare in efficiency.

Overview

Description of Standards Proposal	<p>We recommend that California revisit its residential swimming pool equipment and portable electric spa regulations and adopt the following changes / standards:</p> <ul style="list-style-type: none">• Bring Title 20 into alignment with the new APSP 15, Voluntary National Residential Swimming Pool Energy Efficiency Standard and improve its applicability to variable speed pump products• Improve variable speed pump testing, reporting, and listing requirements to include performance specifications at high, medium, and low speed operating points on CEC Pool System Curves A, B, and C• Replace the current prescriptive pool pump motor design regulation with a performance based one• Update and clarify the pool pump controller language to better cover variable speed pump controller features• Require the testing, reporting, and listing of TDH values for pool heaters. Develop and adopt maximum TDH values for pool heaters• Require the testing, reporting, and listing of LED pool underwater lights, so their relative performance can be known• Require that portable electric spas be marked with their energy efficiency performance and certification of compliance with Title 20
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California Stock and Sales	<p>According to the CEC's Residential Appliance Saturation Survey (RASS) (KEMA 2009), 10% of single family residences have pools; totaling about 1.5 million. The pool heating saturation is 5% of all homes with gas accounts; totaling 750 thousand gas fired pool heaters associated with residential pools.</p> <p>The Effective Useful Life of pool pumps and heaters is estimated to be 10 years, so exclusive of new construction, the pool pump and heater replacement sales are estimated to be 150,000 and 75,000 units respectively.</p> <p>All of California's 1.5 Million residential pools are expected to have at least one pool light, however limited usage makes it difficult to estimate the annual sales.</p> <p>Portable electric spa saturation is estimated to be a utility weighted average of about 4.6% of all residences, totaling 600 thousand. (KEMA 2009) With an estimated 10 year EUL, annual replacement sales would be 60,000.</p>
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Energy Savings and Demand Reduction	<p>Significant energy savings and demand reduction have already been established with prior CASE Studies for pool and spa regulations. This proposal would update the regulations to better align with current products and the APSP 15 standard, as well as add some measures. Savings estimates by pool related measure follow:</p> <p>Improving variable speed pump testing, reporting, and listing will help the trade better choose properly sized pumps, as well as help utilities with the design of their voluntary incentive programs</p> <p>Replacing the current prescriptive pool pump motor design regulation with a performance based one is estimated to result in a 5% incremental motor efficiency improvement. As the Unit Energy Consumption of residential pools is estimated by the CEC's RASS (KEMA 2009) to be 3,502 kWh, stock turnover is estimated to result in a savings of 262.6 GWh (3,502 kWh x .05 x 1.5 M) and peak demand savings of 50 MW, using a .19 GWh/MW multiplier from Brown and Koomey (2002).</p> <p>Developing and adopting maximum Total Dynamic Head values for pool heaters, both when they are firing and not, is expected to reduce TDH by 10 feet, and required hydraulic horsepower by .15 ((60 GPM of flow x 10 ft (head reduction) x 8.33) / 33,000 (constants from Cameron Hydraulic Manual). Available demand reduction would be 0.17 kW ((.15 HP x .746 kW/HP / .65 pump efficiency). Aggregate non-coincident demand savings would then be 127.5 MW (.75 M heaters x .17 kW). Annual energy savings is estimated to be 214 GWh (.75 M heaters x .17 kW x 4.6 hrs x 365 days/year) and peak demand savings of 40 MW, using a .19 GWh/MW multiplier from Brown and Koomey (2002).</p> <p>Including performance information about LED pool underwater lighting is expected to increase the adoption rate and consumers' choice of quality products. Residential pools normally have 1 – 500 Watt underwater light. Industry standards for commercial pools recommend ½ Watt of incandescent pool underwater lighting per square foot of pool surface, resulting in multiple lights in large pools. LED replacements provide the same or better illumination at 70 Watts of power demand, yielding a 430 Watt power reduction, and at an estimate of 2 hours per night, 5 months out of the year, annual savings of 341 kWh, or 193.5 GWh for the 1.5 million pools with no peak demand savings. Forthcoming survey data may further refine the annual usage.</p> <p>Improving the code language to better address variable speed pump controllers is important for clarity, but will have negligible incremental savings.</p> <p>Tuning up the current Title 20 Regulations with Spa Labeling are expected to result in a 5% additional realization of previously estimated savings through</p>
2011 California Appliance Efficiency Standards Residential Swimming Pool & Portable Spa Equipment Update	<p>Improving code compliance (Davis Energy Group & Energy Solutions 2004) to 5% of 1,238.1 GWh and 26 MW = 6.9 GWh, 1.3 MW</p>

Economic Analysis	<p>None of the proposed measures have significant incremental cost except for pool heater hydraulic efficiency improvement. This is estimated to be less than \$50, which would be more than offset by the value of the 214 kWh per year saved over 10 years, approximately \$290, calculated using the CEC based methodology for calculating electricity costs (Energy Solutions 2011).</p> <p>There is no expected impact to the California economy, revenue or jobs.</p>
Non-Energy Benefits	None anticipated.
Environmental Impacts	None anticipated.
Acceptance Issues	Industry acceptance and support for these measures is anticipated.
Federal Preemption or other Regulatory or Legislative Considerations	There are no preemptive, regulatory, or legislative concerns, except that natural gas pool heaters are federally regulated appliances. Their hydraulic performance is not regulated.

Methodology and Modeling used in the Development of the proposal

UPDATING POOL PUMP REGULATIONS:

During the time since California first adopted residential pool pump regulations in Title 20, the Association of Pool and Spa Professionals formed a standards writing committee and began working of voluntary national standards for residential swimming pool energy efficiency. Title 20, and subsequently Title 24 regulations served as a basis for the new standards. PG&E was asked to serve on the committee and participated in the standards development. The standard has now been accepted as an ANSI Standard. While the form of APSP 15 is not the same as not the same as Title 20, it is desirable to make these two standards as compatible as possible. During the rulemaking process, APSP and PG&E are expected to develop a joint code language revision proposal addressing minor differences between the standards.

Additionally, changes are recommended to the way pump performance are tested, reported, and listed so as to allow better comparisons between products at typical operating conditions on CEC System Curves A, B, and C.

POOL PUMP MOTORS:

When the original prescriptive motor design regulations were proposed and adopted, manufacturers expressed a preference for performance minimum energy efficiency performance specifications, which would allow more flexibility in achieving the efficiency goals. Unfortunately, pool pump motor performance specifications on which to base recommended performance levels, were not available at the time. Now, those values are reported for motors supplied on an OEM basis with new pumps. During the proceeding, APSP, the motor manufacturers, and PG&E will develop a joint design neutral, performance based recommendation.

POOL PUMP CONTROLLERS:

The original pool pump controller language was intended to assure that the default speed of two speed pumps was the lowest speed, and that the controller would return the pump to normal operation within no more than 24 hours after it might have been stepped up for cleaning or maintenance (as contrasted to remaining on high speed until manually reset). With the advent of variable speed drives and controllers, the present language no longer clearly conveys the intent of the regulation. A joint APSA / PG&E revision proposal will be submitted to clarify this. Also, VS pump controllers often come with factory preset speeds and times. A recommendation will be made addressing what these should be relative to the default of half speed in the current regulations.

POOL HEATER HYDRAULIC PERFORMANCE:

According to the CEC's Residential Appliance Saturation Survey, roughly half of residential pools have heaters. Again, according to RASS, the unit annual energy consumption of gas pool heaters is 240 Therms. These heaters typically have an input rating of 400 MBtuh, or 4 Therms per hour (1 Therm = 0.1 MBtu). By dividing 4 Therms per hour into an annual usage of 240 Therms, we can see that while half the pools have heaters, on average, they only operate 30 full load hours per year. With this limited usage, for occasional parties or heating in-ground spas, they do not present a very good gas energy savings opportunity.

During the course of operating utility pool pump incentive programs, and recommending improvements to California's Energy Efficiency Regulations, utility personnel discovered that virtually

all of these pool heaters are permanently plumbed into the pool's plumbing system between the filter outlet and the pool returns. This presents additional friction, or head loss that the pumps need to work against. If this static and dynamic head were to be eliminated, two or variable speed pumps could produce the desired flow while demanding less power and using less energy.

Energy efficiency performance has traditionally looked only at the in-kind efficiency of appliances under consideration (output / input). In the case of pool heaters, their design also affects the system efficiency of the pool filtration pump, offering an efficiency improvement opportunity for pool filtration pumping.

The total dynamic head of a common 400 MBtuh pool heater was measured in the field by the author at 16 feet at VSD motor speeds ranging from 1400 to 2400 RPM. By reducing this head from the 16 feet measured to the 5 feet or less recommended, consumers could save \$290 annually in electrical pumping costs (214 kWh x 10 year PV of \$1.35) (Energy Solutions 2011).

This could be achieved by adding an external automatic or manual bypass valve in new construction, but to address the larger market of existing as well as new pools, we recommend that the reduction in TDH be integral to all new and replacement heaters offer for sale in California. Heater manifolds, pressure switches and the internal bypasses could be redesigned in necessary, of an external automatic bypass could be included with products offered for sale in California.

Data, Analysis and Results

Table 1 Estimated California Statewide Stock and Sales

	California Stock	California Annual Sales	
	Units (millions)	Units (millions)	'12-17 Estimated Average Annual Growth

Equipment Type			Rate
Pool	1.5	.15	TBD
Spa	600,000	.06	TBD

Table 2 Estimated California Statewide Energy Consumption and Demand

	For First-Year Sales		For Entire Stock	
Equipment Type	Coincident Peak Demand (MW)	Annual Energy Consumption (GWh/yr)	Coincident Peak Demand (MW)	Annual Energy Consumption (GWh/yr)
Pool	100	525	1,000	5,250
Spa	26	138	260	1,380

Table 3 Estimated California Statewide Energy Savings for Proposed Standards

	For First-Year Sales		After Entire Stock Turnover	
Equipment Type	Coincident Peak Demand Reduction (MW)	Annual Energy Savings (GWh/yr)	Coincident Peak Demand Reduction (MW)	Annual Energy Savings (GWh/yr)
Pool	9.5	66	95	660
Spa	.5	3	5	30

Proposed Standards and Recommendations

Specific recommendations, minimum energy efficiency performance levels, and standards language are expected to be developed with key stakeholders and presented as a consensus recommendation.

Bibliography and Other Research

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