January 15, 2021

Ms. Abigail Daken
U.S. Environmental Protection Agency
Climate Protection Partnership Division
Office of Air and Radiation
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Topic: Draft 1 Version 3.1 ENERGY STAR® Specification for Pool Pumps (Connected Criteria)

Dear Ms. Daken:

This letter comprises the comments of the Pacific Gas and Electric Company (PG&E), San Diego Gas and Electric (SDG&E), and Southern California Edison (SCE) in response to the United States (U.S.) Environmental Protection Agency (EPA) Draft of the Version 3.1 ENERGY STAR Specification for Pool Pumps (Connected Criteria).

The signatories of this letter, collectively referred to herein as the California Investor-Owned Utilities (CA IOUs), represent some of the largest utility companies in the Western U.S., serving over 32 million customers. As energy companies, we understand the potential of appliance efficiency standards to cut costs and reduce consumption while maintaining or increasing consumer utility of products. We have a responsibility to our customers to advocate for standards that accurately reflect the climate and conditions of our respective service areas, so as to maximize these positive effects.

We appreciate this opportunity to provide comments on these connected criteria revisions. We are supportive of the core demand response (DR) updates in this revision, as they reflect the recent DR market trends towards the Open ADR and CTA 2045 application layers for connectivity. We conducted an analysis of the potential impact of DR on pool sanitation and auxiliary equipment and provide corresponding recommendations to ensure consumer heath, experience, and equipment are protected from unexpected changes to their pool environment. We also provide comments on pool pump replacement motors, which could be addressed via a dot revision, as this does not impact certified products. We urge EPA to consider the following comments:

1. **The CA IOUs are supportive of updates to the connected criteria to reflect the recent DR advancements and terminology.**

   We are supportive of the simplification of the standard by allowing any combination of Open ADR 2.0 or CTA 2045 as a path to the connected functionality certification requirement. We agree that these protocols have emerged over the past several years as the primary application layers in consumer product DR and agree with EPA's assessment that making this restriction would be unlikely to impact current, under development, or proposed DR equipped pool pump products. Therefore, this change serves to dramatically simplify the requirements with minimal practical downsides.

A connected pool pump specification that encourages consistency in design patterns for these devices is beneficial in the marketplace for numerous reasons. Activities related to California's Senate Bill 49 and underlying research by Lawrence Berkeley National Laboratory have identified pool pumps as a unique residential load in the ability to flexibly and reliably shape, shift, and shed load.[1] Note that shaping load can have real time price response applications, which are anticipated to grow in California following the implementation of Load Management Standards 1621 and 1623,[2] which will create a universal real-time tariff and statewide price portal based on five-minute interval data. Time-of-use rates will also be defaulted effectively in 2021, and hourly rates will be available to consumers by 2023.[3] Price responsive load shaping strategies have the benefit of automatically moving pool filtration activities to off-peak as the monthly peak time periods shift seasonally with distributed generation (e.g., solar and wind generation) and energy use (e.g., heating and cooling load) inputs. Load shifting with an increase in load is highly unique to pool pumps, where these devices can be used as a sink to absorb excess grid energy, potentially reducing filtration needs in a later time period. See Comment 2 for potential DR filtration implications at increased speed.

We are highly supportive of the restructuring and clarifications made to ENERGY STAR pool pumps connected sections to compartmentalize the connected sections for those respective product design staff who would be looking for this information. We also appreciate the addition of the supplemental appendix to translate between Open ADR and CTA 2045 application layer commands.

We recommend a minor clarification on the requirement for either Open ADR 2.0b or CTA 2045. In the webinar, EPA notes that CTA 2045 A or B is not specified as either version could be used to meet the functionality requirements. Instead, we recommend that this is made explicit in the specification via a footnote or comment, to eliminate this potential point of confusion in the DR requirements.

2. **The CA IOUs recommend that pool pump DR commands are updated with additional flexibility and user defined setpoints to safeguard individual consumer experience at scale.**

In line with other ENERGY STAR specifications with connected functionality, the current ENERGY STAR pool pump connected criteria require a suite of DR commands, such that if an end user enrolls into a demand response program, the user's equipment could respond to any of those commands. The ENERGY STAR connected criteria also provides a number of prescribed default operational speeds:[4]

- General curtailment subtype A requires reduction to a third of maximum operating speed,
- General curtailment subtype B prevents operation above a third speed,
- Grid emergency requires reduction to zero speed (i.e., shutdown), and
- A load up command on an active pump requires a ten percent operating speed increase.

We estimate that these defaults will be satisfactory for most scenarios; however, we anticipate several edge cases that would require different operating speeds or may preclude a limited

[1] See https://www.etcc-ca.com/reports/connected-pool-pump-market-assessment?dl=1610329558, 2020, p. 38-42 for a detailed discussion on shift, shape, shed response strategies specific to pool pumps.
[2] See 20 CCR § 1621-1623.
[3] See 20 CCR § 1623 (b) for marginal cost rates and implementation timeline.
[4] https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Draft%20Version%203.1%20Pool%20Pumps%20Specification.pdf, Section (4.4)(D)(i-iii).

number of pool pump owners from responding to specific event types altogether. For instance, some specific installations may be negatively impacted by emergency curtailment, and therefore should disable that DR function, but may be able to participate in conventional load shift (shed/load up) behavior.

EPA connected criteria provide equipment operational safeguards, in the form of:[5, 6]

> *"[DR section preamble] Either delay or reject a demand response request if responding would compromise safety or result in equipment damages as determined by the manufacturer"*, and
>
> *"[Load up] The CPPS shall not increase speed to a rate outside the proper operating conditions of equipment and/or filtration systems connected to the pump, as determined by the manufacturer."*

In both of these safeguards, this field equipment centric operating data is anticipated to be provided by the manufacturer.

In our analysis of field impacts at a consumer site, we conclude that this field centric equipment operating data would most likely be provided by the consumer and pool technician or installer (as an extension of the interests of the consumer). To account for these additional field settings, we recommend that the pool pump DR criteria are amended to include:

- A minimum operating speed point,
- A maximum operating speed point, and
- Individual opt-in/opt-out logic for each DR event type, which is stored with that pump (i.e., persistent).

We note that many downstream equipment (e.g., pool heater, chlorinator) manufacturers have no-flow and/or low-flow detection in their product controls,[7, 8, 9, 10] or awareness of other product operating states,[11] however this would not have assured cross-compatibility between manufacturers or with legacy equipment. Therefore, by incorporating this functionality into the pump (and system processing DR commands), we can ensure a unified consumer experience that is designed to protect the field installation from operating conditions outside of tolerances for any site equipment. By addressing these cases via the DR framework directly, this allows pool pump DR programs to be implemented at scale with streamlined consumer eligibility screening, as the installations with unique challenges can be easily programmed with safeguards at the pool pump level. For the majority of consumers who will experience no adverse impacts for DR events, the

[5] Id., Section (4.4)(D)(4).
[6] Id., Section (4.4)(D)(iii)(b).
[7] https://www.etcc-ca.com/reports/connected-pool-pump-market-assessment?dl=1610329558, 2020, p. 16-19 and Table 4. Pentair and Hayward connected systems can each control 3 auxiliary loads including booster pumps and pool heaters.
[8] No flow detection for Pentair IntelliChlor® product: https://www.pentair.com/content/dam/extranet/product-related/product-manuals/pool-and-spa-equipment/intellichlor/IntelliChlor_Owners_Manual_Version_3_units_after_Nov_2011_English.pdf, p. 7.
[9] IntelliConnect® flow dependent devices have a special relay configuration to ensure they will not activate until 2 minutes after the filter pump has been operating, to ensure the system is primed: https://www.pentair.com/content/dam/extranet/pentair-pool/residential/manuals/automation/intelliconnect/intelliconnect-manual-english.pdf, p. 4. See p. 5. for heater specific controls.
[10] Hayward Heat Pro®, water pressure switch: https://hayward-pool-assets.com/assets/documents/pools/pdf/manuals/HeatPro-Owners-HP2xxxxT-HP2xxxxBT.pdf, p. 7. Note inconsistent flow can cause compressor cycling, troubleshooting p. 17.
[11] https://www.etcc-ca.com/reports/connected-pool-pump-market-assessment?dl=1610329558, 2020, p. 17-18.

limits could be set to zero percent (minimum operating speed point), 100 percent (maximum operating speed point), and opt-in all event types.

From the perspective of each DR event type, we address four specific equipment types:

i. Chlorine Generation Equipment

Salt chlorine generators are estimated to have a global deployment of over three million units,[12] 13 percent of U.S. residential and commercial pools,[13] and represent approximately 35 percent of automatic pool sanitation equipment.[14]

Following typical municipal (i.e., commercial) pool recommendations, pool chlorination should be maintained at over 1 part per million (ppm) free chlorine, as this is the primary method to control growth of bacteria, algae, and other unwanted microorganisms.[15] This is due to the fact that the more difficult to eliminate microorganisms require continuous exposure to chlorine for over ten days.[16]

Automatic chlorine systems have the benefit of lower peak chlorine levels, but conversely must be calibrated to maintain recommended levels. The ultraviolet (UV) sunlight degradation of chlorine sanitizers is a well-known issue, where un-stabilized chlorine is noted to be reduced by 90 percent in two hours;[17] to combat this, pool chlorine is typically stabilized with cyanuric acid (CYA), either directly or via Dichlor or Trichlor products. In our literature review, we discovered experimental data documenting that free chlorine loss in pool water stabilized at preferred CYA levels,[18, 19] 55 and 35 ppm, exposed to a typical "High" UV index day[20] would lose up to 60 and 75 percent of free chlorine levels per day, respectively (as seen in Figure 1).

[12] https://blog.hayward-pool.com/commercial/salt-chlorine-pools-becoming-norm-commercial-pools-spas/, T. McGinty, 2013.
[13] https://www.wsj.com/articles/SB10001424053111903461304576526201430239750, S. Ramachandran, 2011.
[14] https://www.popsci.com/swimming-pools-salt-water-chlorine/, E. Cummins, 2018.
[15] https://www.co.shasta.ca.us/docs/libraries/resource-management-docs/ehd-docs/Pool_Chemistry_Fact_Sheet.pdf, p. 1, n.d., estimated 2017.
[16] https://www.cdc.gov/healthywater/swimming/residential/disinfection-testing.html#howquickly.
[17] https://repository.lib.ncsu.edu/bitstream/handle/1840.4/8164/Askins%2C%20Aaron%20final.pdf?sequence=1&isAllowed=y, A. Askins, 2013, p. 9.
[18] https://repository.lib.ncsu.edu/bitstream/handle/1840.4/8164/Askins%2C%20Aaron%20final.pdf?sequence=1&isAllowed=y, A. Askins, p. 16-17. Recommended surveyed CYA levels ranged between minimum 30 ppm and maximum 100 ppm.
[19] https://www.co.shasta.ca.us/docs/libraries/resource-management-docs/ehd-docs/Pool_Chemistry_Fact_Sheet.pdf, p. 2. "The recommended level is 20-50 ppm; levels over 100 ppm will not be accepted."
[20] This experiment occurred in Raleigh, NC on April 7, 2013. Clear sky UV index for this day was 7.4. Note experiment discusses cloud cover as being low, thus clear sky UV index is the most suitable UV estimate, ftp://ftp.cpc.ncep.noaa.gov/long/uv/cities/2013/RDU_13.dat.

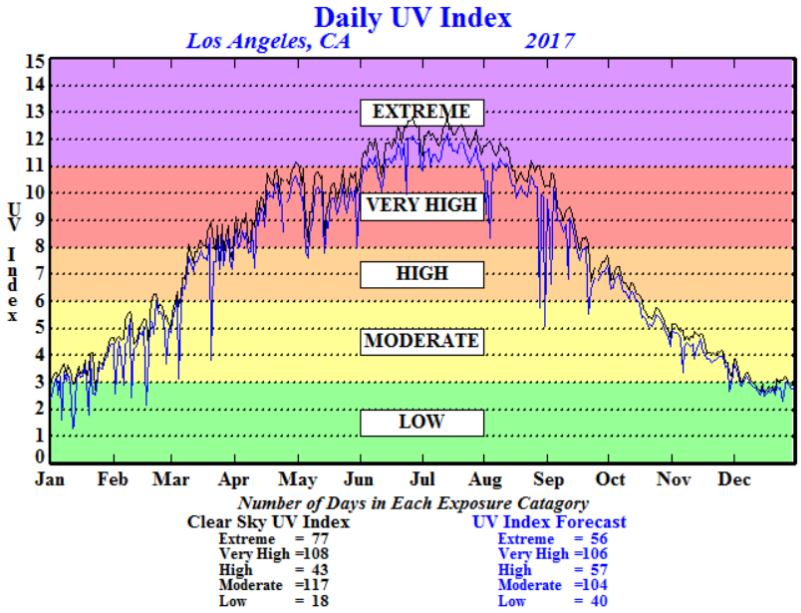

Figure 1: Daily UV index for Los Angeles CA, 2017
Source: National Weather Service, UV Index Annual Time Series, LAX, 2017.[21]

In Figure 2, A. Askins uses five gallon buckets for this experiment. Bucket 6 (CYA 150 ppm), which is an extreme best-case scenario for chlorine loss, is corroborated with a field test with a 25,000 gallon pool at 138 ppm CYA in Phoenix, Arizona: this source daily free chlorine loss rate is 15 percent,[22] Askins' loss rate: approximately 17 percent (Bucket 6). Note modern pool guidelines recommend draining a pool if CYA concentration exceeds 100 ppm,[23] for consumer health and loss of chlorine oxidation effectiveness concerns.

[21] Accessed at: https://www.cpc.ncep.noaa.gov/products/stratosphere/uv_index/gif_files/lax_17.png.
[22] http://www.poolhelp.com/wp-content/uploads/2017/05/JSPSI_V5N1_pp15-19.pdf, Table 2, rows 3-5.
[23] https://www.co.shasta.ca.us/docs/libraries/resource-management-docs/ehd-docs/Pool_Chemistry_Fact_Sheet.pdf, p. 2.

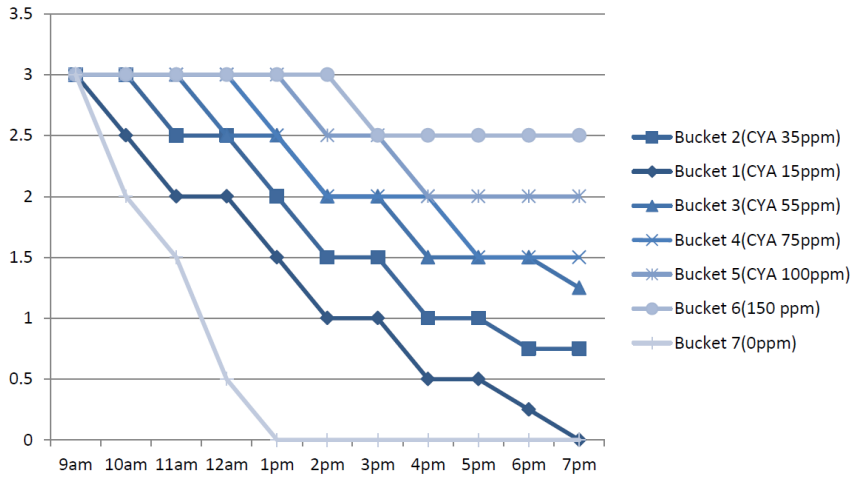

Figure 2: Daily free chlorine loss in PPM by CYA concentration, at UV index of 7.4.
Source: A. Askins, 2013, Figure 6, page 23.[24]
Note: The y-axis of this figure denotes free chlorine readings in ppm

As chlorine in this system requires daily replenishment at an accurate rate, we caution the use of DR events below the minimum flow rate of the chlorine generator, which lowers production and ultimately lowers free chlorine levels below targets. For example, the footnoted salt chlorine generator requires a minimum flow rate of 25 gallons per minute (gpm).[25] In this scenario, the minimum flow setpoint may have to be set to above the DR default value to protect the consumer experience.

Similarly, some tablet chlorinators also have minimum flow requirements. For example, a conventional Powerclean Ultra® system requires a minimum flow rate of 40 to 50 gallons per minute (gpm), otherwise the chlorination process is halted.[26] Variable-speed pump optimized chlorinators, which can operate at a 20 gpm input rate,[27] exist but may not be installed in all residential variable-speed systems, especially in retrofit scenarios. Some user sites with non-optimized equipment may reach the target chlorination via regularly scheduled high-speed pump operation (cleaning mode), so frequent curtailment events, which change the low- to high-speed operation ratio of a pool, could result in a drop below target levels. These pools may need to opt-out of high-speed curtailment but could shift filtration times. A Centers for Disease Control source also notes that in general, tablet chlorinators are influenced by water flow.[28]

ii. Other Sanitation Equipment

Ozone systems and UV disinfection systems, while less common in residential pools, should be considered in any DR events. The use of ozone generators in a combined chlorine/ozone pool allows for the safe use of lower free chlorine ppm, typically between

[24] Accessed at: https://repository.lib.ncsu.edu/bitstream/handle/1840.4/8164/Askins%2C%20Aaron%20final.pdf?sequence=1&isAllowed=y.
[25] https://www.pentair.com/content/dam/extranet/product-related/product-manuals/pool-and-spa-equipment/intellichlor/IntelliChlor_Owners_Manual_Version_3_units_after_Nov_2011_English.pdf, p. 21.
[26] https://www.c-m-p.com/essential-guide-chlorinating-variable-speed-pumps/, SANITATION WITH VARIABLE SPEED, 2017.
[27] Id. How to get high flow chlorination with variable-speed pumps.
[28] https://www.cdc.gov/nceh/publications/books/housing/cha14.htm, 2009. [Erosion Feeder].

0.5 to 1 ppm.[29, 30] In an extended curtailment event or multiple consecutive shed events throughout a week, these sanitation chlorine levels could also drop below the recommended levels, and worst case, minimum acceptable levels. Ozone generators must be operated with water flow.[31]

Consumers using UV disinfection systems experience a significant drop in performance at higher flow rates, as the relationship between flow and disinfection rate is logarithmic: an increase in flow speed by a factor of two will drop the disinfection potential of that system by a factor of 100.[32] This is due to UV sterilization requiring a minimum exposure time to a given block of water to inactivate microorganisms in that block of water before it exits the UV apparatus.

iii. Pool Filtration

Regarding pool filtration at increased flow, we note that filtration efficiency can be reduced for three reasons: (1) lower filtration flow allows a longer contact between a block of water in the filter in the filter media, (2) high filtration flow can cause channels and voids in the filter media which will significantly reduce filtration performance, or (3) higher flow rates cause more pool water mixing in the pool turnover, which increases the portion of already filtered water in new water sent to the filtration system.[33] In summary, pool filters have a recommended operating range that should not be exceeded to prevent these issues, especially channeling in the filter media. Note that filter types have significant differences in maximum flow speeds, between conventional pressure sand filters (3 gpm per square foot filter surface area (gpm/ ft^2SA)), high rate sand filters (20 gpm/ft^2SA), and diatomaceous earth (2 gpm/ft^2SA),[34] so some sites would not obtain significant filtration benefits from load up. Specifically, high rate sand filters perform best at flow under 15 to 20 gpm.[35]

Another filtration impact, pool skimmers require approximately 25 gpm flow for adequate performance.[36] Curtailment events with operating speeds below this threshold could impact pool cleanliness if used frequently.

iv. Pool Heating

We note that at least five percent of pools are electrically heated, according to the Energy Information Administration study on miscellaneous electric loads.[37] Electric heating (resistance or heat pump) require significantly longer operating times to maintain pool temp, as they are typically one half to one third the output (in British thermal units per

[29] https://www.prozoneint.com/pdf/p_s%20marketing%20article.pdf, p. 70. Type I: Sanitization system with Ozone can meet NSF 50 requirements requiring only 0.5 ppm of free chlorine.
[30] https://www.poolspanews.com/how-to/maintenance/getting-to-know-ozone_o, Chlorine levels. 2008.
[31] https://www.poolspanews.com/how-to/maintenance/getting-to-know-ozone_o, Power: running the ozonator [return side] without the pump on can cause major damage to the unit. 2008.
[32] https://www.aquaticsintl.com/facilities/maintenance/10-things-to-know-about-variable-speed-pumps_o, 7. VSPs improve UV system performance, 2017.
[33] https://www.aquaticsintl.com/facilities/maintenance/10-things-to-know-about-variable-speed-pumps_o, 3. VSPs improve filtration – 4. VSPs improve the effectiveness of each pool turnover. 2017.
[34] https://www.dph.illinois.gov/sites/default/files/publications/course-042716.pdf, p. 8-9, 2016.
[35] https://www.cdc.gov/nceh/publications/books/housing/cha14.htm, High Rate Sand Filters, 2009.
[36] https://scoophvac.com/wp-content/uploads/2018/03/Dept_of_Energy_-_replacing_single_speed_pool_pump_motor_with_variable_speed_motor.pdf, p. 5, 2012.
[37] https://www.eia.gov/analysis/studies/demand/miscelectric/pdf/miscelectric.pdf, 96, 2013.

hour) of gas-fired units.[38] Thus, this equipment will be more sensitive to curtailment events, especially in the case that this equipment is set up to only run in high-speed (cleaning) operating states.

Solar pool heaters experience lower effectiveness at lower flows; these systems have custom controllers designed to increase flow when solar heat is available,[39] and may benefit from exclusion from DR events altogether.

Gas-fired pool heaters have an estimated burner operation of 104 hours per year,[40] such that the daily high-speed operation of a variable-speed pump would be enough time for a gas-fired pool heater to maintain temperature, so some pools may use a control scheme which relies on periodic availability of this operating speed.[41] Shed events would be anticipated to prevent these systems from firing the heater during that time period.

In summary, we recommend that the ENERGY STAR specification be updated to require a minimum and maximum operating speed point (RPM) and allow opt-in capabilities such that pool pump DR commands safeguard individual consumer experience at scale.

3. **The CA IOUs encourage EPA to evaluate the benefits of replacement pool pump motors in this revision.**

When a pool pump fails, the point of failure is often associated with the motor as compared to the pump head. There are many factors that impact whether a pool service professional will perform a dedicated-purpose pool pump (DPPP) or "motor only" replacement, including cost, existing plumbing configuration, and the pool service professional's technical aptitude. Another issue impacting this decision to do a full DPPP or a "motor only" replacement is whether one or both of these products have the ENERGY STAR marking. For many years, the ENERGY STAR label (and thus utility rebates) has been awarded to DPPPs but has remained unavailable to replacement motors. Based on discussions with manufacturers and contractors, this has created an imbalance in the market, as pool service professionals were incentivized to perform DPPP replacements over motor only replacements. This scenario is further complicated for products that have ENERGY STAR connected functionality, where the replacement of a motor on such a pump would also result in the loss of ENERGY STAR connected and DR functionality to this user, unless the replacement motor was both variable speed and capable of meeting the connected requirements.

Acknowledging the disparity between pump labeling and motor replacement, EPA included "pool pump replacement motors" in the scope with ENERGY STAR Version 2.0 and 3.0 in 2018, with a "to be determined" energy efficiency level to earn the ENERGY STAR designation.[42] This was understandable, as at the time there was no test procedure or standard level for replacement motors through which to base a replacement motor ENERGY STAR designation.

However, since 2018, there has been significant development of test procedures, metrics, and standards for the pool pump replacement motors. The CA IOUs worked extensively with

[38] https://www.bnl.gov/isd/documents/73878.pdf, R. McDonald, Table EX-3, 2009.
[39] https://floridasolardesigngroup.com/how-variable-speed-pumps-affect-solar-pool-heaters/, 2016.
[40] https://www.law.cornell.edu/cfr/text/10/appendix-P_to_subpart_B_of_part_430, 5.2.
[41] https://www.swimmingpoolsteve.com/pages/vs-programming.html, S. Goodale, Variable speed pump schedule for gas heaters, n.d.
[42] https://www.energystar.gov/sites/default/files/ENERGY%20STAR%20Final%20Version%203.0%20Pool%20Pumps%20Specification.pdf, Table 1.

manufacturers, efficiency advocates, and other stakeholders throughout 2017 and 2018 on a consensus agreement to develop standards for replacement motors to align with existing U.S. Department of Energy (DOE) DPPP standards. This led to the subsequent development of the DPPP motor Joint Petition, submitted to DOE on August 14, 2018.[43] Key to this recommendation was requiring the American National Standards Institute/Underwriters Laboratories (ANSI/UL) Standard 1004-10-2020 as a part of the label on all DPPP motors. The key component of the ANSI/UL Standard 1004-10-2020 is a requirement that all pool pump motors over 1.15 total horsepower be of multi- or variable-speed design. As of the time of this letter submission, DOE has not proposed a final rule requiring this label, thus EPA could use the ANSI/UL Standard 1004-10-2020 designation to set an ENERGY STAR energy efficiency level for pool pump replacement motors.

Additionally, the California Energy Commission (CEC) adopted a more stringent appliance standard for "Replacement Dedicated-purpose Pool Pump Motors" (RDPPMs) in the state's Appliance Efficiency Regulations (Title 20) in April of 2020. These standards are set to take effect on July 19, 2021, in alignment with the DOE DPPP standard effective date, and requires RDPPMs to have variable-speed capacity over 0.5 total horsepower and requires minimum motor efficiency requirements per the Canadian Standards Association CSA-C747-2009 test procedure at full speed as shown in Figure 3. Background materials for these requirements include technical feasibility, potential savings, and economic impacts are available for EPA to use.[44]

Table ES-1: Proposed Standards for Replacement DPPP Motors

Total Motor Capacity	Prescriptive Requirements	Motor Phase	Minimum Motor Efficiency
Motor hp < 0.5 hp	None	Any	66%
0.5 hp ≤ Motor hp <1.0 hp	Variable Speed	Any	72%
1.0 hp ≤ Motor hp ≤5.0 hp	Variable Speed	Any	80%

Source: CEC

Figure 3: CEC requirements for replacement pool pump motors, effective July 19, 2021.
Source: CA Title 20 (20 CCR § 1605.3), Table G-4.[45]

Either the ANSI/UL Standard 1004-10-2020 or the Title 20 appliance standard efficiency levels would serve the purpose of setting an energy efficiency level for ENERGY STAR. EPA could also consider going beyond these standards to set an even higher bar for efficiency. Regardless, establishing an energy efficiency level for pool pump replacement motors would help address a market imbalance, protect the user experience, encourage utility incentive programs activity, and provide a signal to manufacturers to design even more efficient products.

[43] https://www.regulations.gov/document?D=EERE-2017-BT-STD-0048-0014.
[44] https://efiling.energy.ca.gov/GetDocument.aspx?tn=232151.
[45] Accessed via Westlaw: https://govt.westlaw.com/calregs/Document/IEEDE2D64EF7B4F168C0E85379828A8C2?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default).
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In conclusion, we would like to reiterate our support to EPA's Draft of the Version 3.1 ENERGY STAR Specification for Pool Pumps (Connected Criteria). We thank EPA for the opportunity to be involved in this process.

Sincerely,

Patrick Eilert
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Karen Klepack
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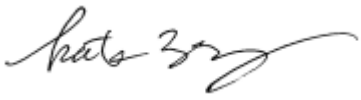

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