

1 Pool Pump Connected Functionality – Draft 1 Criteria

2 **Note:** The U.S. Environmental Protection Agency (EPA) has released this proposed Draft 1 criteria as a follow up
3 to the Connected Functionality Discussion document released in August 2012. This Draft 1 reflects both feedback
4 received from pool pump stakeholders and understanding gained during the development of connected
5 functionality criteria for refrigerators and freezers, recently finalized, and thus is meaningfully evolved since the
6 discussion document.

7 EPA ultimately intends to place the enclosed criteria, once vetted by stakeholders and finalized, into the Pool
8 Pumps Version 1.0 specification starting at Section 4. EPA invites stakeholders to provide comments on the
9 proposed criteria and respond to the questions placed throughout this document. EPA will work closely with
10 stakeholders on the development of these criteria, and will release for stakeholder review, a subsequent draft
11 informed by comments on this draft.

12 In support of the new pool pump connected criteria, the U.S. Department of Energy (DOE) plans to develop a test
13 method for validating pool pumps with connected functionality. DOE is requesting that manufacturers provide
14 products or participate in the development testing of pool pumps with connected functionality.

15 4. Connected Product Criteria

16 The following are optional connected criteria for ENERGY STAR certified pool pumps to be identified on the
17 Qualified Product List (QPL) as having ‘connected functionality.’
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19 **Note:** EPA’s intent in offering connected criteria through the ENERGY STAR program is to help advance the
20 market for products with intelligent features that can offer immediate energy savings and convenience benefits for
21 consumers and smart grid¹ capabilities that will support a low-carbon, reliable, secure, and more affordable
22 electrical grid over the long-term. As part of this, EPA hopes to:

- 23 • Recognize products that offer consumers new functionality that can enable immediate energy savings and
24 convenience opportunities such as: a notification to the consumer that pool pump flow is reduced and filter
25 cleaning or backwashing may be needed to restore energy efficient performance, or the ability to remotely
26 view pool pump energy consumption and configure pump operation through remote displays, smart phones,
27 and tablets;
- 28 • Ensure consumer control at all levels of smart grid deployment by providing users the ability to override any
29 Demand Response (DR) or other remote request at any time; and
- 30 • Encourage manufacturers to design products with DR capabilities that can support a more reliable, lower
31 emissions electric grid by allowing utilities real time load balancing to better accommodate more variable
32 sources of electricity, whether from utility scale generation or distributed sources such as roof-top photovoltaic.
33 Such capabilities could help utilities manage stresses on the grid, such as peak demand, and may allow utilities
34 to avoid new infrastructure investments. Resulting cost savings could be passed on to consumers through lower
35 rates. For consumers with time of use (TOU) or variable rates, DR capable pool pumps can save consumers
36 money through the use of pre-configured default pumping schedules that will automatically avoid times of the
37 day when electricity is more expensive or by responding to event- or price-based signals from the grid that
38 request a temporary change to the pumping schedule.

39 ¹ For further background on the smart grid, see: A Policy Framework for a 21st Century Grid (2011) at
40 <http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc-smart-grid-june2011.pdf> and the 2013 Progress Report at
41 http://www.whitehouse.gov/sites/default/files/microsites/ostp/2013_nstc_grid.pdf

42 **Note (Cont.):** Based on research and input from several ENERGY STAR pool pump stakeholders, EPA is
43 proposing an initial set of optional connected criteria to define and recognize pool pump products in the market
44 that can help achieve the immediate consumer and long term grid benefits mentioned above. The proposed
45 connected criteria for pool pumps also leverage existing connected criteria recently developed through close work
46 with a number of home appliance stakeholders for the ENERGY STAR Version 5.0 Residential Refrigerators and
47 Freezers specification.

48 The connected criteria stress interoperability and the use of open protocols while also reflecting a flexible
49 approach that allows for multiple paths of implementation. This approach provides the Agency a basis upon which
50 to consider products with connected functionality as they begin to enter the market and make more prescriptive
51 changes to the requirements, based on real-world market experience, as warranted.

52 EPA also plans to play a role in consumer education to help further the understanding of the consumer
53 convenience and additional savings opportunities associated with ENERGY STAR products that have connected
54 functionality, as well as how to best capture these savings (e.g. use of energy saving modes / opportunities for
55 smart grid interconnection) and in what scenarios these savings may be realized.

56 **4.1 Acronyms**

- 57 A) API – Application Programming Interface
- 58 B) CPPS – Connected Pool Pump System
- 59 C) DL – Delay Load
- 60 D) DR – Demand Response
- 61 E) ICD – Interface Control Document
- 62 F) TLR – Temporary Load Reduction
- 63 G) TLI – Temporary Load Increase

65 **4.2 Definitions**

66 The following definitions are applicable to Section 4 of this specification:

- 67 A) Communication Link: As shown in Figure 1, the mechanism for bi-directional data transfers between the
68 CPPS and one or more external applications, devices or systems.
- 69 B) Connected Pool Pump System (CPPS): As shown in Figure 1, includes the ENERGY STAR certified pool
70 pump, integrated or separate communications hardware, and additional hardware and software required
71 to enable connected functionality
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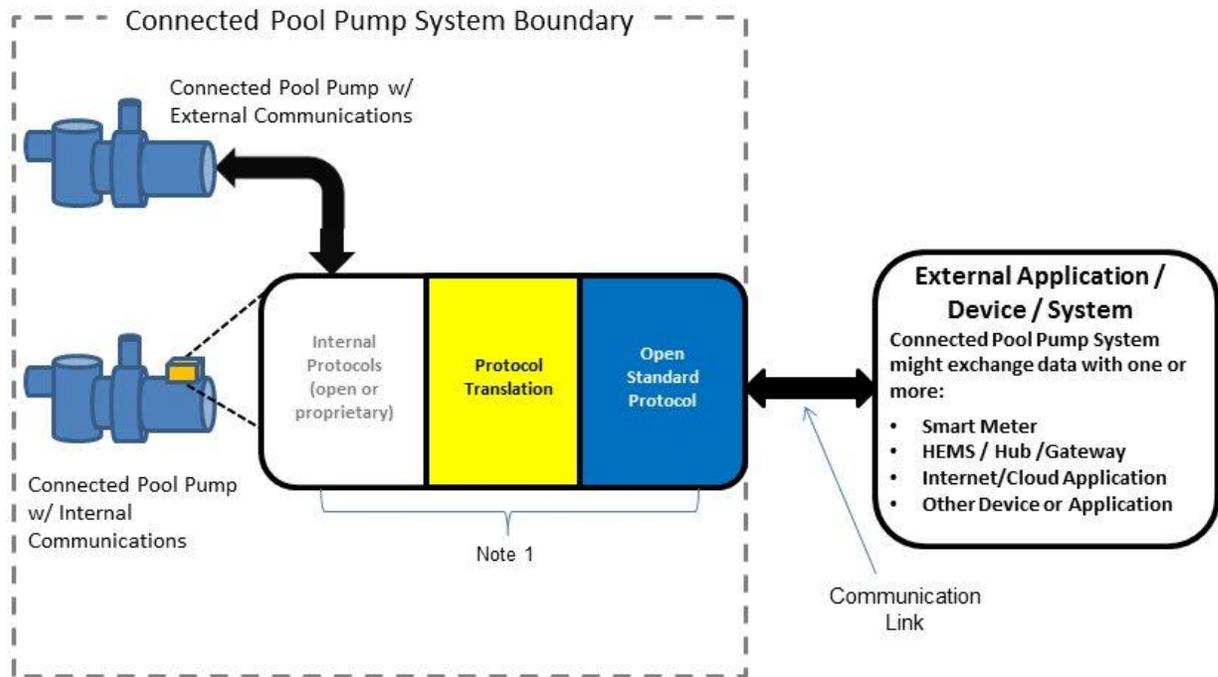


Figure 1. Connected Pool Pump System (CPPS)

Note 1: Communication device(s), link(s) and/or processing that enables open standards-based communication between the CPPS and external application / device / system(s). These elements could be within the pump/controller, and/or an external communication module, a hub/gateway, or in the Internet/cloud.

C) Consumer Authorized Third Party: Any entity for which the consumer has provided explicit permission to access the CPPS connected functionality, in-whole or in-part, via a communication link.

D) Open Standards: Standards that are:

1. Included in the Smart Grid Interoperability Panel (SGIP) Catalog of Standards,¹ and/or
2. Included in the National Institute of Standards and Technology (NIST) Smart Grid framework Tables 4.1 and 4.2,² and/or
3. Adopted by the American National Standards Institute (ANSI) or another well-established international standards organization such as the International Organization for Standardization (ISO), International Electrotechnical Commission (IEC), International Telecommunication Union (ITU), Institute of Electrical and Electronics Engineers (IEEE), or Internet Engineering Task Force (IETF).

E) Premises: Land and the improvements on it.

¹ http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PMO#Catalog_of_Standards_Processes

² http://www.nist.gov/smartgrid/upload/NIST_Framework_Release_2-0_corr.pdf

92 **Note:** In order to enhance clarity and understanding of connected criteria, EPA is proposing to include a list of
93 acronyms and definitions specific to connected functionality within this Section of the specification.

94 EPA proposes that the CPPS system boundary, shown in Figure 1 and to which this criteria applies, includes the
95 pool pump and all internal and/or modular/external devices needed to enable open standards based
96 communication to an external application, device or system (e.g. smart meter, home energy management system,
97 hub, gateway, internet/cloud application). For discussion on the communication requirements for a CPPS, see the
98 Section 4.3 communications note box.

99 EPA has defined the term “consumer authorized third party” as any organization or entity that the consumer has
100 given limited or comprehensive permission to access the CPPS’s connected functionality. Key examples of
101 consumer authorized third parties include the consumer’s utility, home control or home energy management
102 device or application, a security system, or pool automation controller.

103 EPA also proposes defining open standards to include standards associated with the NIST SGIP process as well
104 as standards adopted by ANSI or by recognized international standards organizations. EPA has taken this broad
105 approach to allow manufacturers and market forces to determine which open-standards protocol to apply.

106 EPA is interested in getting feedback on whether Figure 1 helps to solidify the concept and boundaries of a
107 connected pool pump system, as defined by this document.

108 4.3 Communications

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110 A) The CPPS communication link, referenced in Figure 1, shall use open standards for all communication
111 layers to enable functionality required by Energy Consumption Reporting, Operational Status, and
112 Demand Response (Sections 4.4, 4.6 and 4.8).

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114 B) An Interface Control Document (ICD), Application Programming Interface (API), or other documentation
115 shall be made available to interested parties that, at a minimum, allows access to the following
116 functionality:

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118 1. Energy Consumption Reporting specified in Energy Consumption Reporting Section 4.4 (must
119 include accuracy, units, and measurement interval);
- 120 2. Operational Status, User Settings, and Messages specified in Operational Status Section 4.6;
- 121 3. Demand Response (DR) specified in Demand Response Section 4.8.

122 **Note:** A CPPS that enables economical and direct communications, that comply with Sections 4.3A and
123 4.3B, on the consumer’s premises is preferred, but alternative approaches are also acceptable.
124

125 **Note:**

126 **Open Standards and API/ICD**

127 To help advance interoperability and open access, EPA is proposing to require CPPS communication link(s) use
128 open standards for all communication layers and the release of technical documentation (e.g., APIs/ICDs) for
129 functionalities described in Sections 4.4., 4.6, and 4.8. With these requirements, EPA seeks to ensure that:

- 130 • When authorized by the consumer, utilities have access to CPPS DR capabilities, and Consumers are able to
131 take advantage of complementary offerings (e.g., apps) available from third parties, for example, energy
132 management applications and systems that facilitate energy efficient pool pump operation by leveraging
133 CPPS functionality appropriate for energy management (i.e. reporting of energy consumption, operational
134 status, DR status, user settings, and messages related to energy consumption). Use of open standards and
135 open access requirements will support interoperability, enabling multiple devices in the home with connected
136 features to be managed through a single system. Manufacturers could also elect –but would not be required–
137 to include remote management, peak period avoidance, or other connected features that are not defined in
138 Section 4, in the open API/ICD.

139 **Note (cont.):** Also, EPA is proposing that Section 4.5 Remote Management (i.e. starting and stopping the pump
140 and changing speed/flow) and Section 4.7 Peak Period Avoidance be excluded from the Section 4.3 open
141 standards and open access requirements. Initial feedback from pool pump stakeholders has indicated that in
142 order to help ensure a good consumer experience, manufacturers need to have the ability to more selectively
143 provide third party access to remote management and the related peak period avoidable capability, to third parties
144 (i.e., to ensure that a third party does not use these capabilities inappropriately). EPA welcomes further
145 stakeholder feedback on whether these capabilities should continue to be excluded from Section 4.3.

146 **On-premises open communications**

147 Based on research and initial conversations, EPA believes that requiring pool pumps to use open standards on
148 the premises would be overly prescriptive at this early stage in the market deployment and may limit innovation
149 and drive up product costs. The Agency noted that some current utility pilots of DR enabled pool pumps do not
150 appear to use open standards on the consumers' premises. Considering this, EPA believes that it is currently in
151 the consumers' interest for the market to continue to test a range of options. EPA recognizes that a number of
152 utility stakeholders have already expressed concern – through related ENERGY STAR specification development
153 processes – with communication architectures that do not provide open standards-based communication access
154 within a consumer's home or on site (e.g., open standards-based interconnection is only possible in the
155 internet/cloud with proprietary signaling to/from a connected product such as a CPPS). These utilities have
156 opposed architectures that enabled open standard communications only in the cloud since they require: 1)
157 consumers to have an Internet connection; and 2) utilities to interface with a product manufacturer's cloud based
158 solution, rather than directly with a consumer's pump, which could drive cost and complexity for utilities, introduce
159 data privacy and security concerns, and reduce consumer choice by not providing options on who "manages"
160 their appliances.

161 To this end, EPA is proposing language in Section 4.3 that stresses interoperability and the use of open protocols
162 for relevant connected functionality in Section 4. While a preference is expressed for open communications on
163 the consumer's premises in light of the needs that have been articulated by a number of utilities, alternative
164 approaches would also be acceptable, again during this period of market exploration. Taking this approach
165 provides the Agency a basis upon which to consider products with connected functionality as they begin to enter
166 the market and to make further changes to the requirements, based on real-world market experience, as
167 warranted. EPA welcomes stakeholder feedback on this proposed approach.

168 EPA also welcomes stakeholder comments on the proposed communications criteria, and feedback on the
169 following questions:

- 170 1. What communication protocols are being piloted, deployed, or considered by utilities, third parties,
171 or product manufacturers, and why?
- 172 2. Do current or planned protocols support on-premises open-standards communications?
- 173 3. Do manufactures see any barriers to creating and releasing ICD's and/or API's to third party developers?

174 **4.4 Energy Consumption Reporting**

175 Whenever pumping, the CPPS shall be capable of transmitting energy consumption data representative of
176 its interval energy consumption to consumers and consumer authorized third parties via a communication
177 link.

178 **Note:** EPA recommends that energy consumption data be reported in watt-hours for intervals of 15 minutes
179 or less, however, representative data may also be reported in alternate units and intervals as specified in the
180 interface specification or API detailed in Section 4.2. The CPPS may also provide energy use feedback to
181 the consumer on the product itself and use any units and format (e.g., \$/month).

182 **Note:** Stakeholders have indicated that there are pool pumps available from multiple manufacturers that track and
183 display energy consumption. EPA proposes including energy consumption reporting in Section 4.3B to ensure
184 that third parties will be able to access the available energy use data over the CPPS' communication link, with
185 consumers' consent. EPA believes this will stimulate development of energy management tools and services that
186 can use this information to provide consumers simple, actionable feedback encouraging reduced consumption
187 through schedule optimization, coordination with TOU rate schedules, and responsiveness to dynamic pricing.
188 EPA envisions that the effectiveness of home energy management systems and applications will be greatly
189 enhanced when energy use reporting from multiple consumptive residential loads is available.

190 Consistent with typical smart meter interval data reporting, EPA recommends reporting in watt-hours for intervals
191 of 15 minutes or less but allows alternate units and reporting intervals.

192 **4.5 Remote Management**

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194 A) At minimum, the CPPS shall be capable of responding to consumer authorized signals received via a
195 communication link requesting:

- 196 1. A start or stop to pumping, and
- 197 2. A change to pumping speed and/or flow rate

198 B) The CPPS is not required to respond to remote requests that would compromise safety as determined by
199 the manufacturer.

200 **Note:** Based on initial research and stakeholder input, EPA believes the proposed remote management criteria,
201 while simple and straightforward, will enable full control of the CPPS operation by consumer authorized signals
202 received over a communication link. The CPPS is not required to respond to requests that would impact safety
203 (e.g., safe and orderly shutdown of pool heaters and/or chemical-feed systems).

204 As noted earlier, EPA has not included remote management in Section 4.3; thus, manufacturers could continue to
205 more selectively offer third-party access to remote management functionality.

206 EPA welcomes stakeholder feedback as to whether the specified remote management functionality is adequate to
207 allow consumers to remotely control their CPPS.

208 **4.6 Operational Status, User Settings & Messages**

209 A) At minimum, the CPPS shall be capable of providing the following information to consumers and
210 consumer authorized third parties via a communication link:

- 211 1. Operational status including off, on, pump speed, and flow rate
- 212 2. DR status including delay load and temporary load reduction
- 213 3. Program schedule including schedule times and scheduled operation

214 B) The CPPS shall be capable of providing at least two types of messages relevant to its energy
215 consumption, either:

- 216 1. On the product, and/or
- 217 2. Transmitted to consumers and consumer authorized third parties via a communication link.

218 **Note:** For example, messages relevant to energy consumption for pool pumps might address a fault
219 condition, a reminder to clean/flush the filter, or a report of energy consumption that is outside the
220 product's normal range.

221 **Note:** Section 4.6A criteria has been proposed to ensure that consumer authorized third parties, including those
222 entities authorized to send DR signals, are able to receive information, via a communication link, in order to
223 assess the order of magnitude of dispatchable pool pump loads prior to signaling. EPA expects that this criteria
224 will be particularly important for products with scheduling capability, such as residential pool pumps, that may be
225 off or already operating at reduced flow.

226 Section 4.6B specifies that the CPPS must provide consumers and consumer-authorized third parties with at least
227 two types of messages relative to the product's energy consumption, e.g., to inform consumers of a pump fault
228 condition or let consumers or to their pool servicer know that the pool filter needs to be serviced. EPA's intent is
229 to encourage features that can help consumers save energy by keeping their pool pumps operating at peak
230 efficiency. In order to provide stakeholders flexibility in implementation, these messages may be provided either
231 on the product display, transmitted via a communication link, or both.

232 EPA welcomes stakeholder comments on the proposed criteria for CPPS operational status reporting and
233 responses to the following questions:

- 234 1. Is the proposed level of operational status reporting detail appropriate to inform utility load-balancing interests?
- 235 2. What other information regarding the product's energy consumption do stakeholders see as helpful to
236 consumers?
- 237 3. Are there consumer privacy considerations and if so, how are these being managed?

238 **4.7 Peak Period Avoidance**

239 A) By default, the pool pump system shall limit operation within a 6-hour, 12 Noon to 6pm period, in
240 accordance with Table 2.

241 B) The CPPS shall provide an option for the consumer and/or a consumer authorized third party to modify
242 scheduling and functional status of this capability.

243 **Note:** For example, schedule modifications may be made to respond to a short term request from the
244 utility, align the avoidance period with on-peak periods for their utility, shift the avoidance period to align
245 with winter peaking, or enable/disable the capability.

246 C) Upon restoration of power after an outage, the CPPS shall not require any interaction from the consumer
247 in order for peak period avoidance to continue with the same settings as prior to the outage.

248 **Note:** EPA is proposing the above peak period avoidance criteria such that the CPPS, as shipped and without
249 participation in a DR program, avoids high-speed, consumptive operation during a 6-hour period that is designed
250 to capture the most common peak periods for electric utilities. The 12 Noon to 6pm avoidance period aligns with
251 peak demand in warmer months. By reducing consumption during this time, the grid will benefit from reduced
252 demand during traditional peak demand periods. Consumers who participate in TOU or other variable price
253 programs that incur higher rates during the peak periods, will benefit from savings on their electric bill.

254 EPA proposes that peak period avoidance may be freely modified or disabled by the consumer and, by extension,
255 the installer. As such, EPA understands the importance of informing both consumers and installers of the benefits
256 associated with this capability and plans to work with stakeholders to develop educational content for the
257 ENERGY STAR website that encourages users to utilize the functionality.

Note (cont.): As noted earlier, EPA is not proposing to include the peak period avoidance capability in Section 4.3. As a result, consumers would be able to modify peak period avoidance scheduling and functional status, while manufacturers could also more selectively provide third parties with the ability to change this peak period avoidance functionality. EPA welcomes stakeholder comments on the proposed peak period avoidance criteria and responses to the following questions:

1. Does the proposed avoidance strategy and schedule effectively align with utility goals?
2. What, if any, potential impacts are there on consumer expectations and pool health when participating in both peak period avoidance and DR if reduced pumping occurs over an extended time period?
3. Are there any impacts of allowing only consumers to modify CPPS peak period avoidance functionality?

4.8 Demand Response

A) At a minimum, the CPPS shall be capable of responding to consumer authorized signals by providing the following:

1. Type 1 Response:
 - a. Upon receipt of a signal and in accordance with consumer settings, the CPPS shall respond in accordance with Table 2.
 - b. The CPPS shall ship with default settings that enable a response in accordance with 4.8A1a for at least 4 hours.
 - c. The CPPS shall be able to provide at least one Type 1 response in a rolling 24-hour period.
 - d. The CPPS is not required to respond if doing so would compromise safety as determined by the manufacturer.
 - e. The consumer shall be able to modify, disable, or override the product's Type 1 response without limitation.

Table 2. Peak Period Avoidance and Type 1 Response	
Pump Type	Allowable Operation
Single-Speed	No pumping shall be performed
Multi-Speed	Pumping shall be limited to the lowest available speed
Variable Speed/Flow	Pumping shall be limited to $\leq 1/3$ of full-speed/flow

2. Type 2 Response:
 - a. Upon receipt of a signal and in accordance with consumer settings, the CPPS shall terminate pumping for the duration of the requested response period.
 - b. The CPPS shall ship with default settings that enable a response in accordance with 4.8A2a for a time period of least 20 minutes.
 - c. The CPPS shall be able to provide at least three Type 2 responses in a rolling 24-hour period.

- 288 d. The CPPS is not required to respond if doing so would compromise safety as determined by the
289 manufacturer.
- 290 e. The consumer shall be able to override the product's Type 2 response without limitation.
- 291 3. Type 3 Response:
- 292 a. Upon receipt of a signal and in accordance with consumer settings, the CPPS shall initiate
293 pumping by increasing pumping speed/flow or extending pumping duration within the requested
294 response period.
- 295 b. This response shall be limited such that the pumped volume is not decreased and energy
296 consumption is not increased compared to the scheduled operation for that day.
- 297 c. The CPPS is not required to respond if doing so would compromise safety as determined by the
298 manufacturer.
- 299 d. The consumer shall be able to override the product's Type 3 response without limitation.

300 **Note:** EPA is proposing that the ENERGY STAR CPPS include, at a minimum, three minimum DR capabilities
301 including:

- 302 - Type 1 Response: a longer-duration but smaller load reduction;
- 303 - Type 2 Response: a shorter-duration but larger load reduction; and
- 304 - Type 3 Response: a temporary increase in pumping speed/flow or an extension in pumping duration (that must
305 be offset by a later reduction in pumping, so as to not increase energy consumption).

306 Proposed load reduction magnitudes, durations, and response frequencies have been informed by research and
307 initial pool pump stakeholder outreach. The proposed criteria have been designed to balance potential consumer
308 impact (e.g. pool health, typical pumping times, and noise considerations) against grid benefits (e.g. emergency
309 shedding, peak demand reductions, and load balancing).

310 The Type 1 responses are specified according to the pump type (i.e. single, multi, and variable flow/speed
311 pumps), in order to maximize the load reduction potential for each type, while allowing most pumps to continue
312 operating at reduced speed/flow.

313 Independent of pump type, the proposed Type 2 capability would require the CPPS to terminate pumping for the
314 duration of the requested response period; the pump's default setting would reduce load for least 20 minutes.
315 Stakeholders indicated this capability would support a utility's need to quickly shed load, in order to, for example,
316 avoid a blackout or brown-out situation.

317 In contrast to the Type 1 and 2 responses where pumping is reduced, a CPPS Type 3 response would extend
318 near-term pumping duration or increase its speed/flow, thereby shifting load away from another scheduled time, to
319 the requested time period. The CPPS must limit its response such that scheduled daily pumping activity is
320 achieved without an increase in overall daily energy consumption. Utility stakeholders have indicated this
321 capability could provide additional load balancing grid benefits by, for example, shifting pool pump operation to
322 time periods with unexpectedly high energy supply from variable renewable energy sources such as from wind
323 and solar. In addition, this capability could save money for consumers that participate in TOU or other variable
324 electricity pricing programs, as these periods would likely coincide with off-peak rates.

325 For all three capabilities:

- 326 - The CPPS is not required to respond to a request that would impact safety; for example, with pool heaters
327 and/or chemical-feed systems that require orderly pump shutdown.
- 328 - Consumers may override at any time.

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Note (Cont.): EPA welcomes stakeholder comments on these DR criteria and responses to the following questions:

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1. Will the proposed Type 1 responses per pump type, default 4-hour minimum duration, and 1x per 24-hour minimum response frequency provide tangible grid benefits while limiting consumer impacts?

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2. Will the proposed Type 2 response, default 20-minute duration, and 3x per 24-hour response frequency provide tangible grid benefits while limiting consumer impacts?

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3. Will the proposed Type 3 response provide grid benefits while effectively guarding consumers against the potential for responses that increase overall consumption or decrease the daily pumped volume? What is the impact to pool pump manufacturers relative to this additional proposed layer of consumer protection?

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4. What changes, if any, do stakeholders recommend in order to provide increased grid benefits, or conversely to limit consumer impacts?

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4.9 Information to Installers and Consumers

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If additional modules, devices, services, and/or supporting infrastructure are required in order to activate the CPPS's communications capabilities, installation instructions and a list of these requirements shall be made available at the point of purchase and prominently displayed in the product literature. It is also suggested that information be provided on the product packaging and on the product. These instructions shall provide specific information on what must be done to activate these capabilities (e.g. a product package or product label might briefly state "*This product has Wi-Fi capability and requires Internet connectivity and a wireless router to enable interconnection with external devices, systems or applications.*").

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Note: EPA believes that it is imperative that installers and consumers have adequate information made available to them to take full advantage of the CPPS's connected functionality. Section 4.9 specifies that instructional information be provided by manufacturers, informing installers and consumers of what additional modules, devices and/or infrastructure are necessary to activate the product's communication capabilities.

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6. TEST REQUIREMENTS

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Compliance with connected criteria, as specified in Section 4, shall be through examination of product and/or product documentation. In addition, DR functionality shall be verified using the ENERGY STAR Test Method to Validate Demand Response (Rev. TBD) once available.

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Note: DOE is initiating the development of a test method to validate connected functionality of pool pumps. The timeline will be dependent upon obtaining products for testing.