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NRDC Submission of Draft Joint Appendix 13 on Water Heater Demand Management

Additional submitted attachment is included below.

NRDC
NATURAL RESOURCES DEFENSE COUNCIL

April 26, 2019

Commissioner McAllister
California Energy Commission
1516 9th St, Sacramento, CA 95814

Re: NRDC Submission of Draft Joint Appendix 13 on Water Heater Demand Management

Dear Commissioner McAllister:

The Natural Resources Defense Council (NRDC) appreciates the opportunity to submit to the California Energy Commission (CEC) a revised draft of a Heat Pump Water Heater Demand Management specification intended to be included in the 2019 Building Energy Efficiency Standards (Title 24 Part 6) as a new joint appendix, to support a compliance option in the 2019 code.

The draft specification included as an appendix to this comment letter is a revision of the version attached to our March 1, 2019 comments on the Alternative Compliance Method (ACM), and of the initial draft attached to our Feb. 21, 2018 comments on the proposed 2019 standards regulatory language.

This proposal sets forth the requirements for a heat pump water heater to be eligible for a self-utilization credit under the 2019 building code, like battery storage. This proposed specification is the outcome of a year-long stakeholder process facilitated by NRDC which included two in-person meetings and a dozen conference calls.

This submission includes the input from a broad group of stakeholders including AO Smith, Bradford-White, GE Appliances, HTP, Rheem, Sanden, Steffes, PG&E, SCE, Sempra, LADWP, SMUD, EPRI, Bonneville Power Administration, Portland General Electric, Northwest Energy Efficiency Alliance, Aquanta, Olivine, SkyCentrics, Virtual Peaker, Building Decarbonization Coalition, Consortium for Energy Efficiency, Ecotope, US EPA, LBNL, OpenADR Alliance, Redwood Energy.

Heat pump water heaters can store energy in the form of hot water at times when electric demand is low and renewable electricity is abundant such as in the middle of the day and release that stored energy when needed by the customer without using electricity during grid peak demand times, helping balance the grid, integrate renewable energy, and reduce customer bills.[1]

[1] Delforge P., Vukovich J., "Can Heat Pump Water Heaters Teach the California Duck to Fly," ACEEE Summer Study 2018.

NRDC strongly supports CEC's intention stated at multiple workshops to include a compliance credit for heat pump water heaters that utilize their thermal storage capacity to provide daily load shifting for the purpose of customer bill reductions, maximized solar self-utilization, and grid harmonization.

Providing a compliance credit will encourage adoption of this technology by builders in new construction in California, creating market demand for demand-flexible water heaters. The attached specification provides a clear set of requirements for manufacturers to design to, enabling them to bring products to market to meet the demand for demand-flexible heat pump water heaters and spur adoption of this technology in California and beyond.

Respectfully submitted,

Pierre Delforge
Senior Scientist
Natural Resources Defense Council

Joint Appendix JA13

Appendix JA13 – Qualification Requirements for Heat Pump Water Heater Demand Management Systems

JA13.1 Purpose and Scope

Joint Appendix JA13 provides the qualification requirements for a heat pump water heater demand management system ("System") to meet the requirements for heat pump water heater demand management compliance credit available in the performance standards set forth in Title 24, Part 6, Sections 150.X(x). The primary function of the System is to serve the user's domestic hot water needs and provide daily load shifting, as applicable, for the purpose of customer bill reductions, maximized solar self-utilization, and grid harmonization.

User interfaces referenced in these requirements should be designed for use by a typical residential user.

JA13.2 Definitions

Heat Pump Water Heater Demand Management System

The Heat Pump Water Heater Demand Management System is comprised of:

(a) Any hardware or software contained inside the water heater;

(b) Any hardware or software installed on premise (including a module); and

(c) Any software contained in applications or in the cloud;

which are necessary to fulfil the primary function of the System.

Local and remote methods

A local method means a method that can be performed from within the building and does not require the System to have a live connection to an off-premise source. A temporary connection **to a live off-premise source** such as via a smart phone, may be used for local setup and updates.

A remote method means a method that is performed via a live connection to an off-premise source, such as the internet, advanced metering infrastructure (AMI), or cellular.

JA13.3 Qualification Requirements

To qualify as a Heat Pump Water Heater Demand Management System for use for compliance with the applicable performance compliance credit, the System shall be certified to the Energy Commission to meet the following requirements:

JA13.3.1 Safety Requirements

The System shall comply with installation standards that are applicable in the California electrical, mechanical, and plumbing codes.

A thermostatic mixing valve that closes in a position that only allows cold water to flow on failure must be installed. The thermostatic mixing valve may be built into the water heater or installed separately.

JA13.3.2 Minimum Performance Requirements

The installed System should meet or exceed the following performance specification:

(a) Efficiency: for heat pump water heaters, meet the requirements of the version 6.0 of the Northwest Energy Efficiency Alliance (NEEA) Advanced Water Heater Specification Tier 3 or higher.

(b) Thermal storage: comply with the first hour rating requirements in the following table (Chapter 5, Table 501.1 in 2018 Uniform Plumbing):

Number of bathrooms	1 to 1.5			2 to 2.5				3 to 3.5			
Number of bedrooms	1	2	3	2	3	4	5	3	4	5	6
First Hour Rating (gallons)	38	49	49	49	62	62	74	62	74	74	74

JA13.3.3 Control Requirements

The requirements below are applicable to all control strategies:

(a) **Time-of-use schedules:** The System shall have the capability of storing at a minimum five time-of-use schedule(s) locally, each supporting at a minimum five distinct time periods for both weekdays and weekends, at least three separate seasonal schedules, and daylight savings time changes. The System shall support both local and remote setup, selection, and update of time-of-use schedules. Local and remote setup, selection, and update shall be possible through a user interface (such as an app).

(b) **Demand management functionality**

Upon receiving a demand management price or dispatch signal, the System shall be capable of the following automatic event responses:

1. **Load-up**: The water heater will store extra thermal energy, and avoid use of electric resistance elements unless customer needs cannot be met;
2. **Light shed**: The water heater will defer complete recovery for the duration of the shed event unless customer needs cannot be met; The water heater shall avoid use of electric resistance elements during and immediately after the event unless customer needs cannot be met;

3. **Deep shed**: light shed, and completely avoid use of electric resistance elements during the event;
4. **Full shed**: light shed, and completely avoid use of both compressor and electric resistance element during the event.

The demand management signals may be sent from a local utility, a remote aggregator, a local demand manager (e.g. local time-of-use demand manager or grid-edge such as smart inverter), or internal to the water heater (e.g. internal schedule- or price-based demand management).

The System shall be able to shift a minimum of 0.5 kWh of customer electrical energy per load shifting event (load up and light shed) for an appropriately sized water heater per JA13.3.2 guidelines.

(c) **Non-standard mode exception:** The demand management functionality shall function in all customer-selected modes except for vacation and off modes. The System shall return to the previous standard operation mode once the water heater exits from non-standard mode.

(d) **Local time management**: The System settings, including operating mode, time-of-use schedules, and local clock, shall be retained or reacquired in the event of a loss of power for at least three months. The local clock shall have a maximum drift of less than 5 minutes per year under standard operating conditions and without requiring remote connectivity.

(e) **Override and permanent disabling:** The System shall provide local and remote means for the user to override or permanently disable the demand management function. The override shall be temporary and have a maximum duration of 72 hours. Permanent disabling shall not be available as an operating mode or as an option in the primary menu.

(f) **User interface**: The System shall provide both a remote and local user interface, such as a web-based portal or a mobile device application, that at a minimum provide the dwelling occupants access to the following information: control strategy that is currently active, remote or local demand management mode, selected time-of-use schedule if applicable, and confirmation of any settings change.

(g) **Measurement and validation**: When connected remotely, the System shall make the following data available: Demand Management Override Status, Demand Management Disabled Status; power demand (watts); cumulative energy consumption (watt-hours); total energy storage capacity (watt-hours), available energy storage capacity (watt-hours).

At the time of inspection, the System shall be installed to meet one of the following control strategies. The System also shall have the capability to be switched to the other control strategies.

JA13.3.3.1 Time-of-Use (TOU) Control

To qualify for the TOU Control, the System shall be installed in the default operation mode to serve domestic hot water user needs while optimizing water heater operation to reduce user bills under the

selected time-of-use schedule. The System shall load up (charge) during the lowest priced TOU hours of the day and shed (minimize charging while serving user needs) during the highest priced TOU hours.

JA13.3.3.2 Advanced Demand Response Control

To qualify for the Advanced Demand Response Control, the System shall meet the demand responsive control requirements specified in Section 110.12(a). Additionally, the System shall be capable of changing the load-up and shed periods in response to real-time or day-ahead dispatch or price signals from the local utility, a remote aggregator, or a local demand manager. If remote communication is lost for more than 12 hours while the water heater is under Advanced Demand Response Control, the water heater shall revert to TOU Control until remote communication is reestablished, and then revert back to Advanced Demand Response Control.

JA13.3.3.3 Alternative Control Approved by the Executive Director

The Executive Director may, after stakeholder consultation, approve alternative control strategies that demonstrate equal or greater benefits to one of the JA13 control strategies. To qualify for Alternative Control, the System shall be operated in a manner that increases self-utilization of the PV array output, responds to utility rates, responds to demand response signals, and/or other strategies that achieve equal or greater benefits. This alternative control option shall be accompanied with well-documented algorithms for incorporation into the compliance software for compliance credit calculations.

JA13.4 Enforcement Agency

The local enforcement agency shall verify that all Certificate of Installations are valid. The System shall be verified as a model certified to the Energy Commission as qualified for a Heat Pump Water Heater Demand Management System Credit.