Appendix H - Demand Responsive Controls

This appendix to the residential compliance manual addresses the demand responsive (DR) control requirements in the 2019 Building Energy Efficiency Standards (Energy Standards).

Demand response is an increasingly important function of buildings as distributed energy resources become more common and customers have access to time of use electricity rates and incentive programs designed to encourage demand side optimization. Demand response occurs on a range of timescales, from seconds to seasons, and represents any demand change in response to grid or economic needs. In addition to current time of use electricity rates, utilities in the future will likely connect electricity costs to high frequency fluctuations in both the supply and demand for electricity. Appropriate demand responsive controls allow building operators to maintain the quality of services a building provides and reduce the total cost of energy by automating a building's response to changes in electricity rates.

The following definitions from §100.1 are relevant to the DR control requirements:

> **Demand response** is short-term changes in electricity usage by end-use customers, from their normal consumption patterns. Demand response may be in response to:
>
> a. Changes in the price of electricity; or
>
> b. Participation in programs or services designed to modify electricity use.
>
> i. In response to wholesale market prices.
>
> ii. When system reliability is jeopardized.
>
> **Demand response period** is a period of time during which electricity loads are modified in response to a demand response signal.
>
> **Demand response signal** is a signal that indicates a price or a request to modify electricity consumption for a limited time period.
>
> **Demand responsive control** is an automatic control that is capable of receiving and automatically responding to a demand response signal.

The DR control requirements ensure that the building is DR capable (i.e., capable of responding to a DR signal). The decision to employ demand response is up to the building owner or manager, in coordination with their utility company and/or a governing authority. A building that is capable of receiving and responding to a demand response signal is sufficient to meet the requirements of the Energy Standards. DR-capable is described as follows:

> **DR-capable:** A building is capable of DR when the building has loads that can be curtailed, DR controls are installed, and the controls have been programed/configured so the test control strategy that is defined in the building code can be deployed (note: the DR controls can be programmed with additional control strategies).

DR-enabled: A building's DR is enabled when the connection between the entity that sends the DR Signal and the DR control in the building has been tested and communications have been allowed or "enabled".

DR-enrolled: A building is enrolled when the building owner/occupant has enrolled in a DR program (note: this may include updating the settings or programming of the DR controls to better match the terms of the program).

The requirements for DR controls only apply if the controls are used to comply with the building standards (i.e., DR Thermostats or a heat pump water heater). If DR control are installed voluntarily and do not contribute to compliance with minimum code requirements, they do not need to adhere to requirements in Title 24, Part 6. (For residential dwellings, DR controls are only required as a part of specific Exceptions to HVAC and Solar Ready requirements.)

1. Communications Requirements for DR Controls

§110.12(a)1-3

There are two main communication requirements that apply to all DR controls:

1. The control must, at minimum, be able to understand a signal sent using OpenADR; and
2. The control must, at a minimum, be able to receive signals over one of the specified paths.

These are minimum requirements, meaning that the control can have (and use) additional communication features provided that the required features are included.

1.1 Communication With Entity That Initiates DR Signal

§110.12(a)1

DR controls must have the capability of communicating with the entity that initiates a DR signal by way of an OpenADR certified virtual end node (VEN).

The OpenADR 2.0 protocol is the primary open-standard protocol used in the California market. It implements a profile within the Organization of Structured Information Standards (OASIS) Energy Interoperation information and communication model that defines two types of communications entities – virtual top nodes (VTNs) and virtual end nodes (VENs). VTNs are information exchange servers typically operated by utilities or third-party providers and can dispatch events. VENs are the recipients of DR payloads and are typically the gateway or end-use devices installed at customer facilities throughout a dispatcher's territory. See OpenADR Alliance's website (http://www.openadr.org/) for more information about OpenADR certified VENs.[1]

There are two ways to comply with the OpenADR certified VEN requirement:

1 The OpenADR Alliance's Frequently Asked Questions web page is a helpful resource: http://www.openadr.org/faq.

Option A: Install an OpenADR 2.0a or 2.0b certified VEN within the building as part of the DR control system (§110.12(a)1A)

If complying using Option A (§110.12(a)1A), the designer of the DR control system(s) must select a VEN that the OpenADR Alliance has certified as being compliant with the OpenADR 2.0a or 2.0b specification.[2] The OpenADR Alliance maintains a list of certified VENs (https://products.openadr.org/). If using Option A, the certified VEN must be installed inside the building at the time of inspection. The building can comply if the DR control system has a certified VEN that is incorporated into a networked system of devices such that the single VEN communicates control strategy information to multiple devices in the network (e.g., a gateway system), or if each device (e.g., thermostat) in the building is itself a certified VEN.

Option B: Install a DR control system that has been certified to the Energy Commission as being capable of communicating with an OpenADR 2.0b certified VEN (§110.12(a)1B)

If complying using Option B (§110.12(a)1B), the designer of the DR control system(s) must select a DR control system that the Energy Commission has approved for the certified list of DR control systems. The Energy Commission maintains a list of certified products and instructions on how manufacturers can certify products on their website: http://www.energy.ca.gov/title24/equipment_cert/. If using Option B, the manufacturer of a DR control system must submit documentation to the Energy Commission confirming that the DR control system is capable of communicating with an OpenADR 2.0b certified VEN.

Option B requires that the manufacturer of the DR control system certify to the Energy Commission that the control system is capable of communicating with an OpenADR 2.0b certified VEN. This requirement does not mean that the DR control system must be connected to a 2.0b certified VEN. When the DR control system is connected to a VEN, it can be connected to either a 2.0a or 2.0b certified VEN.

As discussed in Section 1.3 below, the DR control system must comply with Option A or Option B, but the control system can also include features that allow the control system to use other communications protocols. It should also be noted that if using Option B, the DR control system is capable of communicating with an OpenADR 2.0b certified VEN, but that does not mean that DR programs have to used OpenADR 2.0b in their programs.

When specifying DR control systems, it is recommended that the controls designer check to see which DR programs are currently available in the area and specify controls that are both compliant with Title 24, Part 6, and eligible for the area's DR programs.

1.2 Communication Pathways

§110.12(a)2

2 The OpenADR 2.0a and 2.0b specifications are available on the OpenADR Alliance's website: http://www.openadr.org/specification.

DR controls must be capable of using one or more of the following to communicate (i.e., send and receive signals):

- Wi-Fi: for more information see the Wi-Fi Alliance website: https://www.wi-fi.org/.
- ZigBee: for more information see the ZigBee Alliance website: http://www.zigbee.org/.
- BACnet: for more information see http://www.bacnet.org/.
- Ethernet; or
- Hard-wiring.

As described in Section 1.3 below, DR control systems can also support additional communications protocols.

1.3 Additional Communication

§110.12(a)3

Section 110.12(a)3 explicitly states that DR controls are allowed to use communications protocols in addition to the ones required above. This means that the control can communicate with entities that initiate DR signals using different protocols, including but not limited to proprietary protocols and other non-proprietary protocols like the American National Standards Institute (ANSI) / Consumer Technology Association (CTA) Standard for Modular Communications Interface for Energy Management (ANSI/CTA-2035-A), provided that it complies with one of the options for OpenADR compatibility. Similarly, the DR control system is allowed to use other physical means of communication provided at least one of the specified methods is supported.

The DR control may use any of its available communication features to participate in DR programs.

2. Other Requirements for DR Controls

2.1 Perform Regular Functions When Not Responding to DR Events

§110.12(a)4

Controls that include demand response with other control functions must perform their regular control functions, as required by other parts of the building code, when the control is not performing DR-related functions. This includes when the controls are not responding to a DR event, when the DR functions are not enabled (see description of DR-enabled in the introduction to this chapter of the compliance manual) or when the DR controls are temporarily disabled or disconnected (e.g., due to a network outage).

For example, if the building owner/operator never enables the DR controls or enrolls in a DR program, the building control system(s) must comply with all other applicable controls requirements and continue to provide those control functions. Similarly, if the building owner/operator does enable the DR controls and is enrolled in a DR program, the building control system(s) must perform as required by the applicable building code requirements whenever the building is not participating in a DR event. The DR control functionality is an additional control feature on top of all of the other required building controls.

2.2 Certification Requirements for DR Thermostats

§110.12(a)5

Residential DR thermostats, also called Occupant Controlled Smart Thermostats (OCSTs), must comply with the technical specifications described in Joint Appendix 5 (JA5). According the requirement in JA5, manufacturers of DR thermostats must submit documentation to the Energy Commission to certify that the thermostat meets the code requirements. See the Energy Commission's website for a list of certified products and for instructions to manufacturers that wish to certify products: http://www.energy.ca.gov/title24/equipment_cert/.

3. DR Controls for Power Distribution Systems

§130.5(e)

DR controls for HVAC equipment may be installed at the circuit level; in this case, the DR controls must meet the complete requirements for DR thermostatic controls.

4. Energy Management Control Systems / Home Automation Systems

Required thermostatic and lighting control functions (including DR control functions) can be incorporated into and performed by an energy management control system (EMCS). Using an EMCS to perform these control functions complies with Title 24 provided that all of the criteria that would apply to the control are met by the EMCS.

A Home Automation Systems that manages energy loads (such as HVAC and lighting systems) is considered a type of energy management control system and, as such, can similarly incorporate the ability to provide required control functions.