Welcome to Module 5 of the nonresidential lighting controls video series. In this module, we will focus on automatic daylighting controls. Automatic daylighting controls reduce or shutoff lighting when daylight is present in the space. In this module, we’ll provide information on automatic daylighting controls required by the 2016 Building Energy Efficiency Standards including an introduction to the technologies that will be discussed in this Series, applications, requirements, and Compliance documentation.

Let’s begin by discussing the uses of daylighting controls. Automatic daylight controls are used to reduce electric lighting energy use by reducing electric lighting power in response to available daylight. These controls are required in daylit zones to automatically reduce or shut off lighting when sufficient daylight is available. A daylit zone is a building area considered to be close to a daylight source. In the built environment, daylight sources include windows, clerestories, roof monitors and skylights. Luminaires installed in daylit areas can be dimmed or switched off when sufficient daylight is available. The 2016 Energy Standards define three types of daylit zones. These daylit zones must be shown on building plans.

Now let’s discuss mandatory requirements. Skylit daylit zone refers to an area under a skylight. It extends 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight. It does not include any daylit areas that fall beyond a permanent obstruction that is taller than one-half the distance from the floor to the bottom of the skylight. Primary sidelit daylit zone is the area directly adjacent to vertical glazing. It is one window head height deep into the area, and is as wide as the window width plus 0.5 times window head height wide on each side. It does not include any daylit areas that extend beyond a permanent obstruction of 6 feet or taller. Secondary sidelit daylit zone is the area directly adjacent to each primary sidelit daylit zone. It extends two window head heights deep into the area if measured from the window itself. It is the same width as the primary daylit zone. It also does not include any area that extends beyond a permanent obstruction that is 6 feet or taller as measured from the floor.

There is a specific control structure that must be followed for luminaires in daylit zones. Under the 2016 Standards: luminaires that provide general lighting in skylit daylit zones or primary sidelit daylit zones must be controlled independently from other lighting. Luminaires in the skylit daylit zone must be controlled separately from those in the primary sidelit daylit zones. And luminaires that fall in both a skylit and primary sidelit daylit zone must be controlled as part of the skylit daylit zone.

For luminaires in daylight zones, automatic daylighting controls must be installed and configured to operate according to specific requirements contained in Section 130.1(d) of the Energy Standards. Photo sensors must be installed where they are not readily accessible to unauthorized personnel, however authorized personnel should be able to easily access them. Controls may be inside a locked case or under a cover, which requires a tool for access. Automatic daylighting controls must provide functional multi-level lighting having at least the number of control steps in TABLE 130.1-A, with an
exception for spaces having a lighting power density less than 0.3 watts per square foot. The combined illuminance from the controlled lighting and daylight must not be less than the illuminance from controlled lighting for each space when no daylight is available. In areas with daylight controlled lighting, when daylight illuminance is greater than 150% of the design illuminance received from the general lighting system at full power, the general lighting power in that daylight zone must be reduced by a minimum of 65%. There are exceptions to the requirements:

- Rooms in which the combined total installed general lighting power in the skylit daylit zone and primary sidelit daylit zone is less than 120 watts.
- Rooms that have a total glazing area of less than 24 square feet.
- Parking garages complying with Section 130.1(d)3, which we are going to go over next.

In a parking garage area with a combined total of 36 square feet or more glazing or opening, luminaires providing general lighting that are in the combined primary and secondary sidelit daylit zones must be controlled independently from other lighting in the parking garage by automatic daylighting controls. As with other types of buildings, all primary and secondary sidelit daylit zones must be shown on the parking garage building plans. Automatic daylighting controls in parking garages must meet the following requirements as applicable: automatic daylighting controls must have photo sensors that are located so that they are not easily accessible to unauthorized personnel but accessible to authorized personnel, automatic daylighting controls must be multilevel, continuous dimming or on/off, and when the combined illuminance levels measured at the farthest edge of the secondary sidelit zone away from the glazing or opening are greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power consumption must be zero. Exceptions to these requirements for parking garages include:

- Luminaires located in the daylight transition zone and luminaires for only dedicated ramps, as defined in Section 100.1.
- Areas where the total combined general lighting power in the primary sidelit daylight zones is less than 60 watts.

Now that we understand how daylighting controls work, we can go over applications and prescriptive requirements. Under the prescriptive compliance approach, all luminaires providing general lighting that are at least 50 percent in a secondary sidelit daylit zone must use automated daylighting controls. Controls must meet the following requirements: General lighting in the secondary sidelit daylit zone must be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9. The general lighting must be controlled in accordance with the applicable requirements in Section 130.1(d)2. All secondary sidelit daylit zones must be shown on the plans submitted to the enforcing agency. There are exceptions to these requirements. Luminaires in secondary sidelit daylit zones in areas where the total wattage of general lighting is less than 120 watts are exempt, as are luminaire in parking garages complying with Section 130.1(d)3.

However, if one complies using the performance approach it is possible to replace automatic daylighting controls in secondary sidelit daylit zones with other building efficiency options and still reach the building energy budget necessary for compliance. Automatic daylighting controls in secondary sidelit daylit zones are not mandatory under the performance compliance approach. Automatic daylighting controls can also be configured in such a way as to earn a power adjustment factor (PAF) under the prescriptive approach to compliance with the Energy Standards. If automatic daylighting controls are configured to fully turn off all the lighting in a primary sidelit or skylit daylit zone, then the system qualifies for a PAF of 0.10.
Now let’s go over the compliance process for daylighting controls. All types of automatic daylighting controls must be documented on certificates of compliance, installation and acceptance, when used to comply with the Energy Standards. Form NRCC-LTI-01-E is required for all buildings. This is the certificate of compliance for indoor lighting. NRCC-LTI-02-E is used to document lighting controls installed to comply with the Standards. Automatic daylighting controls must be noted in Table A and listed separately in Table B, for both mandatory devices and controls qualifying for a PAF.

Following installation, compliance is documented on certificate of installation NRCI-LTI-01-E. Details on installed shut-off controls must be provided on this form. In addition, if automatic daylighting controls are installed and use the full off option to qualify for a PAF, certificate of installation NRCI-LTI-05-E is required. The responsible party must certify that the daylighting controls are properly installed and meet all the requirements of the PAF. Acceptance testing is required for all types of automatic daylighting controls. Acceptance test results are documented on compliance form NRCA-LTI-03-A. However, there is an exception to this requirement that exclusively applies to alterations projects. For alterations, if controls are installed to control 20 or fewer luminaires for the entire project, acceptance testing is not required.

Before we end this Module let’s review what we’ve learned. We’ve learned that automatic daylighting controls reduce lighting near a daylight source when sufficient daylight is available. Under the Standards, there are three type of building areas that could require automatic daylighting controls – primary sidelit daylit zone, secondary sidelit daylit zone, and skylit daylit zone. When these controls are required they must reduce the controlled lighting power by at least 65 percent when the daylight illuminance exceeds 150 percent of designed illuminance received from the general lighting system. With some exceptions, automatic daylighting controls are required in primary sidelit and skylit daylit zones, but in the secondary sidelit daylit zone, they are only required under the prescriptive compliance approach. Automatic daylighting controls configured to fully turn off all the lighting in primary sidelit and skylit daylit zones qualify for a PAF.

This concludes Module 5. For more information on nonresidential lighting controls, please visit the Energy Commission website at www.energy.ca.gov/title24/2016Standards