

Lighting commissioning guidelines and standards

The complexity of lighting design has made commissioning of lighting controls an essential part of projects.

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Lighting design has grown increasingly complex due to the integration of daylighting, movable and fixed shading devices, occupancy sensors, addressable fixtures, and control sequences, as well as integration with building automation systems (BAS), life safety, and security. This complexity has made commissioning of lighting controls an essential part of more and more projects. Commissioning for the most part is voluntary; however, if an owner is contemplating U.S. Green Building Council LEED certification or if ASHRAE 90.1-2010 compliance is required, commissioning is mandatory. Commissioning is not only for new construction, which is the primary focus of this article; it is also a valuable service for existing facilities that may or may not have had commissioning services. These services are referred to as retro-commissioning and re-commissioning.

There are many useful guidelines and websites that explain and illustrate the commissioning process, such as ASHRAE Guideline 0-2005, The Commissioning Process, and the ACG Commissioning Guideline. Until 2011, there were no specific commissioning guidelines for lighting and lighting controls. In 2011, the Illuminating Engineering Society published IES DG-29-11, The Commissioning Process Applied to Lighting and Control Systems, a detailed design guide for the commissioning of lighting and lighting control systems. IES DG-29-11 is intended to be a supplement to ASHRAE Guideline 0-2005. DG-29-11 gives specific examples of basis of design and construction checklists for lighting and lighting control systems.

Commissioning is defined by ASHRAE Guideline 0-2005 as “A quality-focused process

for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed and tested, operated, and maintained to meet the owner’s project requirements (OPR).”

A common misconception is that factory start-up is commissioning. In reality it is just a small part of the commissioning process. Factory start-up of a lighting system is performed at the end of construction and typically involves the lighting control system manufacturer or representative, lighting designer, and contractor verifying the system performs per the manufacturer’s instructions and the lighting designer’s intent, sequences of operations, plans, and specifications. This includes properly locating the daylight sensor in the room, setting the dimming curves, and addressing all of the components in the lighting control system. Unlike factory start-up, commissioning is a quality assurance process that starts prior to design and doesn’t end until months after the building is occupied.

The commissioning process phases for new buildings per ASHRAE Guideline 0-2005 are as follows:

- Pre-design phase
- Design phase
- Construction phase
- Occupancy and operations phase.

It is common for owners to contract only some phases of the commissioning process. Many contract only the construction phase. When commissioning occurs throughout the design and construction process, benefits include identifying more issues, which results in fewer change

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orders, fewer project delays, and fewer installation issues requiring contractor callbacks. These cost and time savings combined with the confidence that the building will operate as the owner/designer intended are the major benefits of commissioning.

According to the ACG Commissioning Guideline, “Most commissioning benefits continue for the life of the building, whereas implementing the commissioning process is a one-time cost.”

For most projects the commissioning is performed by a third-party consultant known as the commissioning authority (CxA). The CxA is typically independent of the design team and construction management. In some cases, the CxA can be part of the same design firm as long as the CxA was not involved in the design process. The following is an example of what occurs during each phase of commissioning:

Pre-design phase: The CxA works with the owner to document the OPR during the pre-design phase while developing the commissioning plan. The OPR is a written document used throughout the commissioning process that details the owner’s expectations on how the lighting and controls are to operate, and sets budget and visual criteria.

The owner typically writes a sequence of operation that can be understood by a nontechnical person. The following is an example of a classroom control sequence of operation that would be included in the OPR:

- 1.Scene “ON” turns the artificial lighting on if occupancy is sensed.
- 2.Scene “AV” dims the artificial lighting 80% if occupancy is sensed.
- 3.Scene “OFF” turns the artificial lighting off until either scene “ON” or “AV” is selected.

OPR would include illuminance (foot-candle) levels in all areas, whether automatic shading will be used for glare reduction, and building orientation. This may require assistance from the design professional. Using a light meter, the design professional can help the owner determine what light levels it wants to achieve.

Design phase: During the design phase, the basis of design (BOD) documents are completed. The BOD includes the lighting and control concepts, and illuminance criteria (footcandle) for artificial and natural lighting to realize the OPR. In addition, the CxA will review design documents and identify items to be included in the systems manual.

Construction phase: The CxA reviews contractor submittals of systems being commissioned, compiles a systems manual for operating staff, and verifies training requirements are in place. The CxA reviews submittals and provides comments to the engineer of record, who ultimately approves the submittal. In addition, the CxA verifies the correct equipment is installed and functioning as per the BOD, facilitates required checklists, logs/reports issues, and issues progress reports.

Systems verification ensures the lighting control systems are installed correctly. Examples from a system verification checklist (SVC) include the following:

- Is the installed light fixture type LF-1 dimming ballast manufacturer and model number as specified?
- Verify daylight sensors are installed per manufacturer’s recommendation.
- Verify lighting control stations are labeled per details.

Functional performance tests verify the lighting control systems work as designed. Here are a few examples from a functional performance checklist (FPC):

- Light fixtures turn off when building is unoccupied.
- Scene 1 turns lights “ON” to 50 foot-candle (± 5 footcandle) average at 30 in. (desk height)
- If natural light is providing 50 foot-candle average, turn lights “OFF”
- Occupancy sensor to turn lights “OFF” if room unoccupied for more than 5 min.

Non-energy related systems, room finishes, geometry, and schedules are just a few additional categories that play vital roles in the commissioning of the lighting control system. If a room is painted

darker than specified, the lighting may not achieve the designed or targeted lighting levels.

Occupancy and operations phase: After substantial completion, the commissioning authority will review the operation of the building with the operations and maintenance (O&M) staff and occupants. The commissioning authority would then write a plan to resolve any outstanding commissioning issues.

Lighting designers now have a valuable tool to guide the commissioning of lighting and lighting controls. Lighting commissioning is an important tool for designers to manage the new complexity of lighting systems. Commissioning is more than factory start-up; it is an ongoing process that begins with understanding the owner’s requirements before design and continues until after the building is occupied. The CxA prepares operations manuals and works with the O&M staff and building users to ensure that that the building operates as designed. Unless the owner is seeking LEED Certification or code required ASHRAE 90.1-2010 compliance, commissioning is voluntary. Commissioning is as equally valuable in renovation as it is in new construction. According to the EPA’s Energy Star Building Upgrade Manual, “Simple calibration of occupancy sensors and photocells can restore correct operation, reducing the energy used by the lighting system in those areas by 50% or more.” **cse**

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