AABC Commissioning Group

AIA Provider Number 50111116

Commissioning Lighting Control Systems

Course Number: CXENERGY1727

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Course Description

Requirements for lighting controls become more complex as energy-conservation codes evolve. With each level of increased complexity, the benefits of formally commissioning lighting control systems increase. There are many steps to examine when commissioning lighting controls, following energy code requirements. This presentation examines the applicable codes, designing the project scope and best practices associated with commissioning lighting control systems.

Learning Objectives

At the end of the this course, participants will be able to:

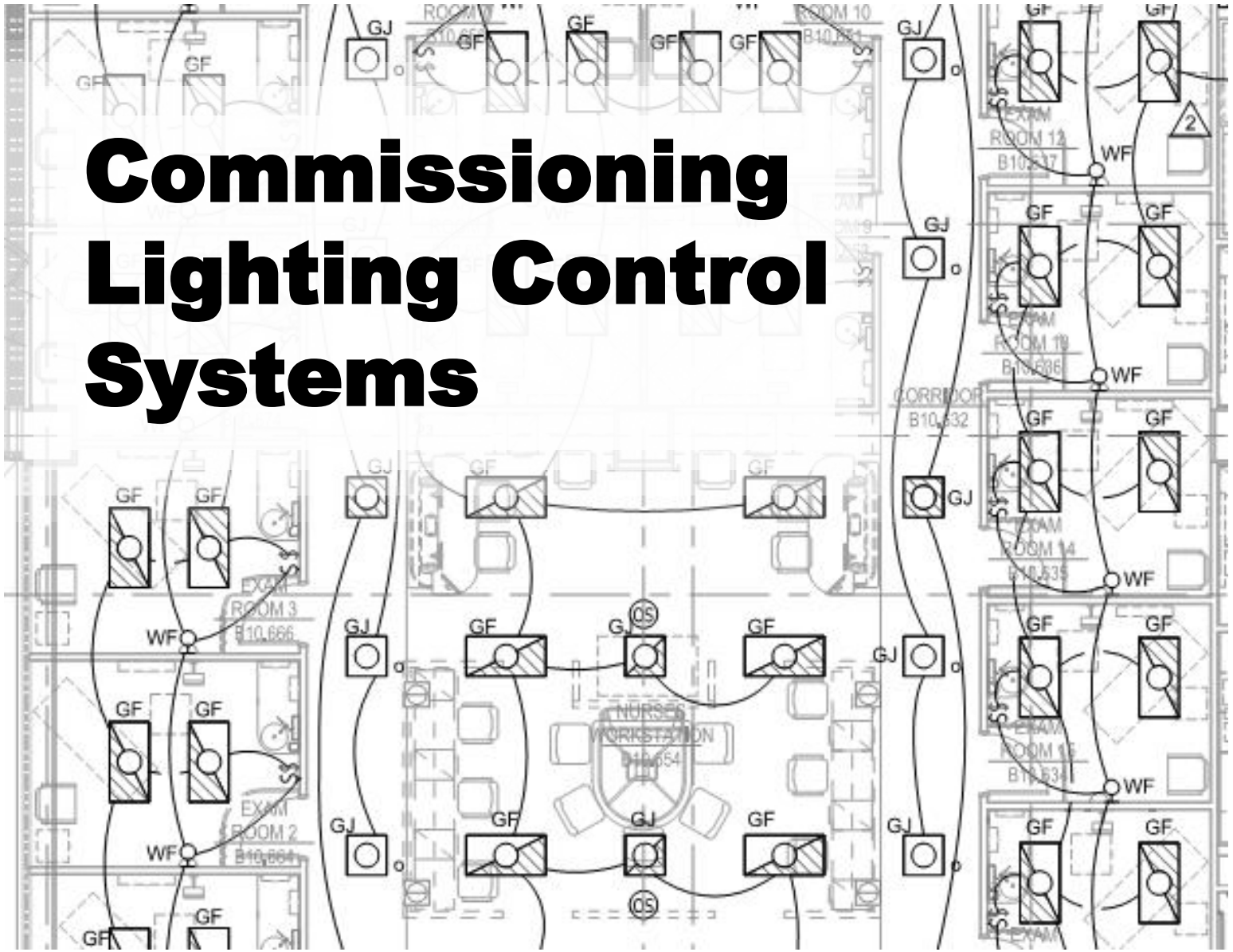
1. Develop a basic understanding of the elements of a commissioning program for lighting control systems.

2. Become familiar with the fundamental documents that determine commissioning scope.

3. Understand the primary components of the commissioning process.

4. Become familiar with the codes that govern lighting systems design and commissioning.

Commissioning Lighting Control Systems



Why Control Lighting?

From a designers perspective:

- Implement a necessary function
- Comply with building code requirements
- Satisfy other code-like requirements:
  - Green building initiatives
  - Owner’s internal goals
- Improve the quality of the indoor environment

Why Control Lighting?

From a Commissioning perspective

- Reduce operational cost
- Check a LEED box
- Mix of both

Why Control Lighting?

Understanding the clients needs, how different roles are affected:

- Maintenance staff is affected by OS in mechanical spaces
- Head nurse is affected with corridor lights that do not dim on schedule, spilling light into patient spaces

Evolution of The Codes

Energy Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1)

- First issued as ASHRAE 90, in 1975, in response to the energy crisis of 1973
- Also promulgated by IESNA and ANSI

Evolution of The Codes

International Energy Conservation Code (IECC)

- First issued in 2000

Both are model energy codes, adopted by many US jurisdictions, to establish minimum design and construction requirements for energy efficiency.

California Code of Regulations Title 24 Part 6

- Specific to California
- Seen as bellwether for other codes
- Much more demanding, specific than IECC or ASHRAE
- Not covered in detail here

Evolution of The Codes

IECC 2000

- Manual control with bi-level switching for each enclosed space
- Automatic switching or photocell for exterior lighting

ASHRAE 90.1 2001

- Manual control with bi-level switching for each enclosed space
- Automatic switching or photocell for exterior lighting
- Separate controls required for display, task, and “nonvisual” lighting

Evolution of The Codes

IECC 2003

- Added automatic scheduled shutoff with occupant override and holiday scheduling, buildings > 5000 SF
- Light reduction controls, replacing bi-level switching

ASHRAE 90.1 2004

- Added occupant sensing to satisfy automatic shutoff requirement

Evolution of The Codes

IECC 2006

- Added occupant sensing to satisfy automatic shutoff requirement
- Added exception to automatic shutoff for occupant safety

ASHRAE 90.1 2007

- Essentially unchanged

Evolution of The Codes

IECC 2009

- Added daylight control zones

ASHRAE 90.1 2010

- Added functional testing, covering occupant sensors, programmable schedule controls, and daylight controls

Evolution of The Codes

IECC 2012

- Added system commissioning section, covering occupant sensors, programmable schedule controls, and daylight controls

ASHRAE 90.1 2013

- Detailed requirements for occupancy sensors, time switch controls, and daylight sensing controls

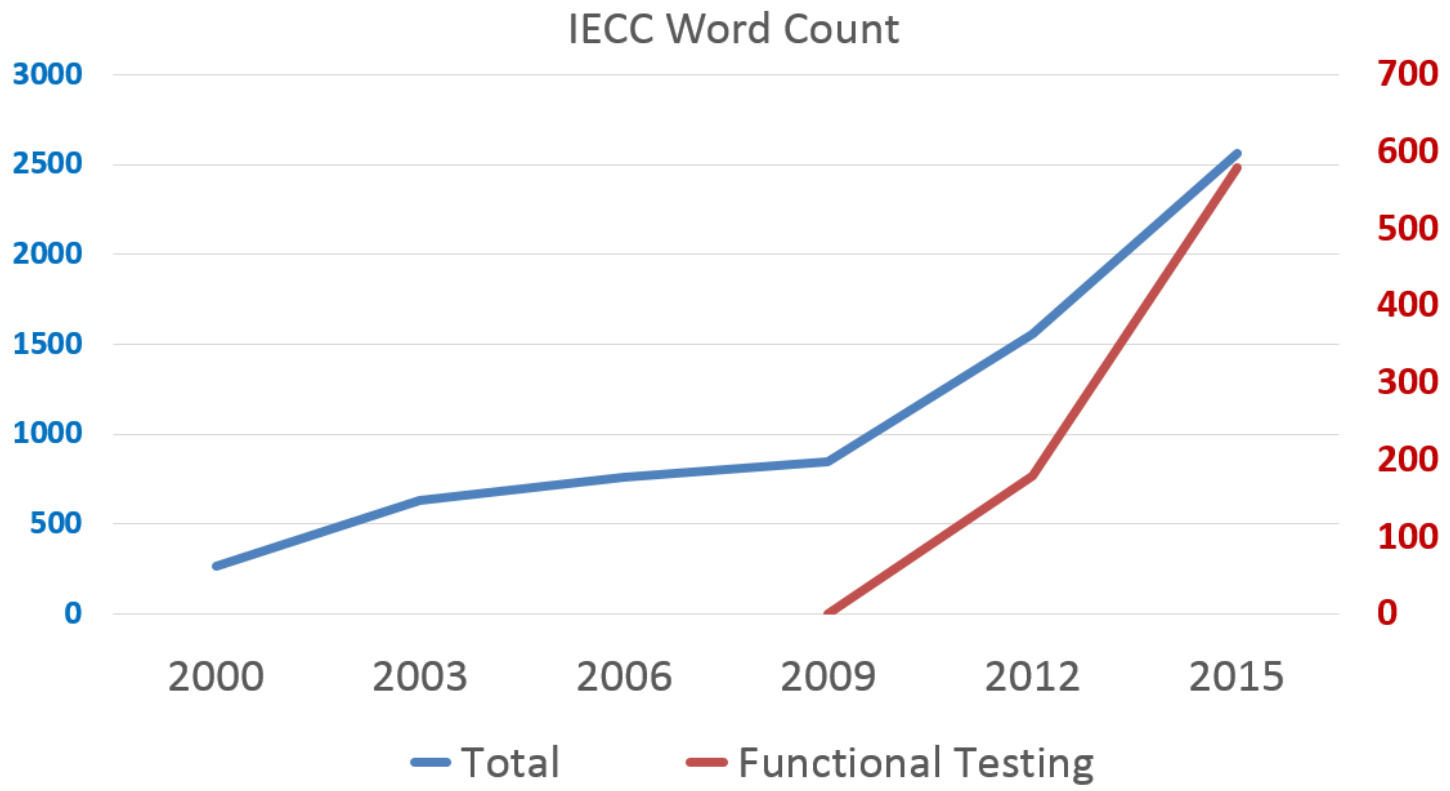
Evolution of The Codes

IECC 2015

- Occupancy sensors become vacancy sensors, or activate lighting to 50% or less, with manual controls
- Manual controls with all automatic controls Multiple level control in daylight zones
- Separate controls required for display, task, and “nonvisual” lighting
- Design professional attests to system performance
- Detailed requirements for occupancy sensors, time switch controls, and daylight sensing controls
- Testing of 10% of occupancy sensor controls, with full testing if 30% fail

Evolution of The Codes

An imprecise estimate of complexity



Evolution of Lighting Control Systems

- Integration with other systems
- Technology versus implementation
- What has allowed greater control of lighting?

Evolution of Lighting Control Systems

- Switches
- Mechanical timer-based controls
- Photocell controls
- Dimmers
- Occupancy sensors
- Computerized control systems
- Distributed control systems
- Integration with building controls

Functional Performance Testing

Local Control Devices

- Motion sensors (Occupancy and Vacancy)
- Timer switches
- Daylight Harvesting*
- Wall stations, multiple scene selections
- Partition sensors

Functional Performance Testing

Daylighting Harvesting System

- Verify installation, location and calibration
- Verify luminaire response to changes in daylighting
- Demonstrate integration with other systems

Functional Performance Testing

Scheduled Events - System Level Control

- Astronomical versus photosensor
- Timeclock
- Relay panel
- Site and exterior lighting

Why Versus How:
Design

- Verify code requirements with AHJ
- Determine the Owner’s requirements
- Resolve conflicts among Owner requirements, code requirements, and cost
- Develop lighting control strategy
- Determine lighting control technology
- Identify daylight zones and boundaries
- Develop specifications
- Develop drawings
- Verify that submitted equipment provides required functionality

Why Versus How: Commissioning

What is done to verify installation meets design intent

- Design review, either peer or for commissionability
- Verify installation (PFC)
- Function performance testing (FPT)
- Documentation
- What is done to verify design intent is satisfied

Commissioning Documents

Owner's Project Requirements (OPR)

- Content: Owner's needs, goals, and expectations
  - Facility purpose
  - Budget, schedule
  - Functionality, quality of environment
  - Operating costs, maintainability
- Author: Owner
- Participants: Owner, design team, construction team
  - Strike a balance among aspirational goals for the project, and the constraints of budget, schedule, constructability, and code requirements.
- Phase: Pre-design

Commissioning Documents

Basis of Design (BOD)

- Content: Technical approach to realizing the elements of the OPR
- Author: Design team
- Participants: Design team
- Phase: Pre-design
  - Updated as design progresses

Commissioning Documents

Commissioning Plan

- Checksheets, formerly referred to as Pre-Functional Checksheets (PFC)
- Functional Performance Testing (FPT)
- Master Equipment List (MEL)
- Master Issue List (MIL)
- Final Report

Commissioning Documents

Commissioning Specifications

- Content: Prescriptive commissioning requirements, as a part of the contract documents
- Author: Commissioning team
- Participants: Design team
- Phase: Design

Commissioning Documents

Pre-Functional Checksheets (PFC)

Content: Inspections and testing required to determine that equipment is:

- As described in construction documents (CD) and submittals
- Installed in accordance with requirements

Commissioning Documents

Functional Performance Test (FPT)

Content: Testing required to verify performance of equipment in full operation

- Author: Commissioning team
- Participants: Commissioning team, construction team
- Phase: Design, construction, and occupancy

Commissioning Documents

Systems Manual

- Content: Information required to properly operate and maintain equipment and systems
  - Systems narrative
  - Maintenance manuals
  - Submittals
  - Construction documents
  - Understandable by users unfamiliar with the project
- Author: Commissioning
- Participants: Design team, construction teams
- Phase: Construction and occupancy

Commissioning Documents

Final Commissioning Report

- Content: Summary of findings and documentation of commissioning process
  - Evaluation of equipment operating condition
  - Deficiencies and corrective measures
  - Tests and results
  - Any deferred testing
- Author: Commissioning team
- Participants:
- Phase: Occupancy

This concludes The American Institute of Architects
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