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Designers Lighting Forum

A Path Through the Wilderness of Lighting Control Specification

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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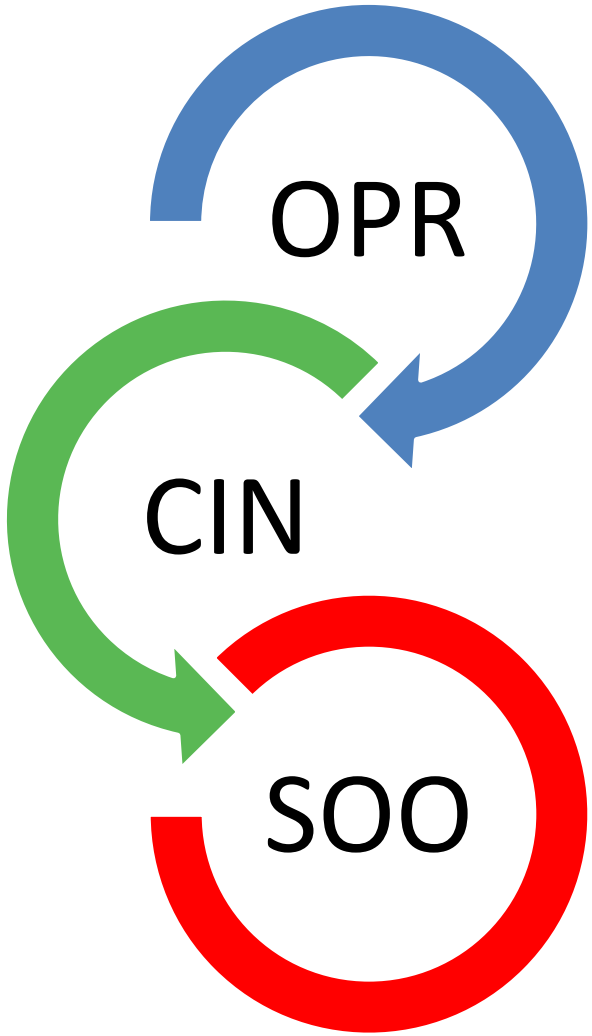
Learning Objectives

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

1. **Identify** the components of a clear and contractually enforceable controls specification.
2. **Compare** the two documents addressed by ANSI/IES LP-16-22
3. **Describe** how to switch from suggestive language to imperative language and why the difference is important.
4. **Analyze** how best to document Control Intent and Operational Characteristics

OPR ➤ CIN ➤ SOO…



OWNERS PROJECT REQUIREMENTS

CONTROL INTENT NARRATIVE

SEQUENCE OF OPERATIONS

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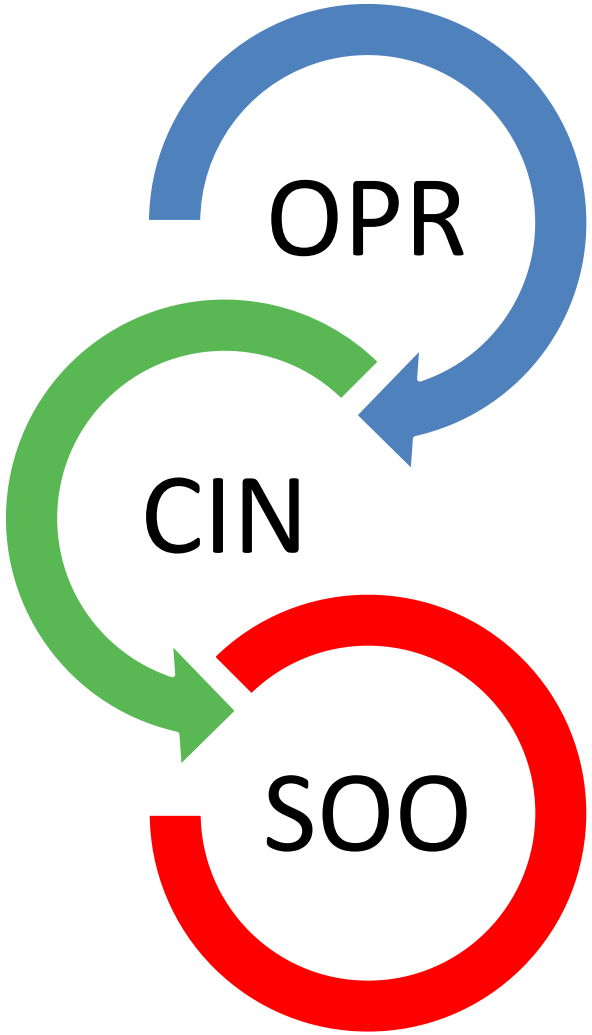
OPR ➤ CIN ➤ SOO… IN BRIEF



DEFINITION

The OPR defines the specific functional and operational requirements for all building systems and their interaction FROM THE OWNER'S Point Of View.

The CIN provides a broad brushstroke view of the lighting control system and its functionality. It draws on information from both the OPR and other Basis of Design docs.

*The SOO is the specific, **contractually enforceable** expression of how the lighting control system operates. It specifies limits and set points, timing, and equipment.*

WHY IT MATTERS

This is the owner's brief for the project. It tells the design and commissioning teams what's expected from the building/project.

*An overview, **IN ENGLISH**, of how the lighting control operates and what happens. Provides both description and guidance.*

Defines the system and its function for suppliers, programmers, and installers. Provides guideposts for Measurement & Verification.

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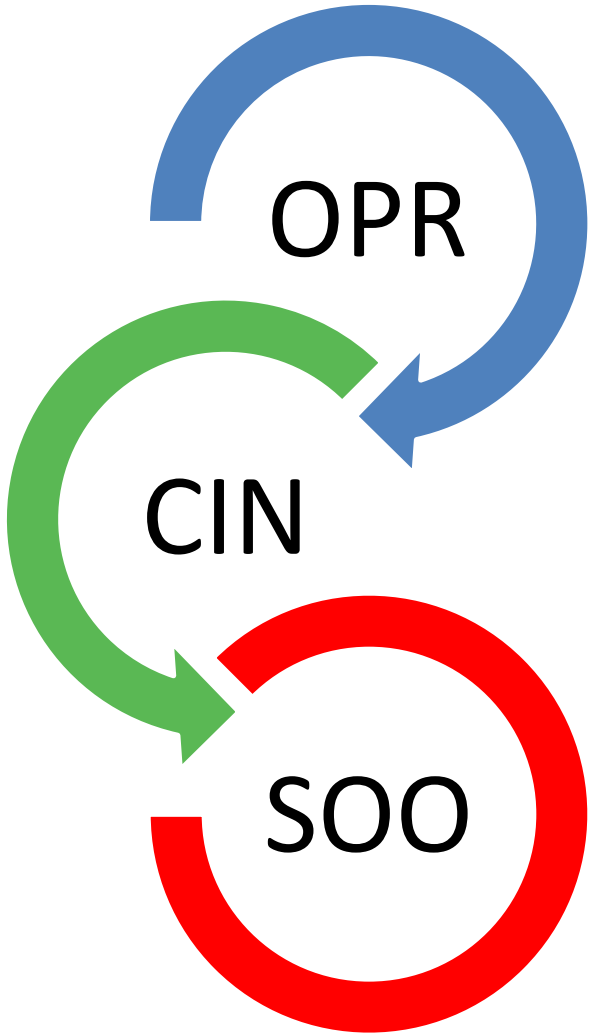
OPR → CIN → SOO…. WHO DOES WHAT?



OWNERS PROJECT REQUIREMENTS
Typically, the owner's team, often in collaboration with the project architect, sometimes not

CONTROL INTENT NARRATIVE
Lighting Control Specifier
NB: Not always the Lighting Designer

SEQUENCE OF OPERATIONS
Lighting Control Specifier in collaboration with EE and Vendor

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HOW DO WE GET STARTED?

TOPICS stay the same

- Code Compliance
- Space Functionality
- Luminaire control
- Design Aesthetics
- Daylight Integration
- System Integrations

WHY

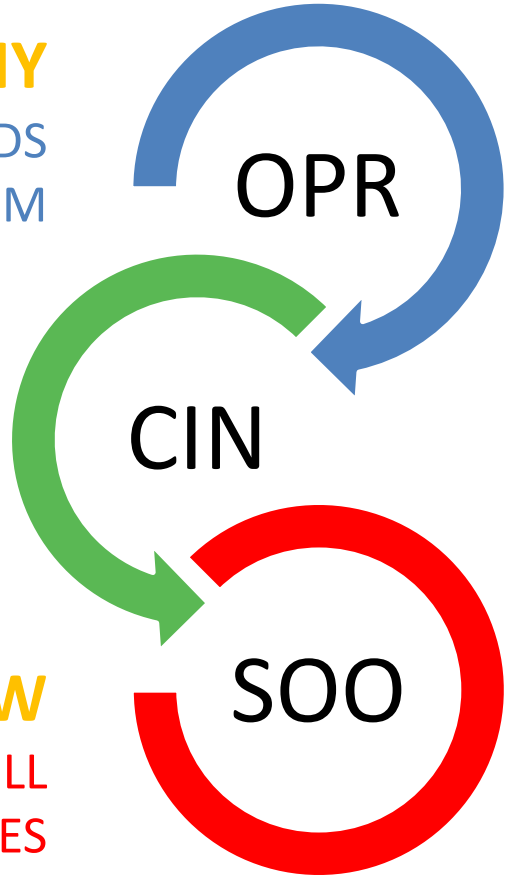
USE CASES THAT THE OWNER WANTS OR NEEDS FROM THE CONTROL SYSTEM

WHAT

DESCRIPTION OF WHAT THE CONTROL SYSTEM PROVIDES (OR SUPPORTS)

HOW

SPECIFIC METHODS THE CONTROL SYSTEM WILL UTILIZE TO SUPPORT USE CASES



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QUESTIONS TO CONSIDER

WHICH SPACES OR FUNCTIONS?

WHAT TYPES OF TECHNOLOGY?

HOW WILL PEOPLE OR THE ENVIRONMENT INTERACT WITH THE SYSTEM?

HOW WILL I KNOW IF IT IS WORKING?

HOW WILL SOMEONE ELSE?

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PRIVATE OFFICE: Q&A

Q: What happens when people leave their office?

A: The lights turn off

Q: What are the controlling variables?

A: Time of day, length of vacancy

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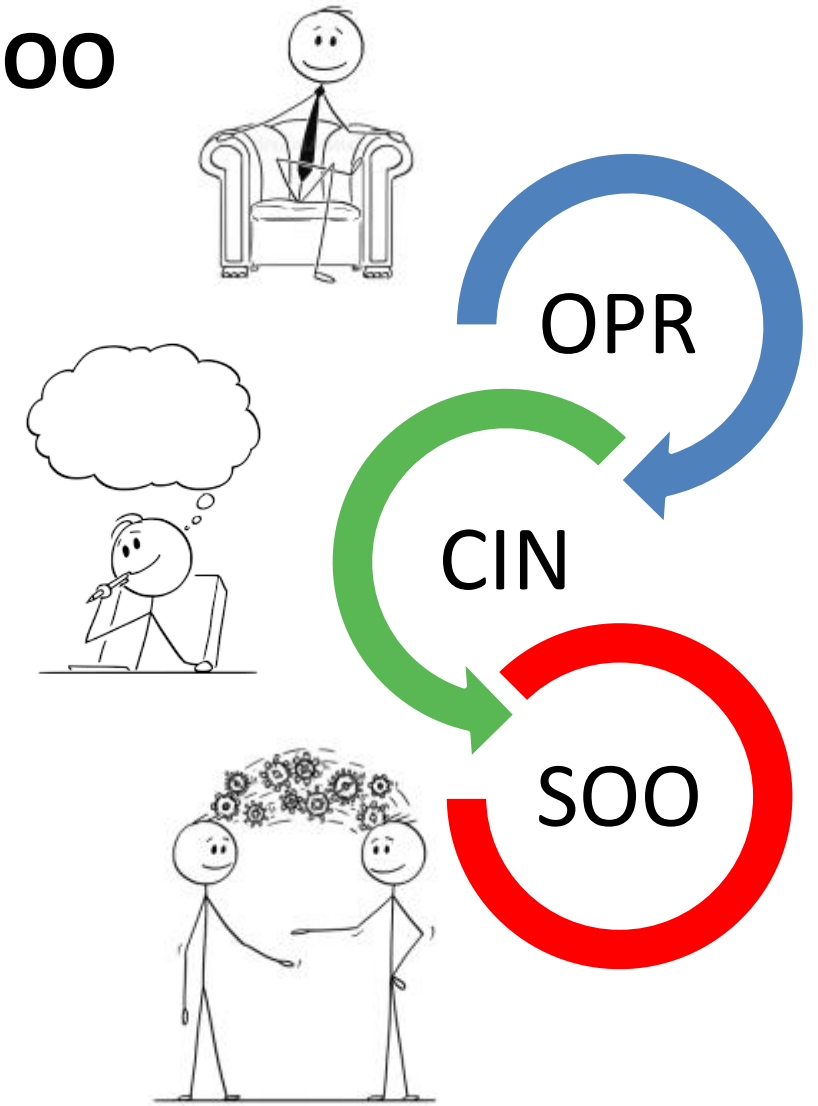
PRIVATE OFFICE: OPR/CIN/SOO



- **OPR**
  - "Simple local control to meet code"
- **CIN STATEMENT**
  - "When people leave their offices during occupied hours, the lights turn off after two minutes"
- **SOO STATEMENT**
  - Private offices shall be equipped with ceiling-mounted vacancy sensors
  - During operational hours, sensors shall operate with a two min (adj) time delay

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COMMON HALLWAYS: Q&A

Q: When are the lights on?

A: Hallways are lit during occupied hours

Q: What happens at night?

A: The lights come back on for security sweeps and maintenance

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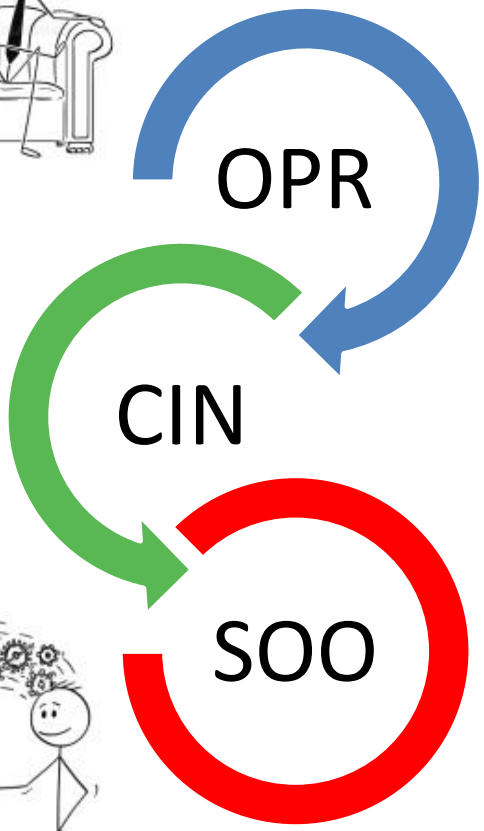
COMMON HALLWAYS: OPR/CIN/SOO

- **OPR**
  - Simple local control to meet code
- **CIN STATEMENT**
  - Hallways are lit during occupied hours
  - Lights come back on for security sweeps and maintenance
- **SOO STATEMENT**
  - Luminaires located in hallways and general circulation areas shall respond to timeclock cues, energizing automatically at the start of the workday and reducing to a lower, nighttime level during evening hours.
  - Occupancy cues – during evening security rounds, luminaires in the hallways shall energize with the operation of a key switch or occupancy sensor.



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LUMINAIRE LEVEL LIGHTING CONTROL (LLLC)*

**NOTE: Non-networked Luminaire Level Controls (NLLC) ARE DIFFERENT than Luminaire Level Lighting Controls*

CIN STATEMENTS

- Luminaires shall have (1) integral sensor for each troffer, (1) per group of 4-6 downlights, and (1) per every eight feet of linear lighting. In addition to increased energy savings beyond code, the high density of sensors shall enable the non-energy benefits called out in the OPR.

- Sensors shall be grouped and configured to ensure acceptable ratios for room surface brightness of walls and ceilings. Granular dimming shall be done in a manner that does not compromise light levels per IES standards.

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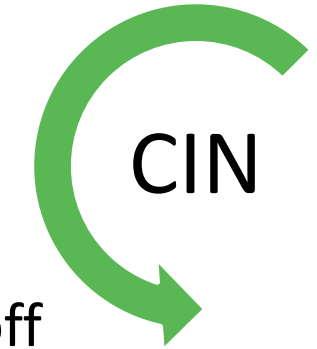
LUMINAIRE LEVEL LIGHTING CONTROL (cont…)



MORE CIN STATEMENTS

- Per the OPR, in addition to fulfilling lighting controls requirements, sensors shall be used to determine occupant presence for the purpose of auto-shutoff as well as for space utilization analysis and integration with the room-reservation system.

- Where more than one software manufacturer is to be used, a prototype installation and demonstration are required. Testing shall be performed to confirm interoperability for devices and proper functionality when APIs* are utilized.

An **A**pplication **P**rogramming **I**nterface is a way for two or more computer programs to communicate with each other. It is a type of software interface, offering a service to other pieces of software. A document or standard that describes how to build or use such a connection or interface is called an API specification

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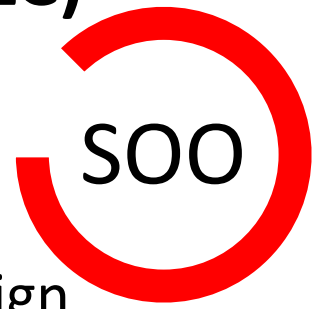
LUMINAIRE LEVEL LIGHTING CONTROL (LLLC)



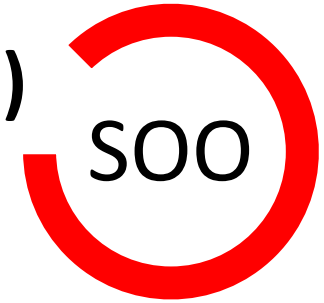
SOO STATEMENTS

- Lighting control functionality shall meet energy code compliance, CIN and design intent, and shall remain intact and functional when the wireless lighting network is non-functional. *[NOTE: more controls SOO needed, similar to earlier examples.]*

- Sensors shall be integral to luminaires. Exceptions are expected and required when sensor locations and design intent are not aligned. Sensor system shall be capable of providing externally located sensors wired to luminaires, as well as fixtureless sensors powered independently without relationship to lighting control.

- Sensor density shall be sufficient for the analytics of the software to *function properly*.

LUMINAIRE LEVEL LIGHTING CONTROL (cont…)



MORE SOO STATEMENTS

- Sensors and control components shall be DALI D4i and Zhaga Book 20 compliant to ensure interoperability of control devices.
- Sensor network shall be capable of maintaining a background light level in large areas in addition to dimming for individual sensor zones, to ensure that individual luminaires do not go off in occupied areas.
- Room reservations shall be capable of automatic adjustment based on occupancy, allowing the ability to rescind a reservation if occupancy is not detected. Durations shall be programmable by onsite occupants.
- All aspects of the digital system shall be forward compatible. This includes over-the-air updates to firmware as necessary for a seamless software functionality, including access to analytics and dashboards.

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COLOR CONTROL

CIN STATEMENTS

- Tunable lighting is adjusted in <room names or designations> to provide lighting color control for occupants.
- Between <hh:mm> a.m. and <hh:mm> p.m., lighting will be neutral white, with a local control provided to select other colors and white tones.
- After <hh:mm> p.m., lighting will slowly change to a warm white unless overridden by occupants.
- When the alarm system is armed, lights will fade out completely.

COLOR CONTROL

SOO

SOO STATEMENTS

- On occupancy detection between <hh:mm> a.m. and <hh:mm> p.m., tunable luminaires of Type <aa> located in spaces <space names or designations> shall energize to a tuned CCT of 4000 K

- On occupancy detection between <hh:mm> p.m. and <hh:mm> a.m., tunable luminaires shall energize to a tuned CCT of 2700 K.

- On occupant adjustment of the tuned color temperature, luminaires shall hold the selected CCT until occupancy detector timeout.

WHAT COULD POSSIBLY GO WRONG?

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WHAT COULD POSSIBLY GO WRONG??

PROBLEMATIC

- Miscommunication
- There is never genuine input from ultimate customer
- Drive to the deadline superseding process
- Vendors gaming the system, resistance is not just measured in ohms
- Technologies don't fulfill the CIN (e.g., color: 0-10v vs. DT6 or DT8 vs. DMX)
- Dimming curves and perceived brightness (different drivers have different curves)
- Digital integrations, system architecture, other system integrations

BETTER

- If you don't know, just ask
- Add CIN into scope, to ensure it happens
- Try-hard. It is OK to get input from customer *(especially for advanced solutions and/or digital use cases)*
- Embrace your inner squeaky wheel
- Know and make CLEAR your pinch points, pain points, use cases in advance
- SPECIFY AN INTEGRATOR (e.g., Ask for help)
- Breathe. Try to have patience with coordination questions and process.

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EXAMPLE: CORPORATE CAMPUS

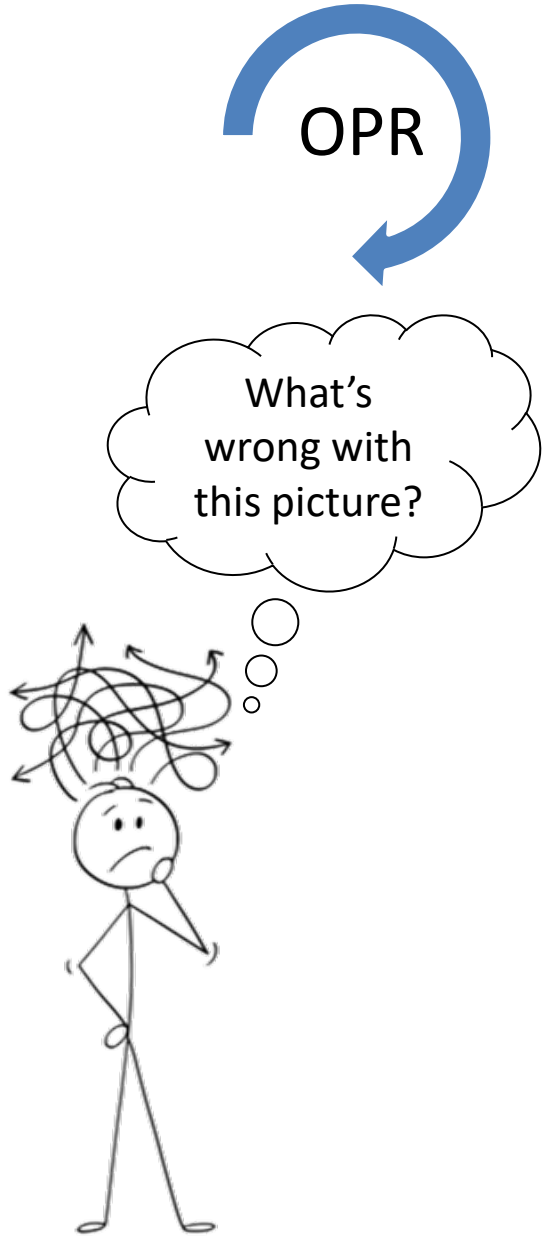
- $65M
- OPR written 4-5 years ago
  (at least)

FROM THE OPR

The Owner prefers to use skylights to introduce daylighting to the building. Design concept should include operable windows at every floor in the uppermost portion controlled by electric motors tied into the building mechanical system for night cooling and ventilation and mechanical system designed to control humidity and temperature…

FROM THE OPR

- Acceptable ballast manufacturers include: G***, A***, S***, U**** and M***. Florescent lamps to be 3500 K in color. Avoid 2'x2' florescent fixtures.
- All lighting, both interior and exterior, to be dimmable 277V, single phase LED type. Color temperature to be 3500K in color. Preference is toward 2x4 fixtures instead of 2x2 fixtures. LED's shall be Reduction of Hazardous Substance (ROHS) compliant, and must comply with IES LM-79, LM-80 and LM-82 requirements. Maximum rated life shall be 50,000 hours per IES L70. All fixtures shall be accessible, serviceable and replacement from below the ceiling. Color temperature needs to be 4000K for interior; 5000K for exterior.



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OPR: LIGHTING CONTROL SYSTEM

OPR

Desired Type:	**Distributed microprocessor-based lighting control system** able to automatically control the entire building lighting
Quality:	Highest quality as allowed by the construction budget
Preferred Manufacturer:	H--------, D--------, N------, C--------- G--------, E----------
Reliability:	Highest reliability **as allowed by** the construction budget
Flexibility:	Control system able to respond to **available daylight by switching or dimming electric light** to save energy and extend lamp life
Maintenance Reqs:	Simplistic systems are desired wherever possible
Efficiency Target:	No Preference
Desired Technologies:	**No Preference**

RECOMMENDATIONS:

- Use precise language, purge old and vague terms
- Avoid superlatives that aren't defined or measurable
- Performance language is usually better than manufacturers (unless there is a good reason)
- Don't repeat specifics from codes/standards, simply reference the document from the OPR
- Make it coherent
- Include what consultants **DON'T** know about **YOUR** needs

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OPR: DAYLIGHT CONTROL SYSTEM

OPR

Desired Type:	Daylight harvesting system **able utilize wireless photocells** to sense daylight levels & dim the lights to low level or 5% light output. Below minimum light level, fixture power will be disconnected. Daylight system shall be well integrated w/ lighting system.
Quality:	Highest quality **as allowed by** the construction budget
Preferred Manufacturer:	**No Preference**
Reliability:	Highest reliability **as allowed by** the construction budget
Automation:	Scalable system providing local as well as central control of the lighting systems having the ability **for granular control of fixture groups,** device management, load monitoring, and **Automatic Demand Response (ADR)**
Flexibility:	No Preference
Maintenance Reqs:	Accessible, serviceable & replacement from below the ceiling
Efficiency Target:	No Preference
Desired Technologies:	No Preference

RECOMMENDATIONS:

- Some of this is good language, but belongs in CIN or SOO
- **WHY** do you want wireless?
- Quality can actually be pretty well defined
- Avoid superlatives that aren't defined or measurable
- Include important features or performance aspects
- Include what consultants **DON'T** know about **YOUR** needs

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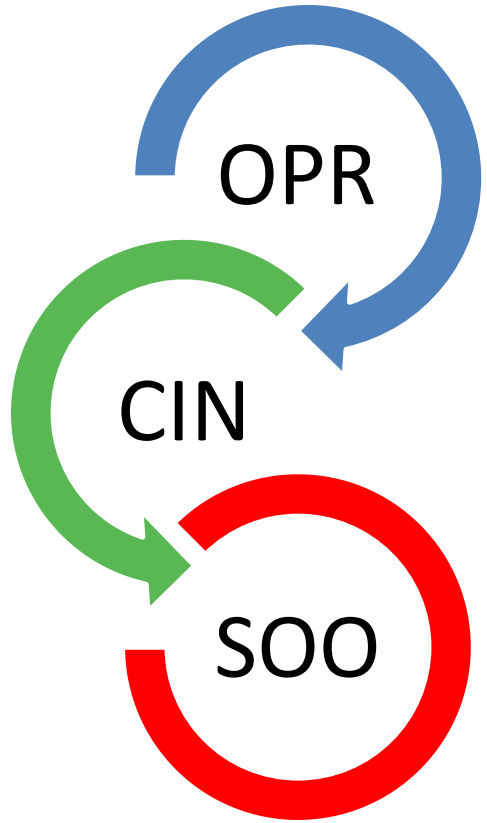
DAYLIGHTING CIN AND SOO THAT FOLLOWS

In all areas where lighting power within daylighting zones exceeds the wattage threshold of the relevant energy code, the lighting shall automatically dim based on daylight contribution to maintain average design illuminance and distribution.



Adjust general lighting (type FXX) in all private offices with daylighting zones to maintain 300 lux avg. When daylight contribution level changes, delay change for 1 min (adj.). If daylight level increases, decrease type FXX by 5% (adj.)/sec. If daylight level decreases increase Type FXX by 5% (adj.)/sec.

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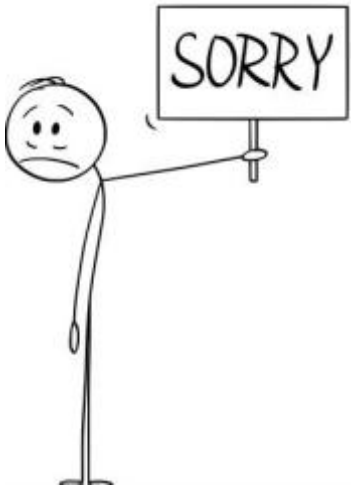
OUTCOMES

WHAT THEY ASKED FOR

- Full Building Control
- Local override
- Low cost, high value
- Daylight integration
- Wireless photocells
- Required automatic demand response
- Granular control

WHAT THEY GOT

- “Distributed system” - no information on how the system operates
- Automatic shades on different system from lighting, so no functional integration
- How do we assure undefined systems work together?
- What does “Granular” mean?



MULTI-FAMILY AMENITY SPACES

Multi-scene Preset Dimming Controls with Timeclock Initiation AND Daylight Responsive Override in Required Zones at Windows.
Provide 4-Button Interface Station for Scene Recall per Room.

What Happens: 4 Buttons to Choose "Looks" to Push for On; Timeclock and Daylight Sensor Control Intensity; Auto Off.

Multi-scene Preset Dimming Control
Provide 4-Button Interface Station for Scene Recall per Room.

What Happens: Manual On; 4 Buttons to Choose "Looks;" Off when Vacant.

Manual On, Vacancy Off Dimming Control.
Provide 2-Button Station with Raise/Lower per Room.

What Happens: 2 Buttons to Push for On; Auto Off.

Timeclock Initiated Preset

What Happens: Automatically On at Start of Day; Off at Night.

24/7 On with Timeclock Initiation.

What Happens: Always On, Timeclock Controls Intensity.

24/7 On with Timeclock Initiation AND Daylight Responsive Override

What Happens: Always On, Timeclock and Daylight Sensor Control Intensity.

24/7 On with Vacancy Override to 50%.

What Happens: Always On; Reduced Intensity when Vacant.

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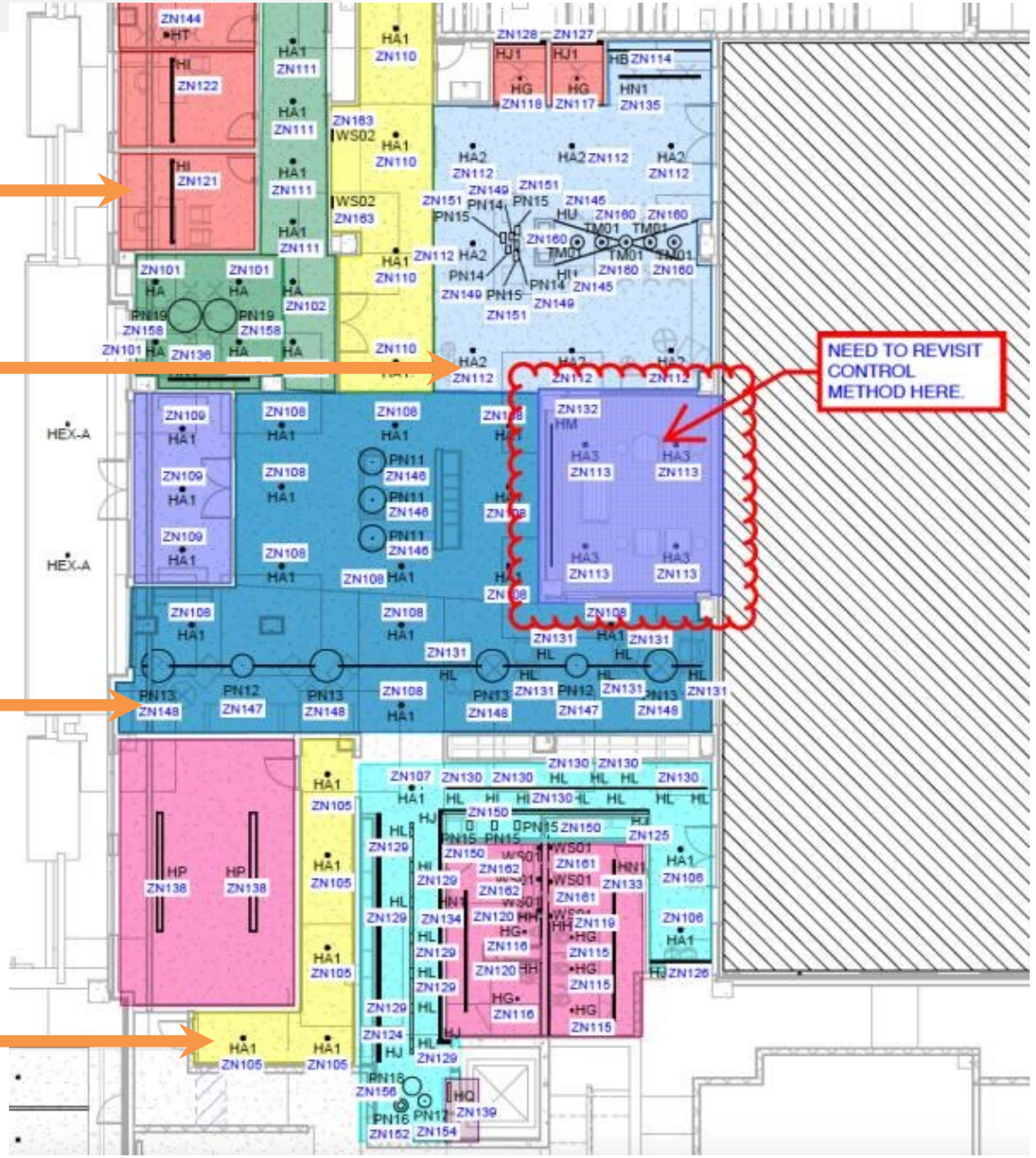

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HOW CAN ANSI/IES LP 16 HELP?

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ANSI/IES LP-16-22

Lighting Practice 16-22:

Documenting Control Intent Narratives & Sequences of Operation

- Developed by Consensus Committee https://www.ansi.org/american-national-standards/ans-introduction/essential-requirements
- Public Review
- Domain experts
- Balanced committee

Excerpt from Introduction*:*

"This Lighting Practice Document will describe how to create a project SOO & CIN that:

1. are detailed enough to ensure that the delivered system provides the functionality required;
2. provide enough information that the construction team can provide exactly the programming required; and
3. are contractually enforceable if something goes wrong."

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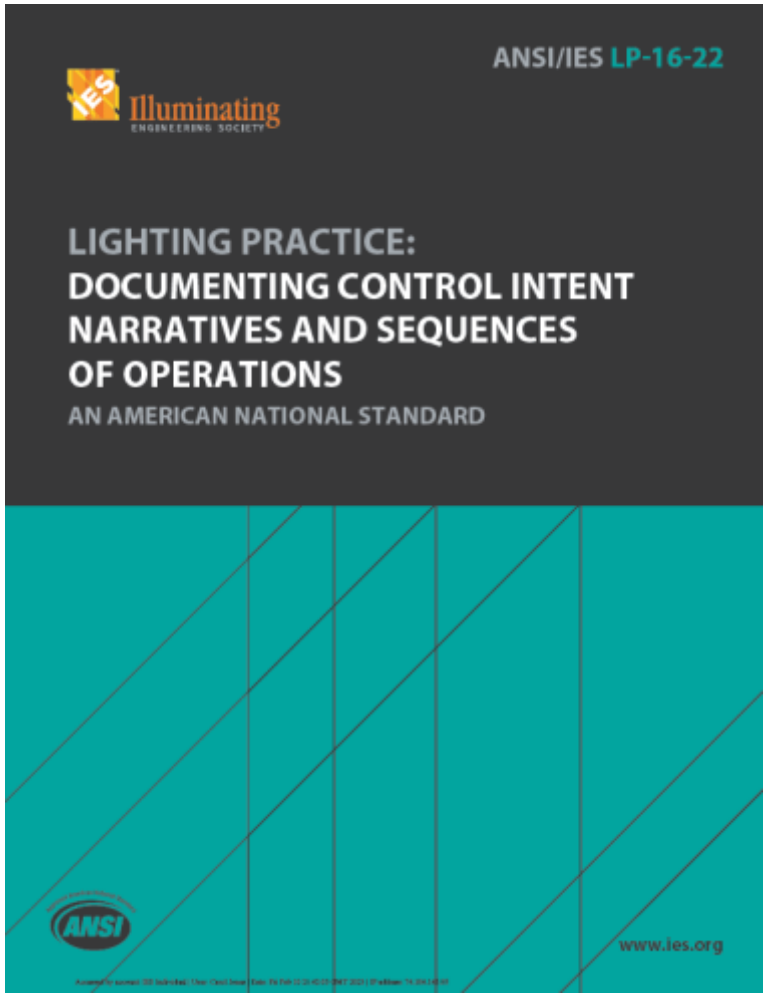
WHAT'S INCLUDED IN LP-16

- Description of roles & responsibilities
- Checklist and step-by-step instructions
- Side-by-side examples
- Sample text
- Timelines
- Documentation examples
- Descriptive language for various control strategies
- Questionnaires for client research



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CONTROL INTENT NARRATIVE

- General description of project goals
- Control strategies to satisfy goals
- Description of the control system
- Preliminary description of Lighting Control Events for each space type

SEQUENCE OF OPERATION

- Specific steps to achieve goals
- Functional and programming requirements
- Equipment requirements
- Set points, levels, timing

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RECAP: What does each include?

CONTROL INTENT NARRATIVE

- Descriptive Language
  - (Higher/Lower)
- Broad Overview
  - “Lighting should automatically dim”
- Written in English
  - “This narrative seeks to describe….”

SEQUENCE OF OPERATION

- Specific Set Points
  - (30% of full - Adj)
- Clear Parameters
  - “general lighting in private offices shall maintain 300 Lux…”
- Contractually Enforceable Language
  - SHALL, NOT SHOULD

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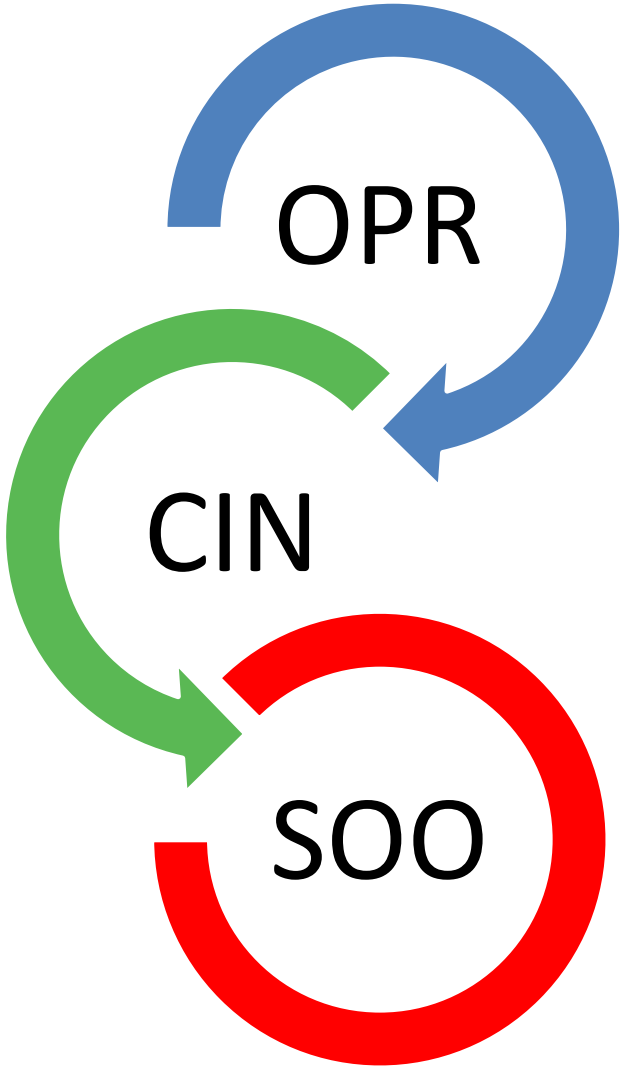

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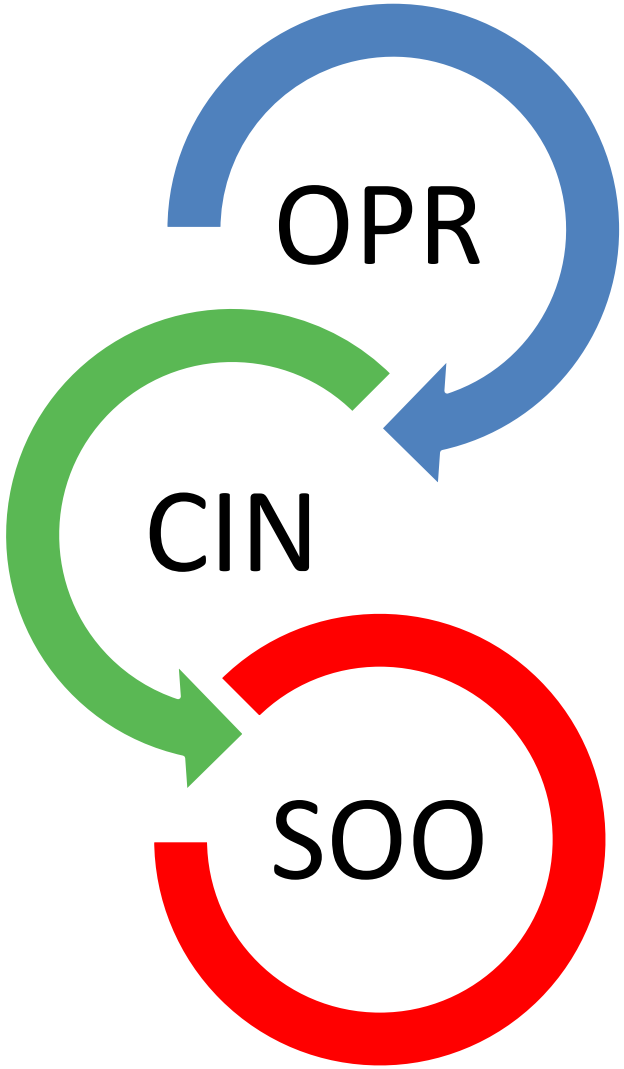

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QUESTIONS?

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