Draft policy for stakeholder comment

Networked Lighting Control System Technical Requirements

Version NLC5

Draft 1

February 4, 2020

Note: Changes from Version 4.0 are highlighted in yellow.

Schedule of Revisions

Revision No.	Date	Description
1.0	Apr 21, 2016	• Initial Technical Requirements published.
1.01	May 7, 2016	• Clarified that the Technical Requirements are for interior control systems. Systems designed and marketed exclusively for exterior applications are not eligible to be qualified.
1.02	Feb 24, 2017	• Clarified that the Technical Requirements do not cover DC or PoE systems.
2.0	Jun 1, 2017	• Version 2.0 published, with addition of exterior control systems.
3.0	Jun 1, 2018	• Version 3.0 published, with addition of DC/PoE systems, scenes, and multi-year plans for energy monitoring and cybersecurity.
4.0	Jun 10, 2019	• Version 4.0 published, with addition of energy monitoring requirement, criteria for cybersecurity certifications, and building management systems capable of networked lighting control.
5.0	Draft 1	• Introdution of an interoperability plan that includes the prior energy monitoring (EM) plan as a sub-topic, and aligns EM definition with AHSRAE 90.1-2016. Requires cybersecurity.

This document defines requirements to be met or reported for lighting control systems listed on the DesignLights Consortium (DLC) Networked Lighting Controls Qualified Products List (QPL).

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Scope of Technical Requirements

These are requirements for interior and exterior networked lighting control (NLC) systems associated with commercial and industrial buildings, roadways, and exterior environments. Note that while the requirements accept exterior NLC systems, these systems are not addressed comprehensively at present. NLC systems are defined for the purposes of these requirements as the combination of sensors, network interfaces, and controllers that effects lighting changes in luminaires, retrofit kits or lamps. Luminaires, retrofit kits and lamps are qualified separately by the DLC's Solid-State Lighting Technical Requirements and Qualified Products List.

DC and PoE networked lighting control systems are eligible to be qualified, in conjunction with the SSL Testing and Reporting Requirements for DC and PoE Lamps, Luminaires, and Retrofit Kits.

Building Management Systems that control networked lighting plus other building systems, such as HVAC, are eligible to be qualified as NLC systems and listed on the QPL, provided that they meet all of the DLC's requirements for NLC. Note that the DLC does not claim to qualify any HVAC-specific capabilities of these systems at this time.

Horticultural control systems are not eligible to be qualified at this time.

For future updates of these requirements, the DLC will explore how to recognize (i.e. "Report" but not "Require") support services; and also how to report more comprehensively on the capabilities of exterior NLC systems.

Definition of "Required" vs. "Reported" Capabilities

The Technical Requirements are built on "Required" and "Reported" system capabilities.

"Required" Capabilities: Required capabilities shall be available in all systems to be listed on the QPL. Systems that do not offer these capabilities are not eligible to be listed. A successful application will provide information on the availability of these capabilities and characteristics. Key information provided by the manufacturer will be published on the QPL.

Note: While the DLC requires systems to offer a particular capability, the DLC does not specify whether a capability must be installed on a project. For instance, while the DLC requires systems to have daylight harvesting/photocell capability, the DLC does not specify which rooms or luminaires on a project must be installed with daylight harvesting/photocell capability. Project-specific requirements for rebates and incentives are determined by individual efficiency programs.

"Reported" Capabilities: The DLC will report on the presence or absence of, type, and/or characteristics of each Reported capability for qualified systems. While systems are not required to include these capabilities, a successful application will provide information on the presence or absence of these capabilities and their characteristics. Key information provided by the manufacturer will be published on the QPL.

Additional Requirements (in addition to Tables 1,2,3)

"Customer Available Information": In order for an applicant to claim a capability listed in Tables 1 and 2, the manufacturer's customer literature must specify that the system has the capability, with instructions for how to configure and/or use this feature.

"Customer available" means the documentation is for a finished product available publicly on a website, and/or included with the product packaging, and/or provided to the customer upon request. It should not be a document produced for the sole purpose of obtaining DLC qualification without further use for customers. The DLC reserves the right to accept, reject, or require changes to documentation to satisfy this requirement. Any documentation provided to the DLC will be used for the purpose of verifying compliance with DLC Technical Requirements and will not be made available publicly or distributed.

The following capabilities from Table 1 and 2 are exempt from this requirement:

- Continuous Dimming
- Individual Addressability
- Luminaire Level Lighting Control (LLLC, integrated)
- Ease of Implementation
- Type of User Interface

Warranty: The DLC requires a minimum warranty of at least 5 years for all components of the system addressed by the requirements, with the exception of software, on-premises computer server, and cloud service. An optional warranty extension to 5 years is acceptable for meeting this requirement; however, the QPL will identify that an extended warranty must be purchased to meet the requirements.

Commercial Availability and Verification: All systems must be fully commercially available in North America, able to be purchased, and with complete, final documentation and literature readily available on the manufacturer's website before they can be listed. The DLC requires that a qualified system has been installed and operated successfully in at least one actual field installation. The DLC will verify this through a case study and/or a customer reference. See the application form for more information.

System Overview Presentation: As part of the application review process, the DLC requires a system overview to be presented via webinar or in-person to the DLC. See the application form for more information. For annual re-listings of a previously qualified system for which a recording of a prior presentation is available and the system has not changed extensively, this requirement may be waived or shortened.

All requirements documents, including the application form, instructions, and supporting documentation can be found on the DLC website at **https://www.designlights.org/lighting-controls/qualify-a-system**.

Multi-Year Plans

In order to serve the needs of stakeholders for long term planning, the DLC includes multi-year plans for some topics and/or requirements. These plans outline a general direction for each topic over the next few years, subject to refinement through the stakeholder input process.

Interoperability Plan

Interoperability is recognized in NLC5 as a new "Reported" NLC capability. The new interoperability capability will provide an umbrella summary to assist in selection of products that support interoperability in relation to specific use cases. Within the interoperability umbrella, the basic energy monitoring capability is "Required", while advanced aspects of energy monitoring, such as data content and format, are "Reported". Other capabilities are "Reported", but not "Required", as described in the section above 'Definition of "Required" vs. "Reported" Capabilities'.

The DLC has identified the following three use cases for initial priority in reporting interoperability. These three topics are addressed under other capabilities: External Systems Integration, Load Shedding/Demand Response and Energy Monitoring. Note that the pre-existing energy monitoring plan has now become part of the broader interoperability plan.

1. **External Systems Integration**

   Data from NLC components, such as luminaires, sensors, and controllers, is made available through an Application Programming Interface (API) and can be utilized by other building systems to improve their operational efficiencies. Accessing the NLC component data using the API allows integration with other building systems, including the Heating Ventilation and Air Conditioning (HVAC) system, energy management system, security system, etc. For example, an HVAC system might use occupancy data from an NLC system.

2. **Load Shedding/Demand Response (LS/DR)**

   A control feedback loop and communication is established between a building's demand response server and a demand control originator (such as a grid operator, energy provider, microgrid, or onsite Distributed Energy Resource), so that the building modifies its real-time energy consumption in response to the originator's needs, and reports the results to the originator. The NLC participates in this ecosystem as one of the load-responding building systems.

3. **Energy Monitoring (EM)**

   Lighting system energy data is reported by the NLC and shared with authorized entities over the Internet. For example, utility energy efficiency programs for NLCs can access the energy data to verify energy savings. The lighting energy data may also be accessed for central display of facility energy end-use status or for a building portfolio management provider to benchmark energy performance. Ideally, the data will use a standardized data model, when available.

Data about each topic that is already in the DLC database will be presented on the QPL as an aspect of interoperability, and the NLC5 application will include some additional Reported questions related to each topic. As applicable standards become available, the DLC will recognize compliant products.

V5 External Systems Integration Plan

An example of data about external systems integration that already exists in the DLC database is occupancy data granularity. Under NLC5, this data will be presented on the QPL as an aspect of interoperability.

The NLC5 application will include additional Reported questions regarding APIs, such as occupancy data mapping between lighting zones and thermal zones and reporting frequency/latency/format.

As applicable standards become available, the DLC will recognize compliant products, and may require compliance in the future in order to claim some scope levels such as "Enterprise/Portfolio" and "Roadway".

V5 Load Shedding/Demand Response (LS/DR) Plan

Examples of data about communication for LS/DR[1] that already exist in the DLC database include power data availability, granularity, and accuracy. Under NLC5, these data will be presented on the QPL as an aspect of interoperability.

The NLC5 application will include additional Reported questions regarding LS/DR, such as availability of the data in Table DR-1 below, and the typical latency of NLC responses. As relevant new standards become available, the DLC will recognize compliant products.

Table LS/DR-1

Inquiry from the DR API	NLC response
Current load status	Kilowatt (kW)
Recurring load status update at a specified interval	Periodic kW report at a specified interval
Forecasted load reduction capacity for a specified future time (peak) and duration (accumulated) period	Kilowatt (kW) – peak Kilowatt-hour (kWh) – accumulation over period
Load reduction request for a specified amount starting at the specified time for a specified time period	Acknowledge and execute
Cancellation of load reduction	Acknowledge and execute

V5 Energy Monitoring Plan

The basic capability of energy monitoring is "Required", with an exception for room-based systems. Data is reported via a .CSV file and/or an API. Methods of energy monitoring may include automated measurement methods and methods that require manual input of wattage to measure energy use. As part of the application or re-application process, each product that qualifies for energy monitoring must provide the DLC with a sample .CSV file or API documentation.

Energy monitoring capability is not required for systems for rooms, or for whole buildings <25,000 square feet. A "room-based system" is defined as follows: A system that is designed to control lighting in a single

[1] For a recent exploration of this topic, see "The Value Proposition for Cost-Effective, Demand Responsive-Enabling, Nonresidential Lighting System Retrofits in California Buildings", April 2019, Peter Schwartz et al, https://www.energy.ca.gov/2019publications/CEC-500-2019-041/CEC-500-2019-041.pdf

room or space, or building < 25,000 square feet, and where the control, configuration, and management of the system is contained within the room or space illuminated by the system. In order to interact with the system, (for instance, to change any settings or to download any data), a user must be physically present in, or in close proximity to, the room or space illuminated by the system.

In order for a system to qualify for this exemption, the DLC review process confirms that the product claims only "Room or Zone, or Whole Building <25,000 sf" for interior scope as listed on the DLC QPL.The basic capability of energy monitoring is "Required", except for "room-based systems" as defined above.

The basic capability of energy monitoring is defined in accordance with ASHRAE 90.1-2016 Section 8.4.3 "Electrical Energy Monitoring", as outlined below in Table 3 Row 11.

Advanced capabilities of energy monitoring are "Reported".

In the absence of a more detailed applicable standard (beyond ASHRAE 90.1) describing energy data reports, details about data content in the following tables are "Reported", not "Required".

Tables EM-1 and EM-2 describe the recommended contents of an energy monitoring data report. The Online NLC QPL will report which systems offer these contents. This table is derived from the DLC report "Energy Savings from Networked Lighting Control (NLC) Systems", 9/21/2017, Appendix A, Tables 8 and 9; and from comments on earlier NLC V4.0 drafts. The DLC is participating in the ANSI/NEMA C137 Committee to develop more specific data requirements.

168 **Table EM-1: Energy Data Reporting Guidelines for .CSV or API; Static Variables**

Row	Topic	Data Element	Definition	Note
1.1	Headings	For each field	Each type of data element is identified by a heading.	Text such as "Manufacturer", "Product", etc.
1.2	System	NLC Manufacturer	The manufacturer of the NLC system	Text
1.3	System	NLC Product	The name of the NLC system	Text
1.4	Site	Building/Business Type [*Note A]	The main business function in the portion of the building where the NLC system is installed	From ASHRAE 90.1-2016 Table 9.5.1
1.5	Baseline for NLC	Maximum Rated Power with no control strategy enabled	The maximum possible power consumption of the lighting system without any control strategy in effect. If a luminaire retrofit has occurred, this value is equal to the maximum rated power of the new luminaire(s). The spatial granularity matches the energy measurements. For instance, if energy is reported at each luminaire, then the baseline power is reported at each luminaire.	Separate data for interior vs. exterior. Units = kiloWatts
1.6	Energy	Energy Reporting Interval [*Note B]	The frequency an energy measurement is reported (15 minutes or less)	Units = minutes
1.7	Energy	Data method	How is energy interval data calculated?	Text such as "15 minute average from 3 samples spaced 5 minutes apart"
1.8	Energy	Nominal Accuracy	% accuracy of the energy data	Text such as "+/-3% or 0.005 kWh, whichever is larger"

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170 **Table EM-2: Energy Data Reporting Guidelines for .CSV or API; Dynamic Variables**

Row	Topic	Data Element	Definition	Note
2.1	Headings	For each field	Each type of data element is identified by a heading.	Text such as "Unix Time", "Energy Data kWh", etc.
2.2	Energy	Timestamp	Date and time of each energy measurement	Unix time or RFC 3339 time
2.3	Energy	Energy Data	The actual energy readings that are recorded for each luminaire or group of luminaires	Units = kWh
2.6	Energy	Confidence Level	The percentage of all possible samples expected to include the true population parameter.	Units = %
2.7	Energy	Record Duration	Months of 15 minute interval data	Units=months

Note A: For Building/Business Type, ASHRAE Standard 90.1-2016, "Energy Standard for Buildings Except Low-Rise Residential Buildings" Table 9.5.1 can be freely viewed at https://www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards, PDF page 155.

Note B: The need for 15 minute interval data is derived from the IPMVP Options A and B, as typically implemented by utility programs (International Performance Measurement and Verification Protocol: Core Concepts and Options for Determining Energy and Water Savings EVO-10000-1.2016, Efficiency Valuation Organization, evo-world.org.)

Future Plans for Interoperability

API

Future plans for interoperability will focus on recognizing NLC data available through an API with the following characteristics:

- Available for automated data exchange through an API available to third parties
- In a common style such as REST
- With a TLS HTTPS security web interface for cybersecurity
- Represented in a standardized format, such as JSON or XML
- When available, using a schema such as Project Haystack, Brick or ASHRAE 223P
- Supporting the three NLC5 use cases (communication with external systems, demand response, and energy monitoring) and additional use cases when added in the future

Additional Use Cases

Additional use cases in the future may involve additional capabilities beyond the three in NLC5.

Configuration Report

Utility members and the DLC will explore development of a configuration report recommendation and standard to identify system configuration and settings such as high-end trim, delay dwell times for occupancy and daylight harvest, lights controlled in each zone, and lighting levels at the time of configuration. The purpose of this report will be to aid efficiency programs and customers in confirming appropriate system configuration and to promote consistent terminology such as NEMA LSD 64-2014.

Cybersecurity Plan

In alignment with the multi-year cybersecurity plan previously published in versions 3.0 and 4.0 of this document, the DLC is taking the next step to help ensure qualified systems utilize best-practice standards for cybersecurity. The cybersecurity capability is Required under NLC5. The criteria have been expanded from NLC V4.0 to offer more options for compliance.

V5 Cybersecurity Program Administration

- In order to claim the cybersecurity capability, a system must either:
    a. Have a valid certification for one or more of the specified standards in Table CS-1 at the time of qualification, or
    b. Report compliance with a standardized third-party methodology such as UL 1376, CSA T200, etc. that meets criteria 2-4 below, but not necessarily criterion 1.
- Cybersecurity compliance will be described on the NLC QPL as either:
    a. One of the recognized standards in Table CS-1 or
    b. "Other".
- The list of applicable standards in Table CS-1 will be reviewed for each incremental revision to the Technical Requirements, or annually, whichever comes sooner.
- Self-certification is recognized, provided that it is accredited by a certifying body with a formal procedure to authorize self-certification. For example, UL has a pilot Data Acceptance Program for cybersecurity to authorize self-certification to ANSI/UL 2900-1.
- Self-assessment (without accreditation) is not recognized in either Option A or B above.
- Certification in any one of the four categories of Table CS-1 (Process, Components, System, Cloud Services) is sufficient.
- Table CS-2 describes how DLC reviewers will comfirm compliance with each standard.
- The DLC will confirm cybersecurity certification will be valid for at least 6 months after the time of application submission.
- The DLC will confirm cybersecurity certification once a year in July, whether or not a system updates data to the next Technical Requirements version. If a certificate has lapsed, a system will need to recertify in order to remain listed.
- Some cybersecurity standards offer different levels of compliance based on risk management. For instance, some standards offer lower performance requirements for room level systems that cannot be upgraded to add a permanent internet connection. Therefore, the DLC cybersecurity requirement applies to all systems—with the understanding that comprehensive systems with many capabilities are subject to more rigor, compared to simple systems with few capabilities.
- The grace period for renewals is described below under "Annual Revisions and Grace Period". For the new cybersecurity requirement introduced with NLC5, the same grace period is extended to products that are not previously listed on the DLC QPL.
- Note: While the standards in Table CS-1 can be applied to NLCs, not all of their requirements may be relevant for lighting control systems. Manufacturers and their certification bodies should review each standard to identify the appropriate requirements for each system being qualified.

Criteria for Acceptable Cybersecurity Standards

The DLC recognizes cybersecurity standards that meet the following criteria:

1. Certifiable with a standardized methodology established through either:
    a. A voluntary consensus process such as ANSI, ISO, IEC, etc.
    b. A federal agency of the USA or Canada
    c. A collaborative multi-stakeholder engagement process such as the Cloud Security Alliance
2. Applies to one or more of the following:
    a. Product development process lifecycle
    b. Components/Embedded Devices
    c. System
    d. Cloud Services
3. Includes at least 3 of the following technical content, for (2. b,c,d) above:
    a. Penetration testing
    b. Communication robustness testing
    c. Vulnerability identification testing
    d. Multiple levels of security
4. Renewal is required at least every 3 years, in order for a certificate to remain valid.

Definitions

- **Cybersecurity:** The practice of defending networked systems and data from malicious attacks.
- **Process:** Standards that address the development process in order to reduce the number of cybersecurity vulnerabilities that are designed into components, systems, and services, and that manifest over the product lifecycle.
- **Components:** Standards that address the cybersecurity of each individual physical end device in a networked system.
- **System:** Standards that address the networked system, including aspects such as authentication, data confidentiality, system integrity, service availability, protocol converters, firewalls, gateways, web servers, and web services interfaces.
- **Cloud Services:** Standards for cloud services that address secure integration with services from a remote cloud computing provider.

List of Standards

Standards that meet the criteria are listed in Table CS-1. Once a standard is on this list, the DLC does not expect to remove it with less than two years of notice.

Table CS-1: Cybersecurity Standards Recognized by the DLC

Standard	Process	Components/ Embedded Devices	System	Cloud Services
ANSI/UL 2900-1	y	y		
IEC 62443	62443-4-1	62443-4-2	62443-3-3	
SOC 2	y		y	y
ISO 27001	y			
ISO 27017 (with 27001)				y
FedRAMP				y
CSA STAR				y

Table CS-2: Proof of Cybersecurity Compliance

Standard	Proof of Compliance
ANSI/UL 2900-1	Certification claim listed on applicant's website, plus a letter or copy of certificate issued by a UL-accredited lab.
IEC 62443	ISASecure registry of a component, system, or CDO at https://www.isasecure.org/en-US/End-Users/
SOC 2	Certification claim listed on applicant's website, plus a letter from 3rd party auditor.
ISO 27001	Copy of an accredited certification from a member of the ANSI-ASQ National Accreditation Board as listed at http://anabdirectory.remoteauditor.com/
ISO 27017 (with 27001)	Copy of an accredited certification from a member of the ANSI-ASQ National Accreditation Board as listed at http://anabdirectory.remoteauditor.com/
FedRAMP	"Authorized" at https://marketplace.fedramp.gov/#/products?status=Compliant;FedRAMP%20Ready&sort=productName
CSA STAR	"Certification" or "Attestation" (not self-assessment) at https://cloudsecurityalliance.org/star/registry/
Other	Copy of certificate or letter from the issuing 3rd party

Annual Revisions and Grace Period

The DLC revises the Networked Lighting Controls Technical Requirements annually, with final revisions completed in early June of each year. The DLC's goal is to display data that either meets the current specification or the previous year's specification, so that all of the QPL data is less than two years old.

Grace Period Policy: A listing grace period until April 15 of the following year (for example, April 15, 2021 for NLC5) will be provided for systems that have been qualified under a previous version of the Technical Requirements, but do not meet revised requirements. These systems can be relisted once under the previous version of the Technical Requirements. This will allow a period of 10.5 months to develop an updated or new system that can be submitted for evaluation according to the most current Technical Requirements.

For example, in June 2020, a system that is currently listed under NLV4.0 (published in June 2019) has two options to remain listed in the future:

a. If the system qualifies for NLC5 (published in June 2020), then the data can be updated to NLC5 at any time until April 15, 2021.

b. If the system does not qualify for NLC5, then the product can remain listed as NLC4 until October 31, 2021. After that, if the product and data have not been updated to either NLC5 (by April 2021) or NLC6 (by October 2021), then the product will be delisted.

Note that in order to use the grace period when a new set of Technical Requirements are published in June (for instance NLC5 in June 2020), a system would need to be listed under the previous version (in this example, NLC4).

For the new cybersecurity requirement introduced with NLC5, the same grace period will be extended to new products (products not previously listed on the DLC QPL). New products will use the NLC5 application form until April 15, 2021. Until April 15, 2021, if they meet all requirements except for the new cybersecurity requirement, then they will be qualified as NLC4.

Requirements for Interior Lighting Systems

Table 1 provides a summary of "Required" and "Reported" system capabilities for interior lighting systems.

Table 1: "Required" and "Reported" Capabilities for Interior Lighting Systems

'Required' Interior System Capabilities	'Reported' Interior System Capabilities
Networking of Luminaires and Devices	Control Persistence
Occupancy Sensing	Scheduling
Daylight Harvesting/Photocell Control	Device Monitoring/Remote Diagnostics
High-End Trim	Type of User Interface
Zoning	Luminaire Level Lighting Control (LLLC, integrated)
Individual Addressability	Personal Control
Continuous Dimming	Load Shedding/Demand Response
Energy Monitoring	Plug Load Control
Cybersecurity	External Systems Integration
	Emergency Lighting
	Color Changing/Tuning
	Ease of Implementation
	Scene Control
	Interoperability

Requirements for Exterior Lighting Systems

Table 2 provides a summary of "Required" and "Reported" system capabilities for exterior lighting systems.

Table 2: "Required" and "Reported" Capabilities for Exterior Lighting Systems

'Required' Exterior System Capabilities	'Reported' Exterior System Capabilities
Networking of Luminaires and Devices	Control Persistence
Occupancy Sensing AND/OR Traffic Sensing	Device Monitoring/Remote Diagnostics
Daylight Harvesting/Photocell Control	Type of User Interface
High-End Trim	Luminaire Level Lighting Control (LLLC, integrated)
Zoning	Load Shedding/Demand Response
Individual Addressability	External Systems Integration
Continuous Dimming	Emergency Lighting
Scheduling	Color Changing/Tuning
Energy Monitoring	Ease of Implementation
Cybersecurity	Scene Control
	Interoperability

Capability and Requirement Definitions

Table 3 provides the detailed definitions for each capability or technical requirement. This table applies to both Interior and Exterior systems, except where noted. Please note that the application form specifies in more detail what information the DLC requires from manufacturers for each capability and what information will be published on the QPL.

Note: Some NLC systems control luminaires and retrofit kits, and some NLC systems control lamps within luminaires. The latter systems use a wireless controller integrated inside each lamp. The "luminaires/lamps" phrase indicates that a requirement applies to luminaires and retrofit kits if an NLC system controls luminaires and retrofit kits; and the requirement applies to lamps if an NLC system controls lamps.

Table 3: Definitions of Capabilities & Requirements

Row	Capability	Definition
1	Networking of Luminaires and Devices	The capability of individual luminaires/lamps and control devices to exchange digital data with other luminaires/lamps and control devices on the system. This capability is required at the room, space, or area level, but not at the whole building level or beyond (e.g. non-lighting systems, or the internet).
2	Occupancy Sensing	The capability to affect the operation of lighting equipment based upon detecting the presence or absence of people in a space or exterior environment. Exterior systems must include either occupancy sensing or traffic sensing. They may include both, but that is not required.
3	Traffic Sensing	The capability to affect the operation of lighting or other equipment based upon detecting the presence or absence of moving vehicles in an area. Systems may satisfy this requirement through external systems integration as described below in lieu of in-system sensors if another source of data is used for presence or absence detection. Exterior systems must include either occupancy sensing or traffic sensing. They may include both, but that is not required.
4	Daylight Harvesting / Photocell Control	The capability to automatically affect the operation of lighting or other equipment based on the amount of daylight and/or ambient light that is present in a space, area, or exterior environment. This capability is typically called daylight harvesting for interior systems, and photocell control for exterior systems.
5	High-End Trim*	The capability to set the maximum light output to a less-than-maximum state of an individual or group of luminaires/lamps at the time of installation or commissioning. High-end trim must be field reconfigurable. This capability is distinct from automatic compensation for lumen depreciation, which automatically increases output as a system operates over time. *While the DLC specifically requires "High-end trim", some manufacturers refer to this capability as "**task tuning**" or "**tuning**" within their system interfaces. Refer to NEMA LSD 64-2014 for definitions of lighting controls terminology.

6	Zoning	The capability to group luminaires/lamps and form unique lighting control zones for a control strategy via software-defined means, and not via physical configuration of mechanical or electrical installation details (e.g. wiring). *Interior:* Zoning is required for occupancy sensing, high-end trim, and daylight harvesting control strategies except for systems that feature luminaire level lighting control (LLLC) capabilities as defined in these requirements under "Reported Capabilities", in which case zoning is only required for occupancy sensing and high-end trim control strategies. *Exterior:* Zoning is required for high-end trim.
7	Individual Addressability	The ability to uniquely identify and/or address each individual luminaire/lamp, sensor, controller, and user interface device in the lighting system, allowing for configuration and re-configuration of devices and control zones independent of electrical circuiting.
8	Continuous Dimming	The capability of a control system to provide control with sufficient resolution in output (100+ steps) to support light level changes perceived as smooth (as opposed to step dimming with a small number of discrete light levels).
9	Control Persistence	The capability of a networked lighting control system's lowest-level ("edge device") luminaire/lamp controllers to execute three energy saving strategies (occupancy sensing, daylight harvesting, and high-end trim) at a room-level, or finer, resolution in the absence of communications with the next higher networked element in the system's topology.
10	Scheduling	The capability to automatically affect the operation of lighting equipment based on time of day. Scheduling capability is reported for interior systems and required for exterior systems. Exterior systems are required to have time-based scheduling, and "astronomical" scheduling functionality for sunrise and sunset programming, based on geographical location and time of year.

11	Energy Monitoring	The capability of a system to report the energy consumption of a luminaire/lamp and/or a group of luminaires/lamps.
		• Individual luminaire/lamp monitoring as well as energy monitoring on dedicated lighting circuits is acceptable.
		• The method by which the system implements this capability must be clearly described, including whether the system provides automated energy measurement or relies on numerical manual input during system setup for accurate measurement (such as inputting the wattage of each luminaire/lamp in a project).
		• Reference consists of one or both of:
		  ○ Sample .CSV file with documentation
		  ○ API documentation
		• The basic, required capability of energy monitoring is defined in accordance with ASHRAE 90.1-2016 Section 8.4.3.
		  ○ Energy use by interior lighting (if applicable), exterior lighting (if applicable) and receptacle circuits (if monitored by the NLC) can be monitored independently.
		  ○ For buildings with tenants, the above applicable systems (interior lighting, exterior lighting, receptacle) can be separately monitored for the total building and for each individual tenant space >10,000 sf. The data for each tenant space can be reported to each tenant.
		  ○ The lighting system energy use can be recorded a minimum of every 15 minutes and reported at least hourly, daily, monthly, and annually.
		  ○ Energy use data can be transmitted to a building control system (if present) and graphically displayed.
		  ○ Data shall be available for a minimum of 36 months.
		• Energy monitoring is not required for room-based systems.
		• In order for a system to qualify for this exemption, the DLC review process will confirm that the product claims only “Room or Zone, or Whole Building <25,000 sf” for interior scope as listed on the DLC QPL.

12	Device Monitoring / Remote Diagnostics	The capability to monitor, diagnose, and report operational performance including system and/or component failures.
13	Type of User Interface	The type of interface provided by the control system for users to read and adjust control system settings during system start-up, commissioning, and/or ongoing operation.

14	Luminaire Level Lighting Control (LLLC, integrated)	The capability to have a networked occupancy sensor and ambient light sensor installed for each luminaire or kit, and directly integrated or embedded into the form factor during the luminaire or kit manufacturing process. In addition to these required integrated components, LLLC systems must have control persistence capability as described in this document. To demonstrate commercial availability of the integrated component options, at least one family, luminaire or kit with integrated control must be verified by the DLC. Manufacturers may choose whether or not to list this information publicly on the QPL.
15	Personal Control	The capability for individual users to adjust to their personal preferences, via networked means, the illuminated environment of a light fixture or group on of light fixtures in a specific task area. The publicly available information must clearly describe a control interface for use by a single individual who does not have access to system-wide settings. A wireless dimmer switch may only be considered a personal control interface if product documentation: • shows that the physical configuration is suitable for workstation use (i.e. a small, self-contained unit without any external wiring, suitable for use as a handheld remote control), and • describes configuration for personal control within a larger area. A software-based interface may only be considered personal control if product documentation: • shows it provides a specific interface intended for personal control by an individual user within a subsection of a larger space, and that • the interface only allows access to personal control functions for the light fixtures in the specific areas being controlled (i.e. each occupant can control their own area, but not their neighbors' areas).
16	Load Shedding/ Demand Response	The capability to reduce the energy consumption of a lighting system, in a pre-defined way, on a temporary basis, in response to a demand response signal without manual intervention. The method by which the system implements this capability (BMS managed, NLC managed, automated, manual intervention) must be clearly described in the publicly available reference(s). The method for pre-defining the system behavior for temporary load reduction must be accessible through a user interface. The data the NLC can receive and interpret from other networked systems must include at least a 1-byte signal that can be used for purposes such as LS/DR.
17	Plug Load Control	The capability to control the power delivered to receptacles through scheduling or occupancy sensing. The method by which the system implements this capability must be clearly described in the publicly available reference(s).

18	External Systems Integration (e.g. BMS, EMS, HVAC, Lighting, API, Cloud)	The capability to exchange data with other networked systems such as building or energy management systems (BMS/EMS), heating ventilation and air conditioning (HVAC) systems, or other lighting and building systems via BACnet, Modbus, LonWorks or other open protocols, application program interface (API) or other methods. In order to claim this "Reported" capability, the data available from the NLC for exchange with other networked systems must include occupancy status at the zone level and energy data at the zone-, circuit- or system-level. The data the NLC can receive and interpret from other networked systems must include at least a 1-byte signal that can be used for purposes such as scene control. The method, including formats and languages, by which the system implements this capability must be clearly described in the publicly available reference(s).
19	Emergency Lighting	Publicly available documentation illustrating how a system's luminaires connect with an emergency power source. The QPL will provide the URL(s) for online documentation provided by manufacturers for system designers to refer to. This documentation will identify wiring diagrams, required components, and/or application guides needed to understand design considerations for integrating the system into an emergency lighting system.
20	Cybersecurity	The compliance with a cybersecurity standard that meets the DLC criteria. The current standards are shown in Table CS-1 and listed here: • ANSI/UL 2900-1 • IEC 62443 • SOC 2 • ISO 27001 • ISO 27017 (with 27001) • FedRAMP • CSA STAR • Other Documentation requirements to demonstrate certification for each standard are shown in Table CS-2.
21	Color Changing / Tuning	The capability to alter the output and color of tunable white and/or variable color output luminaires via a dedicated control interface(s). To demonstrate compliance with this capability, the interface(s) must be clearly described in the product literature and allow for at least two CCT settings. These settings may be described in terms of CCT, such as 3000K or 5000K, or simple descriptive terms for the desired setting such as 'Night' or 'Day'. The product literature must also specify installation and configuration requirements to implement this functionality.
22	Ease of Implementation	The QPL will identify the most typical responsible party and their required level of training to start-up and configure the system to the extent that all required capabilities are functioning. Documentation is not required.
23	Scenes	The capability of a system to provide two or more pre-programmed light level settings for a group or multiple groups of luminaires to suit multiple activities in a space, and allow for recall of these settings via a switch, control device, or signal from a BMS or API.

24	Interoperability	The capability of a system or component to communicate data to/from another system or component in a published, repeatable and non-proprietary way. Data sent from an NLC is fully documented such that others can receive, interpret, and use the data accurately and reliably. This also includes the network protocol requirements, messaging, and related functionality. This capability consists of aspects of other NLC capabilities: currently External Systems Integration, Load Shedding/Demand Response, and Energy Monitoring. Additional capabilities may be included under this umbrella in the future.

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