



Light Usage for Night Applications (LUNA)

Version 1, Draft 1

April 28, 2021

Today's Agenda

- Introductions
- Webinar Logistics
- LUNA Overview
- Technical Requirements
- Q&A



Light Usage for Night Applications (LUNA) Technical Requirements Version 1

Draft 1

Released for Comment: April 12, 2021

 DRAFT 1: Light Usage for Night Applications (LUNA), Version 1
Released for comment April 12, 2021

Introductions

Presenters



Christina
Halfpenny



Levin
Nock



Leora
Radetsky



Kasey
Holland

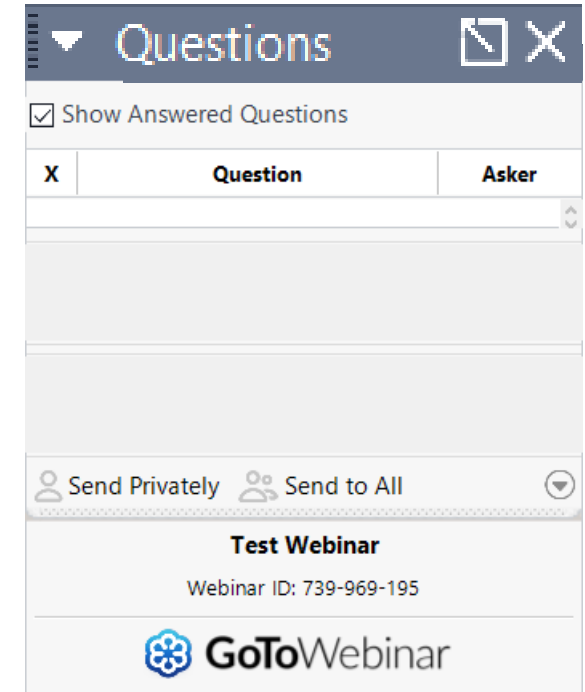
Q&A Support



Axel
Pearson

Webinar Logistics

- Please enter your questions in the Questions pane in GoToWebinar.
 - Some questions answered in the Questions Pane
 - Some questions answered aloud (anonymously) at the end during the Q&A session
- All attendees are automatically muted
 - If you experience technical issues, please use the chat pane to let us know



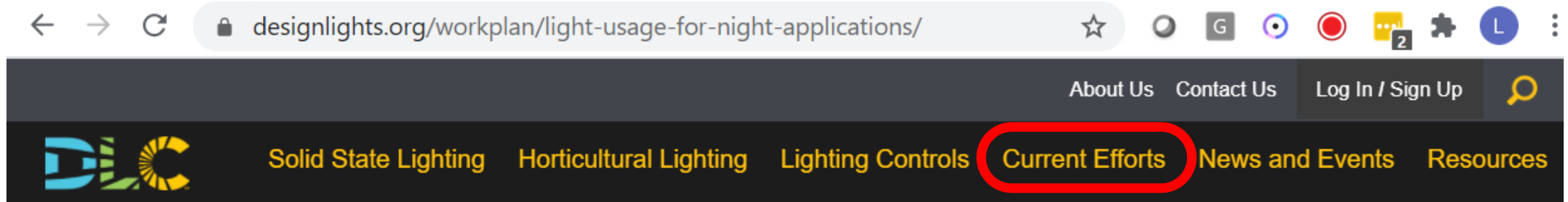
Recordings

- **Slides and recorded webinar will be posted** on the *DLC News & Events* page at www.designlights.org/news-events shortly after today's presentation

The screenshot shows the website designlights.org/news-events/. The navigation menu includes: Solid State Lighting, Horticultural Lighting, Lighting Controls, Current Events, **News and Events** (circled in red), and Resources. The main content area is titled "DLC News" and features four news items:

Date	Title
Apr 28, 2020	SSL V5 Technical Requirements updates due to COVID-19
Apr 16, 2020	New DLC Draft Policy: Draft 2 Networked Lighting Controls Technical Requirements V5 (NLC5)
Mar 23, 2020	System Promoted to DLC Networked Lighting Controls V4.0 QPL
Feb 14, 2020	New DLC Policy: SSL Technical Requirements V5.0 & V5.1 Released

Find LUNA at designlights.org under “Current Efforts”



Cover Letter for Draft LUNA Technical Requirements V1

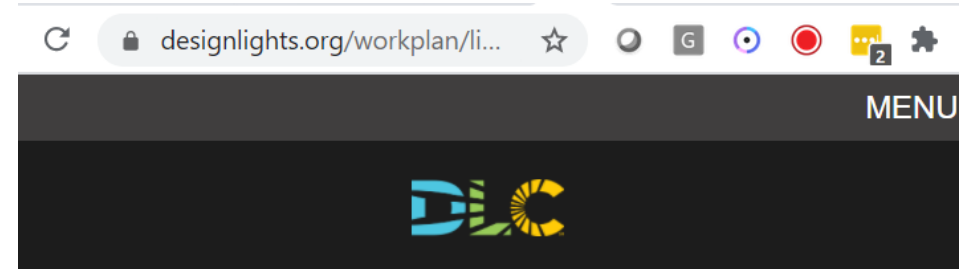
Draft 1 LUNA Technical Requirements V1

Comment Form for Draft 1 LUNA Technical Requirements V1



Comment Forms

Please download the Luna Comment Form and email your completed form to comments@designlights.org by Friday May 21.



Cover Letter for Draft LUNA Technical Requirements V1

Draft 1 LUNA Technical Requirements V1

Comment Form for Draft 1 LUNA Technical Requirements V1

LUNA Comment Form Instructions

Technical Requirements for Light Usage for Night Applications (LUNA)

Version 1, Draft 1

Close of business, Friday, March 21, 2021

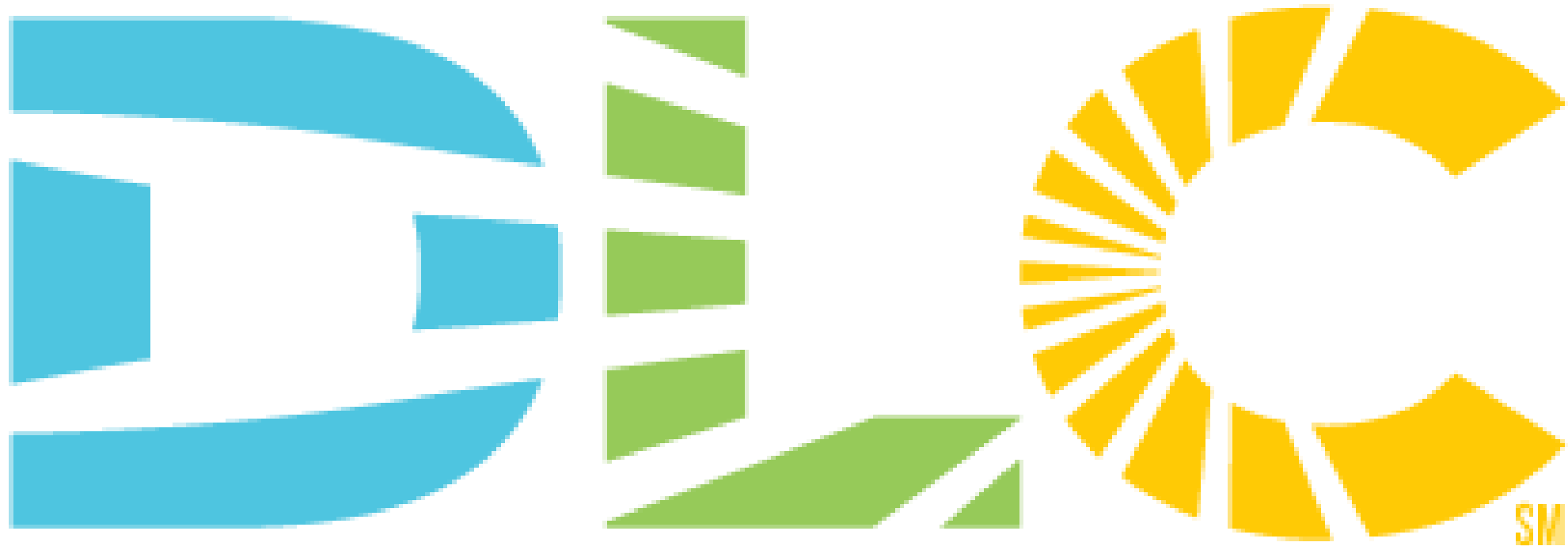
Please follow these steps to ensure your comments are received and considered by the DesignLights Consortium:

1. Enter your Organization, Name, Email Address, and Phone Number in Row 8 of this worksheet.
2. There are three (3) sections included in this release: Distribution, Spectral Quality, and Controllability. Navigate to the tab at the bottom of this worksheet corresponding to the section of the draft policy on which you'd like to comment. Comments that are not related to a specific section or topic may be added at the "General Comments" tab.
3. After your review of the draft documents, please consider each Key Question in Columns B, C, and D and submit your answer in Column D and potential solutions in Column E. Comments to the Technical Requirements that are not related to a specific Key Question may be added to the remainder of each worksheet. Please enter the line number of the draft corresponding to your comment.
4. Save this Excel file with your comments and include your organization name appended to the end of the filename (for example: "DLC_LUNA-V1Draft1_CommentForm_AcmeLighting").
5. Email the file to comments@designlights.org by close of business, **Friday, May 21, 2021**.

LUNA Overview



The DLC is a non-profit organization whose mission is to achieve energy optimization by enabling controllability with a focus on quality, people, and the environment.



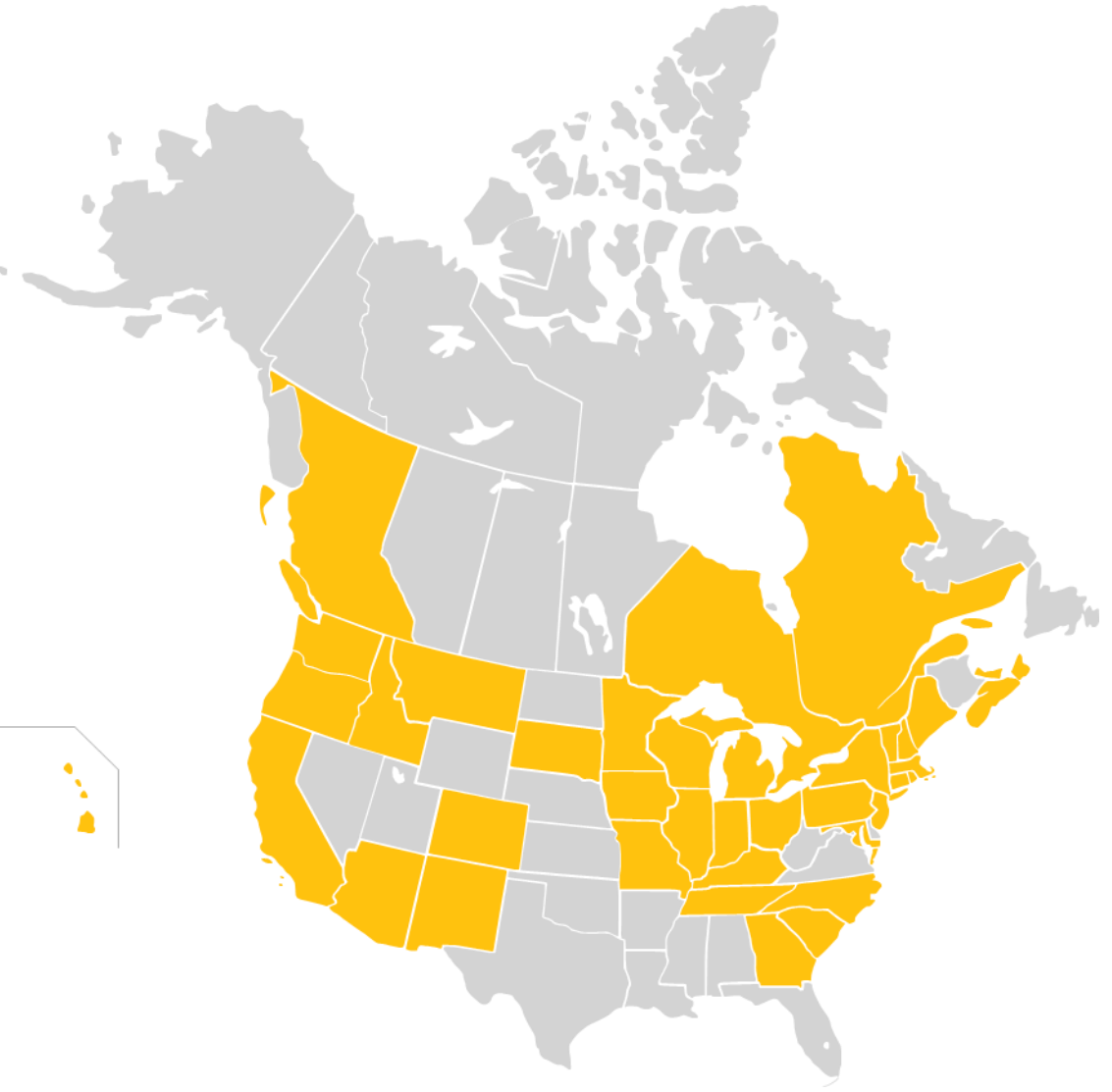
Energy - Quality - ControllabilitySM

The DLC is made up of:

24 staff

1800+ Lighting Manufacturers

75 Energy Efficiency Programs.



LUNA Program Goals

1. Minimize lighting energy use

2. Minimize light pollution

3. Provide appropriate visibility for people



Why Now?

“Researchers predict that at the current rate of increasing light pollution, by 2025 no dark skies will remain in the continental United States. The two main culprits are light and air pollution.” *National Park Service*

Light Pollution Affects Everything



Wildlife



Health



Energy



Heritage



Safety

Why DLC?

Outdoor Luminaires	Primary Use Designation	Number of Qualified Fixtures
	Outdoor Pole/Arm-Mounted Area and Roadway Luminaires	114370
	Architectural Flood and Spot Luminaires	40032
	Outdoor Full-Cutoff Wall-Mounted Area Luminaires	32082
	Outdoor Pole/Arm-Mounted Decorative Luminaires	10993
	Parking Garage Luminaires	9740
	Outdoor Non-Cutoff and Semi-Cutoff Wall-Mounted Area Luminaires	9264
	Fuel Pump Canopy Luminaires	8335
	Stairwell and Passageway Luminaires	6167
	Specialty	4581
Bollards	367	
Landscape/Accent Flood and Spot Luminaires	16	
Grand Total	235947	



Before



After



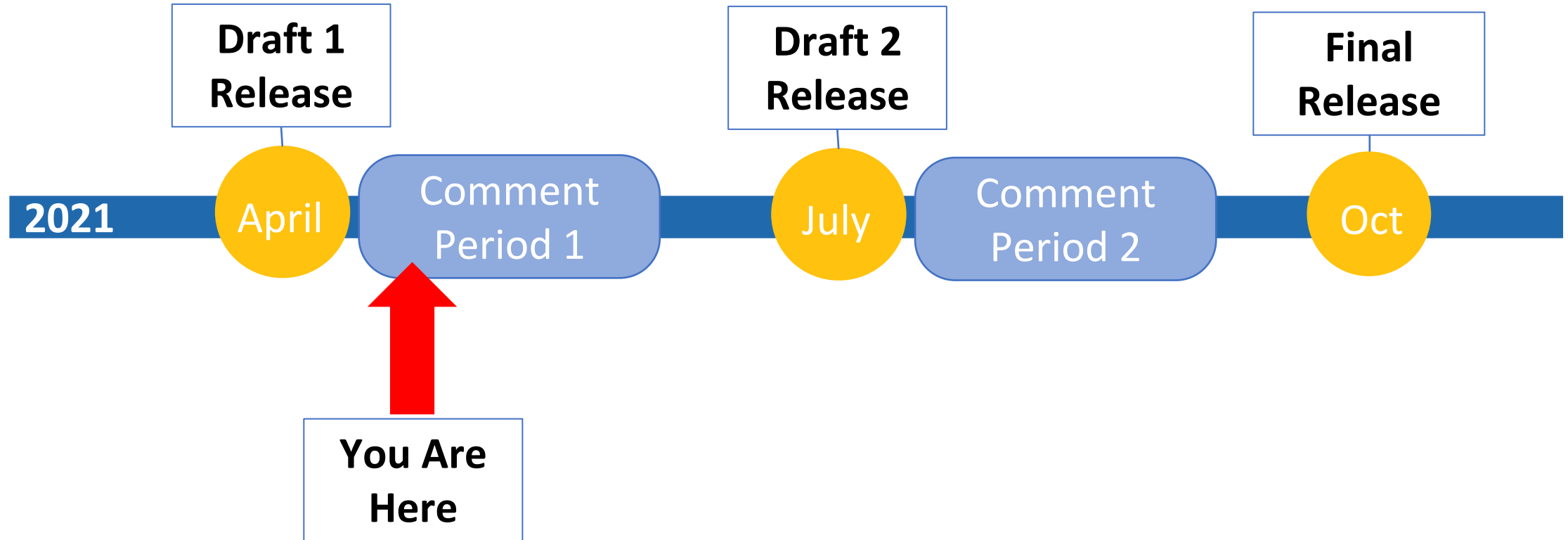
NOAA/NGDC/DMSP Digital Archive

Before and during the 2003 Northeast blackout, a massive power outage that affected 55 million people. Photo by Todd Carlson. Photo and image credit: IDA, <https://www.darksky.org/>

LUNA Timeline and Structure



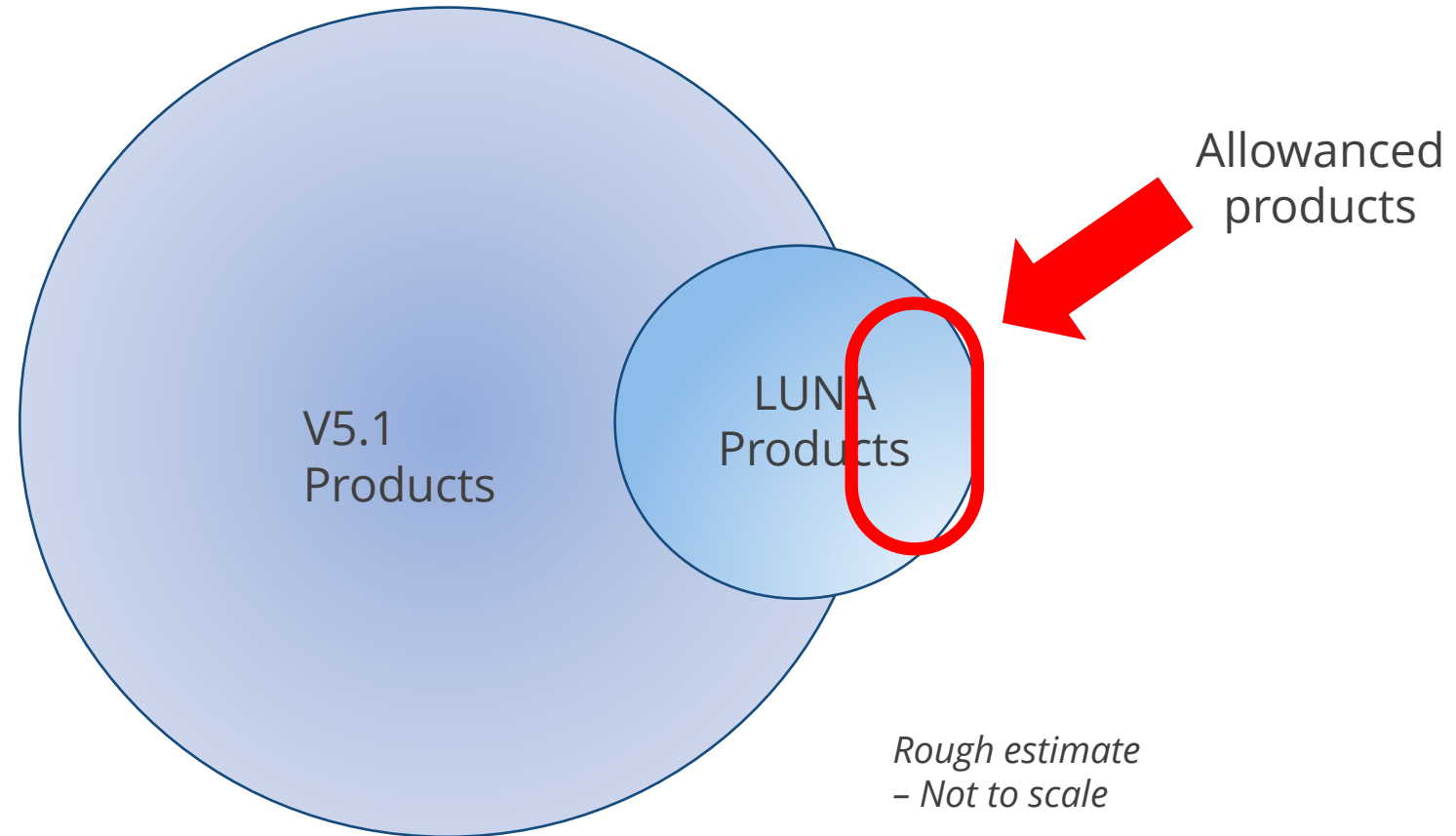
2021 Timeline



Organization of the LUNA Technical Requirements

- Overview of SSL Baseline Requirements
- New requirements for
 - Light Distribution
 - Spectral Quality
 - Controllability
 - Allowances and Tolerances
 - ANSI/IES LM-79-19 Reports

LUNA starts with SSL V5.1, and adds some new requirements



SSL V5.1 Outdoor Requirements (baseline released Q1 2020)

Distribution



- **BUG Ratings Reported**
- Zonal Lumen distribution requirements by product type (PUD)
- Field Adjustable Distributions Reported

Spectral Quality



- Minimum CRI: 70, or:
 - Minimum Rf: 70, and
 - Minimum Rg: 89, and
 - Required Rcs,h1: -18% to 23%
- **Required CCT: 2200 K – 6500 K**
- Color maintenance: maximum $\Delta u'v'$
- Color-tunable reporting (white-tunable & warm-dimming)

Controllability

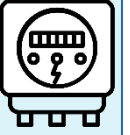


- Continuous **or step**-dimming required
 - **Standard: Step dimming to $\leq 70\%$ of full light output**
 - Premium: Continuous dimming to $\leq 20\%$ of full light output
- **Reporting on integral control sensors and capabilities**
- **Reporting of communication protocols**

Other

- Minimum light output by PUD and General Application
- Minimum PF: ≥ 0.90
- Maximum THD: $\leq 20\%$
- Minimum Warranty: 5 year

Minimum Efficacy



- Std: 105 LPW
- Premium: 120 LPW
- **Efficacy allowance** for CCTs under 3000K
- Efficacy allowance for better color rendering

Lumen Maintenance



- Standard: L70 $\geq 50,000$ hours
- Premium: L90 $\geq 36,000$ hours

Table 1: DLC SSL Primary Use Designations (PUDs) eligible for LUNA

Primary Use Letter	Primary Use Designations Eligible for LUNA Qualification
A	Outdoor Pole/Arm-Mounted Area and Roadway Luminaires
B	Outdoor Pole/Arm-Mounted Decorative Luminaires
C	Outdoor Full-Cutoff Wall-Mounted Area Luminaires
D	Outdoor Non-Cutoff and Semi-Cutoff Wall-Mounted Area Luminaires
E	Bollards
F	Parking Garage Luminaires
G	Fuel Pump Canopy Luminaires
	Specialty: Hazardous Area Lighting
	Specialty: Hazardous Outdoor Pole/Arm-Mounted Area and Roadway Luminaires
	Specialty: Hazardous Wall Mounted Luminaire
	Specialty: Canopy Lighting
	Specialty: Directional Fuel Pump Canopy Luminaires
	Specialty: Transportation



Proposed Draft 1
Requirements: **Distribution**

Draft 1 – Distribution Rationale

- Uplight emitted directly from luminaires is unused light, wasting energy and increasing sky glow.
- LUNA is using prescriptive BUG Rating thresholds to set maximum limits on uplight emitted directly from listed luminaires.
- Aimable luminaires are not eligible for LUNA V1
- Luminaires with auxiliary shielding may improve the quality of the light distribution



Draft 1 - Distribution

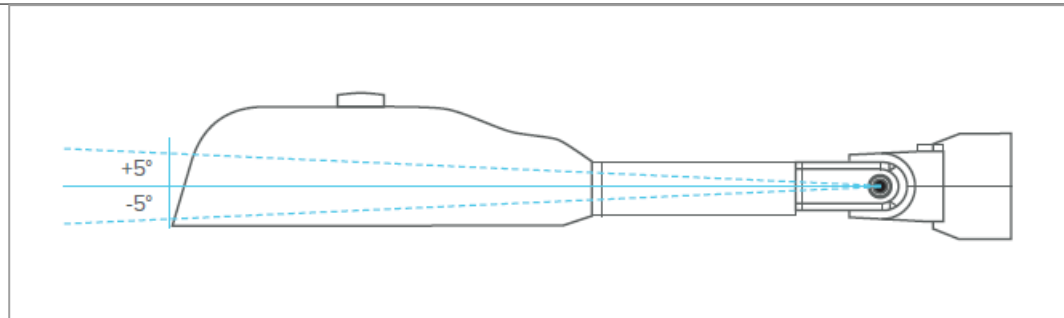
Metric	LUNA V1 Draft Requirements	QPL Listing	Measurement/Evaluation
Uplight Rating (from the IES BUG system)	Products shall have a U-Rating of 1 or 2 , depending on Primary Use Designation indicated in Table 4.	<ul style="list-style-type: none"> • BUG Ratings are shown • Intensity Distribution shown as JPG 	ANSI/IES LM-79-19 ANSI/IES TM-33 .xml document or LM-63 .ies file

Primary Use Letter	Primary Use Designations Eligible for LUNA Qualification	U Rating Threshold
A	Outdoor Pole/Arm-Mounted Area and Roadway Luminaires	1
B	Outdoor Pole/Arm-Mounted Decorative Luminaires	2
C	Outdoor Full-Cutoff Wall-Mounted Area Luminaires	1
D	Outdoor Non-Cutoff and Semi-Cutoff Wall-Mounted Area Luminaires	2
E	Bollards	1
F	Parking Garage Luminaires	2
G	Fuel Pump Canopy Luminaires	2
	Specialty: Hazardous Area Lighting	1
	Specialty: Hazardous Outdoor Pole/Arm-Mounted Area and Roadway Luminaires	1
	Specialty: Hazardous Wall Mounted Luminaire	2
	Specialty: Canopy Lighting	2
	Specialty: Directional Fuel Pump Canopy Luminaires	2
	Specialty: Transportation	2



Draft 1 - Distribution

Metric	LUNA V1 Draft Requirements	QPL Listing	Method of Measurement/Evaluation
Aiming	Products shall only include mounting options that will not allow tilt angles beyond +/- 5 degrees	Model number includes allowable mounting options	Specification sheet or installation instructions shall include images of mounting options with allowable tilt angles or fixed mounting options clearly documented.

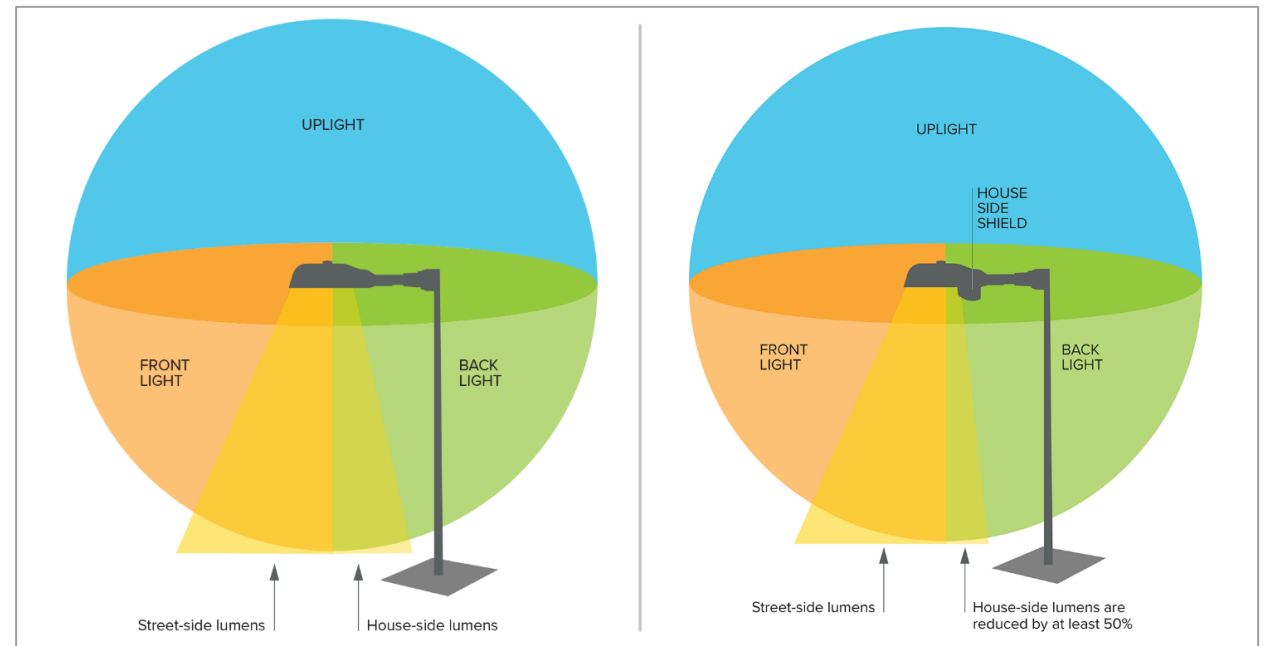


Draft 1 - Distribution

Metric	LUNA V1 Draft Requirements	QPL Listing	Method of Measurement/Evaluation
Shielding	Shielding options shall be included on specification sheet for pole/arm-mounted area/roadway/decorative PUDs and specialty hazardous area lighting and specialty hazardous pole/arm-mounted area and roadway PUDs	Within each given shielding subgroup, shielded products with the lowest efficacy products will be listed as worst-case-efficacy parent products on the QPL.	Specification sheet review to determine that at least one shielding option is available and graphically shown.

- Shielded products typically have lower efficacy values because the shield reduces the luminaire efficiency
- To encourage shielded products to be listed on the QPL, DLC is offering efficacy allowances if zonal lumens are reduced in solid angle of concern
- Allowances based on shielding subgroups: HSS – house-side shields; CSS – cul-de-sac shields; FSS – front side shields

Draft 1 – Distribution (Shielding Allowances)



Primary Use Designations

Performance Metric

- Outdoor Pole/Arm-Mounted Area and Roadway Luminaires
- Outdoor Pole/Arm-Mounted Decorative Luminaires
- Specialty: Hazardous Area Lighting
- Specialty: Hazardous Outdoor Pole/Arm-Mounted Area and Roadway Luminaires

Luminaires with house-side shields (HSS) are offered an efficacy allowance of 20% if they reduce the house-side lumens by at least 50% compared to an unshielded product with the same distribution.

Luminaires with cul-de-sac shields (CSS) are offered an efficacy allowance of 35% if they reduce the house-side lumens by at least 70% compared to an unshielded product with same distribution.

Luminaires with front-side shields (FSS) are offered an efficacy allowance of 20% if they reduce the street-side lumens by at least 30% compared to an unshielded product with same distribution.

Draft 1 – Distribution Key Questions

Key Questions

1. Should the DLC consider specifying separate lumen thresholds for the Uplight Low (UL) secondary solid angle and the Uplight High (UH) secondary solid angle rather than using a threshold U Rating? If so, what thresholds are required for each secondary solid angle and why?
2. Are optional QPL reporting listings desirable for shielding options on other LUNA-eligible PUDs, such as bollards, or canopy lighting?
3. The DLC is proposing to allow applicants to use scaled data for unshielded products as part of the process for applicants pursuing efficacy allowances for shielded products. Should the comparative unshielded product data used to determine the relative reduction in house-side or street-side lumens be submitted as absolute test data instead?
4. The DLC is proposing showing an image of the luminous intensity distribution for parent products on the QPL. Should the DLC consider sharing TM-33 xml data instead of images of the distributions?
5. Are there any other Primary Use Designations (PUDs) that DLC should consider?
6. Is other terminology used to describe the listed shield types, such as house-side shields or cul-de-sac shields, instead of the terminology given here?

Answer Key Questions & submit comments to:

comments@designlights.org

Proposed Draft 1
Requirements: **Spectral
Quality**



Draft 1 – Spectral Quality Rationale

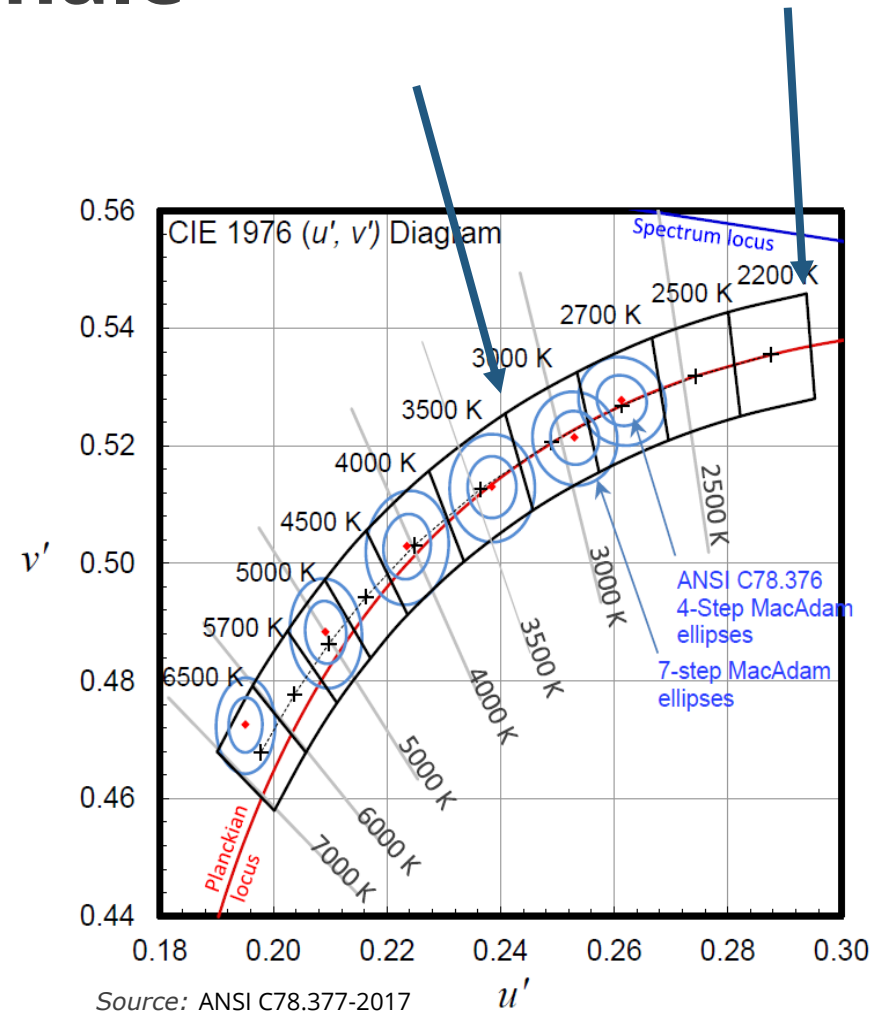


Minimize light pollution and energy use while maintaining appropriate visibility for people

- Baseline of V5.1 Requirements
- Draft 1 Proposal: Mitigate sky glow caused by outdoor LED lighting at night

Draft 1 – Spectral Quality Rationale

- Proposal: Mitigate sky glow caused by outdoor LED lighting at night
 - Rayleigh scatter is a significant contributor to sky glow
- Department of Energy found CCT to be a poor predictor of sky glow
 - Rayleigh scatter is a significant contributor to sky glow and is wavelength dependent
 - CCT is not wavelength dependent
- ANSI/IES LP-11-20
 - ≤ 3000 K in commercial zones
 - ≤ 2200 K in sensitive environments



Draft 1 – Spectral Quality Proposed Requirements

Metric	LUNA V1 Draft Requirements	QPL Listing	Measurement/ Evaluation
Chromaticity (CCT & D_{uv})	Products shall exhibit chromaticity consistent with at least one of the basic, flexible, or extended, nominal 7-step quadrangle CCTs from 2200 K – 3000 K .	<ul style="list-style-type: none">• CCT & D_{uv} data• Spectral Power Distribution shown as JPG	ANSI/IES LM-79-19 ANSI C78.377-2017

- Proposes to collect spectral data per TM-33
 - Provisional TM-27 pathway
- Spectrally tunable products (white-tunable & warm-dimming) *are eligible* if they *only tune between the proposed eligible chromaticity range*
- Eligible for V5.1 efficacy allowance (5%)
 - CCTs ≤ 2700K (LPW ≥ 114)

Additional Reporting Guidelines

- DLC is requiring the use of the most recent test and reporting methods however a grace period is being granted with an end date TBD and published later
- During the grace period, the DLC will accept:
 - LM-79-08 and LM-79-19 reports
 - TM-33-18 .xml documents containing luminous intensity data and absolute SPD data OR TM-27 .spdx data (absolute) AND LM-63-02 or LM-63-19 .ies data as detailed in the draft
 - Manufacturers using the provisional testing and reporting methods will have to submit updated test reports and file formats by the end of the grace period

Draft 1 – Spectral Quality Key Questions

341 Key Questions

- 342 1. The DLC has proposed that color-tunable products that can tune to non-white and/or ineligible
343 CCTs (per LUNA requirements) are not eligible for LUNA qualification. Should the DLC consider
344 LUNA Qqualification eligibility for color-tunable products that can deliver spectra beyond currently
345 eligible chromaticities? If so, what additional information or functionality should be required to
346 mitigate misuse?
- 347 2. The DLC has proposed that the maximum and minimum CCT options undergo LM-79 testing and
348 are required to provide SPD images as accompanying elements to the TM-33-18 document, which
349 will be listed on the QPL for download. What, if any, formatting considerations should be taken
350 into account to ensure the QPL provides useful information to users of the QPL?
- 351 3. While the limitations of CCT being used as a metric for accurately and consistently predicting the
352 impact of spectra on sky glow (or Rayleigh scatter) are well known, the DLC seeks your input. Are
353 consensus-based standards or alternative metrics available for quantifying the impact of spectra
354 on Rayleigh scatter and/or sky glow?
- 355 4. The DLC has proposed industry standardized CCTs (per [ANSI C78.377-2017](#)) between 2200 and
356 3000 K as eligible for LUNA listing. Recognizing that some non-white chromaticities spectra (e.g.
357 narrowband amber) and CCTs below 2200 K are desirable for area lighting in sensitive outdoor
358 environments, the DLC seeks your input. Are standards that extend the ANSI C78.377 CCT range to
359 below 2200 K under development? Is there an applicable standard that the DLC could reference
360 that could enable eligibility of non-white spectra and/or lower CCTs not included in ANSI C78.377?

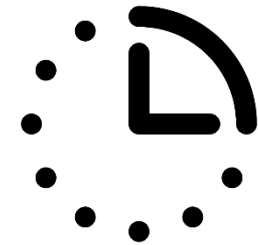
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Proposed Draft 1
Requirements: **Controllability**

Draft 1 – Controllability Rationale

- 1) Minimize sky glow and light trespass flexibly throughout the night
- 2) Minimize lighting energy use flexibly throughout the night
- 3) Recognize circuit level controls and standalone controls as inexpensive ways to address Goals 1,2



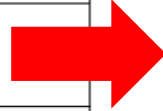
Controllability

Highlights from Table 7: Draft LUNA controllability testing and reporting requirements
(not required for Specialty Primary Use Designations intended for hazardous locations)

Metric	LUNA V1 Draft Requirements
Dimming Capability	Continuous dimming capability to $\leq 20\%$ of maximum output power is required .
Dimming standard protocol between driver and sensor/ controller	The dimming standard protocol is required .
Integral Controls	Capability for integral controls is reported .
Communication standard protocol between luminaires and other devices	Communication standard protocol is reported .

Required: Dimming Standard Protocol

Metric	LUNA V1 Draft Requirements
Dimming Capability	Continuous dimming capability to $\leq 20\%$ of maximum output power is required.
Dimming standard protocol between driver and sensor/ controller	The dimming standard protocol is required.
Integral Controls	Capability for integral controls is reported.
Communication standard protocol between luminaires and other devices	Communication standard protocol is reported.



- Wired, Analog

- o 0-10V IEC 60929 Annex E
- o 0-10V ANSI C137.1-2019 (8-Volt)
- o 0-10V ANSI C137.1-2019 (9-Volt)

- Wired, Digital

- o DALI
- o DALI 2
- o D4i

Excerpt from SSL V5.1 Table 8: Integral Control Features

Metric	LUNA V1 Draft Requirements
Dimming Capability	Continuous dimming capability to $\leq 20\%$ of maximum output power is required.
Dimming standard protocol between driver and sensor/ controller	The dimming standard protocol is required.
Integral Controls	Capability for integral controls is reported.
Communication standard protocol between luminaires and other devices	Communication standard protocol is reported.

- Sensors
 - Occupancy
 - Daylight
 - Multifunction (Occupancy + daylight)
 - Traffic
 - Photocell
 - Sensor Receptacle
- Capabilities
 - High-End Trim
 - LLLC
 - Energy Monitoring
 - Networked Replacement Lamp

Reported: Integral Controls

Metric	LUNA V1 Draft Requirements
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Dimming standard protocol between driver and sensor/ controller	The dimming standard protocol is required.
Integral Controls	Capability for integral controls is reported.
Communication standard protocol between luminaires and other devices	Communication standard protocol is reported.

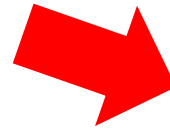


Table 8 shows integral control capabilities beyond those listed in Table 8 of [SSL Technical Requirements V5.1](#), and also a list of integral control receptacles.

Topic	Additional types of integral controls	Method of evaluation
Integral control capabilities beyond those listed in V5.1	<ol style="list-style-type: none"> 1. Field adjustable high-end trim 2. Part night dim 3. Photocontrol with self-calibrating astronomic time clock 4. Field adjustable low-end trim for vacancy mode 	List of acceptable terms to be determined
Integral control receptacles for outdoor luminaires	<ol style="list-style-type: none"> 1. ANSI C136.41-2013 (NEMA 5-pin) 2. ANSI C136.41-2013 (NEMA 7-pin) 3. ANSI C136.58-2019 (Zhaga Book 18) 4. Z10 (ANSI C136.xx possible) 5. Other 	List of acceptable terms to be determined

Reported: Communication standard protocol between luminaires and other devices (Table 9)

Metric	LUNA V1 Draft Requirements
Dimming Capability	Continuous dimming capability to $\leq 20\%$ of maximum output power is required.
Dimming standard protocol between driver and sensor/ controller	The dimming standard protocol is required.
Integral Controls	Capability for integral controls is reported.
Communication standard protocol between luminaires and other devices	Communication standard protocol is reported.



Physical Medium	Standard Protocol
Wireless	<ul style="list-style-type: none"> • Bluetooth Mesh <ul style="list-style-type: none"> ○ BLE MDP v2 ○ BLE SIG Mesh v1.x ○ BLE Proprietary • Cellular <ul style="list-style-type: none"> ○ 4G ○ 5G • <u>EnOcean</u> • <u>WiFi</u> • Zigbee <ul style="list-style-type: none"> ○ Zigbee 3.0 ○ Zigbee Proprietary • Other (describe)
Wired	<ul style="list-style-type: none"> • DALI • DALI2 • DMX • Other (describe)

Draft 1 – Controllability Key Questions

413 Key Questions

- 414 1. Is the threshold of 20% for continuous dimming appropriate? If not, should it be higher or lower,
415 and why?
- 416 2. For the Method of Evaluation column in Tables 8 and 9, what specific terms and phrases should be
417 accepted on the product specification sheet?
- 418 3. On the QPL, how useful will the reported data about the communication standard protocols
419 between luminaires and other devices be? This is shown in Table 7 bottom row, and Table 9.
420 Should this be included as useful, or omitted as an unnecessary complication?
- 421 4. Should any standards be added to or omitted from Table 9?

Answer Key Questions &
submit comments to:

comments@designlights.org



Question and Answers

Thank you!

Comments are due **May 21!** Send completed comment forms to:

Comments@DesignLights.org

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Questions about applications and general inquiries should be sent to:

Info@DesignLights.org