Robert J. Humm
Senior Counsel

December 3, 2018

VIA HAND DELIVERY & ELECTRONIC MAIL

Luly E. Massaro, Commission Clerk
Rhode Island Public Utilities Commission
89 Jefferson Boulevard
Warwick, RI 02888

RE: Docket 4513 – In Re: Proceeding to Establish a Pilot Metering Proposal for Municipal-Owned Streetlights
National Grid's Rebuttal Testimony

Dear Ms. Massaro:

In connection with the above-referenced docket, enclosed please find National Grid's[1] rebuttal testimony in response to the pre-filed testimony submitted on October 1, 2018 by George Woodbury of LightSmart Energy Consulting LLC and William A. White III of CIMCON Lighting regarding National Grid's Street Light Metering Pilot (Pilot) Final Report dated November 21, 2017 (Final Report).

This filing consists of the pre-filed rebuttal testimony and attachments of John E. Walter. Mr. Walter's rebuttal testimony explains that the Company's conclusions set forth in the Final Report remain unchanged. The Pilot's results and findings of the independent third-party laboratory and meter farm testing generally reflect metrology accuracy that was inconsistent and/or below tolerance criteria of the individual manufacturer's 2016 networked lighting control (NLC) technology and/or the competency of the communication service provider's systems to provide reliable, timely, and validated metered consumption values. The Company understands that since the release of the Final Report, improvements in NLC metrology accuracy have been made by some manufacturers. However, the Company maintains that the Final Report recommendations must still be addressed before this technology can be universally applied for billing purposes and benefit all stakeholders.

Thank you for your attention to this matter. If you have any questions, please contact me at 401-784-7415.

Very truly yours,

Robert J. Humm

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[1] The Narragansett Electric Company d/b/a National Grid (National Grid or the Company).

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Certificate of Service

I hereby certify that a copy of the cover letter and any materials accompanying this certificate was electronically transmitted to the individuals listed below.

The paper copies of this filing are being hand delivered to the Rhode Island Public Utilities Commission and to the Rhode Island Division of Public Utilities and Carriers.

_____ December 3, 2018

Docket No. 4513 - National Grid – Streetlight Metering Pilot Proposal
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REBUTTAL TESTIMONY

OF

JOHN E. WALTER

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I. Introduction

Q. Please state your name and business address.

A. My name is John E. Walter and my business address is 144 Kensington Avenue, Buffalo, New York 14214.

Q. By whom are you employed and in what position?

A. I am employed by PRO Unlimited, Inc. having corporate headquarters located at 7777 Glades Road, Suite 208, Boca Raton, Florida 33434. In particular, I am working as a contingent employee for National Grid USA Service Company, Inc. (National Grid or Service Company). In this role, I am responsible for providing outdoor lighting business consulting services specific to assigned projects generally involving technology advancements, regulatory compliance, process change development, and business financial matters.

Previously, I worked at National Grid or one of its affiliates from 1983 through December 2017. Most recently, I was the Outdoor Lighting – NY group Program Manager for Niagara Mohawk Power Corporation d/b/a National Grid. Before that, I was a Principal Engineer in the Outdoor Lighting & Attachments group of the Service Company. The Service Company provides various services to the National Grid affiliates, including The Narragansett Electric Company d/b/a National Grid (the Company). In my role, I provided technical expertise in support of all outdoor lighting

business, regulatory, and information systems-related matters. I retired from National Grid effective January 1, 2018.

Q. Have you previously submitted testimony in this proceeding?

A. Yes. On December 10, 2014, I submitted pre-filed joint direct testimony with Jeanne A. Lloyd, Jeffrey P. Martin, and Larry G. Durante in this proceeding on behalf of the Company.

II. Purpose and Structure of Testimony

Q. What is the purpose of your rebuttal testimony?

A. The purpose of my rebuttal testimony is to respond to the pre-filed direct testimony submitted to the Public Utilities Commission (PUC) in this proceeding by George Woodbury of LightSmart Energy Consulting LLC (LightSmart) and William A. White III of CIMCON Lighting (CIMCON).

Q. How is your rebuttal testimony organized?

A. Section I of my rebuttal testimony presents the Introduction. Section II presents the Purpose and Structure of my testimony. Section III provides a brief summary of the Street Light Metering Pilot (Pilot) Final Report filed on November 21, 2017 (Final Report), and provides updates to the Pilot technology since the publication of the Final Report. Section IV and Section V present the Company's rebuttal to the testimony of Mr.

Woodbury of LightSmart and Mr. White of CIMCON, respectively. Section VI is the Conclusion to my rebuttal testimony.

Q. Are you sponsoring any attachments to your rebuttal testimony?

A. Yes. I am sponsoring the following attachments that accompany my rebuttal testimony:

Attachment JEW-1 Memorandum of Understanding executed by CIMCON

Attachment JEW-2 Company's December 22, 2015 email to CIMCON

Attachment JEW-3 Company's March 14, 2016 email to CIMCON

Attachment JEW-4 Company's July 28, 2016 email to CIMCON

Attachment JEW-5 CIMCON's 2015 technical specifications

III. Summary of Final Report and Updates After Publication of the Final Report

Q. Please summarize the purpose of the Pilot.

Pursuant to the PUC's Report and Order No. 22413 issued on May 20, 2016 (Report and Order) in this proceeding, the Company conducted a multi-faceted study to investigate solid state circuit meter accuracy integrated within networked lighting controls (NLCs)[1] in the Company's Final Report and the operational performance of the integral wireless communication networks and data management systems. The Report and Order directed the Company to address (1) meter accuracy; (2) integration of meters with the Company's billing system; (3) a comparison of metered rates to unmetered rates; and (4) cost allocation. The Pilot included a two-stage process, with each stage comprised of

[1] Networked lighting controls are commonly referred to as "nodes", "controls", or "NLCs".

two phases. Stage 1-Phase 1 called for laboratory testing of integrated circuit metering within NLC devices. Stage 1-Phase 2 provided for field testing of in-service NLCs and their integral metering capability operating on an accessible wireless communications network in collaboration with the Rhode Island Department of Transportation (RIDOT). Stage 2-Phase 1 involved the determination of how metrology information and other luminaire operating data collected from the NLCs could be accurately and securely integrated into the Company's Information Systems (i.e., its meter data management and billing systems). Stage 2-Phase 2 focused on a comparative analysis of the NLCs' metering data compared to the Company's unmetered energy consumption calculations and the preparation of a final report on the results of the Pilot.

Q. Please summarize the Company's findings and conclusions in the Pilot's Final Report.

A. The Final Report summarizes the results for Stage 1-Phases 1 and 2, as well as Stage 2-Phase 2.[2] In compliance with the PUC's Report and Order, the Company conducted the Pilot in 2016 and 2017, using NLC and light emitting diode (LED) luminaire equipment and technologies manufactured in 2016. All metrology testing was performed by an independent third-party laboratory testing firm utilizing validated laboratory equipment calibrated to industry testing standards and following industry accepted meter testing

[2] Although the Company initially worked to understand and recognize the Information System impacts associated with the application of the new metering technology, the assessment proved much more complicated and time-consuming than originally estimated, resulting higher costs and a more expanded schedule than originally proposed. As a result, on March 10, 2017, the PUC suspended Stage 2-Phase 1 through the completion of the Stage 1 testing.

standards and protocols. Laboratory and field testing metrology data was obtained from the source NLC or directly from the wireless communication provider in a mutually acceptable form to maintain data integrity and security. Based on the NLC testing results, the Company's findings are as follows:

- The NLCs' integrated circuit meter technology generally performed adequately enough during laboratory testing to provide reasonable energy consumption measurement values for street lighting service. However, the testing results of the various NLCs' integrated meter circuit technology did not comply with established industry standards of 0.5 or 2.0 percent (error percentage) for the "revenue grade" meter accuracy classification pursuant to the American National Standards Institute (ANSI) Standards C12.1 and C12.20 and as reported within each NLC manufacturers' published marketing literature at that time.

- The individual communication network operations and associated proprietary head-end software applications presented a diverse array of challenges, including inconsistencies in the meter reading data, timing anomalies, and inexplicable data gaps.

- Metrology data from in-service NLC field testing also exhibited inconsistencies and inaccuracies beyond industry established tolerance

thresholds for revenue grade meters. However, when the NLCs were verified to be operating properly, the reported energy consumption values were close to the values determined by the dusk-to-dawn operating schedule burn hours calculation as defined in the Company's Street and Area Lighting – Customer Owned Equipment S-05 tariff, currently RIPUC No. 2190 (the S-05 Tariff). In consideration of (a) the lessons learned from the experiences to resolve the Pilot's complexities associated with NLC commissioning and data transmission anomalies; (b) the anticipated Information System interface programming requirements; and (c) the total costs of procurement, deployment, and operation of a NLC system including the metering component, the Company determined that, at this time, it would be more economical and efficient to employ additional unmetered billing metrics to the existing billing system and utilize individual static dimming or part-night photoelectric control operating schedules to achieve an acceptable energy consumption determination for the applicable customer desired luminaire operating schedule.

In short, the Company agrees that the NLC integrated circuit meter technology represents the future energy consumption methodology for street lighting and ancillary energized attachments, but does not believe that acceptable technology or industry standards were in place at the time of the Company's testing and publication of the Final Report. To

advance the use and acceptance of the NLCs and associated meter technology, the Final Report offers several recommendations, such as further testing, closer industry collaboration, establishing regulatory compliance standards, and completing the Information System integration study portion of the Pilot.

Q. Since the Company published its Final Report on November 21, 2017, has the landscape changed with respect to the potential for the metering of NLCs?

A. Yes. Since the Company published its Final Report, the Company has become aware that certain manufacturers have made NLC product technology improvements and facilitated independent third-party metrology testing in support of their documented claim of providing revenue grade metering. For example, Exhibit A to Mr. Woodbury's pre-filed testimony dated September 28, 2018 appears to indicate that one NLC manufacturer has improved metrology accuracy. According to Exhibit A to Mr. Woodbury's testimony, this manufacturer's newer vintage NLCs have significantly improved compared to the NLCs supplied to the Company in 2016 for testing in the Pilot.

Also, the Company has recently been made aware of (1) a limited number of utilities adopting street lighting NLC metering for energy billing under certain tariffed circumstances; and (2) other utilities exploring the use of "small format" technology to meter other, non-street lighting electric loads. One example is the adaptation of the technology for use in metering electric vehicle charging stations. This supports the

Company's premise that, at the time of the testing, the Company did not know the application limitations or the extent of electric loads for which the NLC meters would be utilized, but anticipated use for customer ancillary devices beyond just street lights.

Q. Since the Company published its Final Report on November 21, 2017, has the Company received feedback and/or commentary from any participants of the Pilot?

A. Yes. Following release of the Final Report, two of the NLC manufacturers have expressed concerns regarding the conclusions having been developed from certain negative test results based upon laboratory test criteria outside the scope of ANSI C12.20 standards and in excess of the individual NLC published operational limits. The Company has responded to each manufacturer that prior to commencement of the laboratory tests, the Company communicated the proposed testing protocols with each NLC manufacturer to afford each an opportunity to provide input and feedback. Additionally, the Company provided justification for the custom testing criteria based upon rational operating scenarios – such as multiple lights relay controlled, series configured cumulative load of lighting and attachments, high amperage electric charging devices, and other scenarios – that could possibly occur and be controlled and metered utilizing a single NLC. As explained in the Final Report, the Company received a response to the proposed testing protocols from only one manufacturer, which recognized the Company's defined optional or custom testing and recommended increases to the stated voltage and amperage conditions. The Company remains confident in the results

of the laboratory testing having been conducted by an independent third-party laboratory using test equipment calibrated to industry accepted standards at the time. The field testing was also conducted and interpreted objectively using data that was (1) reported by the NLC through the communication network service provider's head-end systems, (2) recorded by ANSI-compliant standard socket meters, and (3) calculated in accordance with the S-05 Tariff unmetered operating schedule burn hours calculation method. During the testing, the Company communicated any problems encountered or issues observed to the appropriate vendor for resolution. The Company's conclusions were derived from the ANSI C12.20 test results and the general performance of each manufacturer's NLC during the meter farm testing. The conclusions in the Final Report were not based on the results of the custom testing.

Q. Has the Company's position set forth in its Final Report filed on November 21, 2017 changed since the time of the filing?

A. No. The Company's position expressed in the Final Report conclusions remains unchanged. The Pilot's results and findings of the independent third-party laboratory and meter farm testing generally reflect metrology accuracy that was inconsistent and/or below tolerance criteria of the individual manufacturer's 2016 NLC technology and/or the competency of the communication service provider's systems to provide reliable, timely, and validated metered consumption values.

It is the understanding of the Company that since the release of the Final Report, improvements in NLC metrology accuracy have been made by some manufacturers. The Company maintains that the Final Report recommendations must still be addressed before this technology can be universally applied for billing purposes and benefit all stakeholders.

Q. Does the Company oppose the use of NLCs?

A. The Company believes that the timely advancement of the NLC technology in conjunction with continued communication network innovation and application software improvements will foster greater interoperability while reducing overall system costs to promote a more rapid adoption rate. The Company anticipates that the continued development progress of these NLC technologies will be similar to the experienced maturity rate of cellular communication and LED technologies, acknowledging the anticipated progress of industry standards and the future widespread utilization of this technology. The Company believes the NLC technology will represent the industry model of small electric load metering in the future.

IV. Response to Pre-Filed Testimony of George A. Woodbury

Q. Please summarize Mr. Woodbury's concerns regarding the Final Report.

A. The Company acknowledges and, in specific scenarios, concurs with Mr. Woodbury's opinion of the potential benefits, added value, and environmental and societal impacts

associated with "intelligent streetlighting controls" and/or "communication platforms" technologies. However, this rebuttal testimony will address only the stated concerns that are directly related to the Company's responses within the Final Report, which the Company completed in compliance with the directives established in the PUC's Report and Order. Mr. Woodbury's testimony focuses on two primary concerns. First, Mr. Woodbury claims that the Company's "current billing is highly inaccurate and metered billing should be compared to that as a baseline." Second, Mr. Woodbury believes that "the testing protocols NGrid applied from ANSI C12.20 (the recognized current national standard) are not consistent with how the streetlights are used and if they had applied testing protocols that were within the design parameters of the controls NGrid would have reached a different conclusion as to their accuracy." The Company will address these two concerns and several subsequent affiliated issues raised by Mr. Woodbury.

Q. Does the Company agree with Mr. Woodbury's opinion that the Company's current billing "is highly inaccurate and metered billing should be compared to that as a baseline"?

No, the Company does not agree with Mr. Woodbury's stated opinion. The current unmetered street light energy consumption billing methodology is in accordance with the S-05 Tariff. This methodology is accepted industry-wide and utilized by nearly all electric utilities offering unmetered electric street lighting service, and is indifferent as to whether the energy consumption determinant is unique or embedded within another

distinct facility or service rate function. In general, the industry and the associated regulatory authorities have accepted the inherent net error potential of the unmetered billing methodology. Unquantifiable errors created by numerous factors cause over- and under-billing conditions, which in aggregate have been considered to minimally impact the customer as compared to the total costs incurred to facilitate metered energy consumption billing for street lighting service. At the present time, the Company agrees with this philosophy until it can be demonstrated and validated that an alternate street light energy consumption metering model can be more economical and provide better quality, reliable, and accurate energy consumption data meeting established industry standards and regulatory approved criteria than the unmetered energy calculation model.

The Company believes the primary intent of the PUC's directive in the Report and Order was to evaluate the accuracy and reliability of the NLC integrated circuit metering capability and to identify the validity of the technology as an acceptable alternative billing opportunity. The Company's various energy metering test results and the Final Report's conclusions identify that the circa 2016 vintage NLC integrated circuit metering technology was less than acceptable as compared to established industry standards for standard revenue grade socket meters. These findings further acknowledge the absence of defined industry standards regarding the application and testing of the NLC integrated circuit metering technology and the lack of associated meter quality criteria accepted by regulatory authorities. Additionally, the Company's field testing experienced various

NLC and communication network problems, which contributed to the observation that the "unmetered burn hours calculation typically had similar results to the node metered usage." Final Report at Page 95, Section 9.1.3. Therefore, Mr. Woodbury's recommended proposal to utilize the NLC metering as a new energy consumption baseline is factually inconclusive.

Q. Does the Company agree with Mr. Woodbury's position that "the testing protocols NGrid applied from ANSI C12.20 (the recognized current national standard) are not consistent with how the streetlights are used and if they had applied testing protocols that were within the design parameters of the controls NGrid would have reached a different conclusion as to their accuracy"?

A. As described in the Final Report, from the Pilot's commencement the Company sought industry accepted testing standards to validate the meter accuracy of the integrated meter circuits used within NLCs by the manufacturers. The Company received no information from integrated circuit meter manufacturers, NLC manufacturers, or established electric meter testing laboratories, so the Company elected to utilize applicable ANSI C12.20 socket meter testing protocols following consultations with the Pacific Northwest National Laboratory and other utilities identified in the Final Report. The twelve ANSI C12.20 compliant laboratory test protocols (Test 4.5.1 through Test 4.6.2.2) produced various unacceptable results from each NLC manufacturer. Following the performance of the ANSI C12.20 tests, the NLCs were exposed to six additional "custom" tests

defined and directed by the Company, as documented in the Final Report. These custom tests were founded on the ANSI C12.20 protocols, but the unique electric test criteria was increased to experience the effects on the operating performance of the individual NLCs and their corresponding integrated meter capability. Although the Company recognized that these tests often exceeded the NLC manufacturer stated operating parameters, the Company also anticipated future NLC metering applications experiencing these electrical conditions. The Company also included an additional custom test to measure the "parasitic load" or energy consumption characteristics of the individual NLCs. These custom test protocols were included in the test plan provided to the NLC manufacturers prior to the performance of the testing. Only one manufacturer provided feedback prior to the performance of the tests, expressing that its NLCs should have the capacity to experience the increased electrical loading criteria or greater and the potential for the tested conditions to exist in future street lighting applications. The Company's conclusions were based on the twelve ANSI C12.20 test results and the associated ANSI 12.1 meter test certification criteria, as presented in the Final Report and further summarized in Table 1 below.

TABLE 1

No.	Test Reference	NLC Test Qty.	Acceptable Test Results (%)				ANSI 12.1 Certification (Pass/Fail)			
			A	B	C	D	A	B	C	D
1	4.5.1	10	100	100	100	100	P	P	P	P
2	4.5.2	10	0	0	100	0	F	F	P	F
3	4.5.3.1	10	0	0	0	70	F	F	F	P
4	4.5.3.2	10	90	90	50	100	P	P	F	P
5	4.5.4	10	0	0	0	90	F	F	F	P
6	4.6.1.2	4	0	0	0	50	F	F	F	P
7	4.6.1.3	4	0	0	0	25	F	F	F	F
8	4.6.1.5	4	0	100	100	75	F	P	P	F
9	4.6.1.6	4	75	100	100	75	F	P	P	F
10	4.6.2.2	4	0	0	0	75	F	F	F	F
11	4.6.2.3	4	0	0	0	75	F	F	F	F
12	4.6.2.5	4	75	100	100	100	F	P	P	P

While the custom test results further supported the Final Report conclusions regarding meter accuracy, the primary contribution of these results were focused toward the development of applicable industry standard testing for NLC metering and the desired collaboration of all parties involved in the industry to identify the potential for expanded usage applications of these devices and the associated electric metering requirements. In this regard, Mr. Woodbury advocates that a singular NLC to LED luminaire relationship will never experience these custom electrical conditions, and therefore the testing protocol and results are irrelevant. However, the Company contends that these conclusions are consistent with Mr. Woodbury's stated opinions regarding municipal deployment of ancillary electric consuming devices, such as motion sensors and cameras to support pedestrian safety, traffic management, and parking solutions. Therefore, the Company maintains that the communicated testing protocols and subsequent laboratory

testing – including the custom protocols – used in the Pilot were reasonable, justifiable, and impartial for the purpose of developing the opinions and conclusions expressed in the Final Report.

Q. Is Mr. Woodbury correct that "NGRID objects to the use of these control devices"?

A. As previously mentioned, the Company does not object to the adoption of NLC infrastructure and agrees that this technology, when matured and less proprietary, will offer many application benefits beyond only energy consumption metering. However, based on the meter accuracy testing conducted at the time of this Pilot, the Company's position is that the metrology technology, communication platforms, and associated proprietary head end systems, in addition to the acceptance of industry standards, need to evolve before the NLC infrastructure can be adopted for energy consumption billing purposes by the utility industry.

Q. Is Mr. Woodbury correct that "NGRID's consistent position is that the utility should own the meter as they do for other applications" and "that the utility should own the control"?

A. At the beginning of this NLC metering debate during Docket No. 4442 and in subsequent proceedings, the Company has expressed a position that Company ownership of electric metering is consistent with current industry practice. This position is founded on the context that the utility, bound by regulatory compliance standards, maintains the means

and methods to assure customer energy billing is accurate using continuously tested and approved meters and cost efficient secure data collection and billing processes and protocols. Although the Company is cognizant of regulatory approved market opportunities for private energy metering and billing services companies, the lack of such companies suggests market entry barriers and/or an unsustainable financial model provided all business requirements remain equal. However, the Company recognizes the various NLC ownership propositions that exist and understands the efficiencies of the conjoined control, communication, and metrology technologies within the NLC device. Therefore, alternate NLC ownership presents a paradigm shift for the utility and regulator requiring new participant responsibilities, industry standards, and functional criteria; and restructured policies, processes, and protocols. As defined by the Report and Order, the Company did not consider meter ownership as part of the Pilot, nor did meter ownership influence the objective meter accuracy testing of the NLCs.

Q. Do you agree with Mr. Woodbury's stated concerns about the accuracy of the data used as input for the current formula used in the billing system?

A. As previously addressed, the industry – including utilities and regulators – recognize the inherent marginal error potential associated with the unmetered street lighting energy consumption calculation model. It is understood that age and type of equipment (i.e., reactor/regulator ballasts, circuit wiring and connections, and lamps) and general operating conditions (i.e., cycling and day burners) typically result in additional energy

consumption while facility knockdown conditions caused by motor vehicle incidents, luminaire/lamp end-of life (i.e., outage), vandalism, and underground circuit failures (i.e., faults and dig-ups) result in reduced energy consumption. The Company, in conjunction with its customers, attempts to minimize the occurrences of these facility and operating conditions that impact the accuracy of the unmetered energy calculation model. However, the alternative metering options have yet to be consistently validated, and a cost efficient and regulatory approved end-to-end process has yet to be developed, to offset the estimated unmetered billing error potential.

Q. Do you agree with Mr. Woodbury's stated concerns about the accuracy of the inventory upon which the formula is applied for the current billing system?

A. The Company acknowledges that for numerous reasons, street light inventory errors exist from time to time. The Company continuously attempts to mitigate the causes associated with these inventory error occurrences by promoting customer communications and providing training, enhancing information systems, and modifying internal policies and procedures. Additionally, random auditing is performed to assure inventory accuracy and the identification of errors caused by external party actions. The Company also routinely addresses customer related billing claims associated with inventory matters. The Company attempts to maintain an accurate inventory of street lighting to provide the customer an accurate service bill.

Q. Mr. Woodbury criticizes the Company for not taking corrective action to address additional non-street light loads discovered at field sites. What is the Company's response?

A. The involvement of RIDOT was acceptable by the parties in the proceeding to meet the Company's requirement to obtain municipal involvement. Although RIDOT utilized a compliant network communication platform and NLC technology from a partner NLC manufacturer, the RIDOT Pilot relationship was considered a time and cost efficient option. To meet the objectives of the Pilot's field testing requirement, the Company and RIDOT jointly selected three general locations for NLC field testing. A prerequisite of the location selection was that the electric circuit would consist of only street lighting related load. RIDOT provided three sites that it initially believed met this criterion. During initial testing sequences, measured electric load conditions identified that two of the sites had continuously operating 120 watt traffic cameras connected to the circuit in addition to the street lights. Due to their constant electric load condition and continuous operation, the Company agreed to continue testing at these sites and reduce the metrology findings by the constant traffic camera energy consumption. After completing the test period, the Company compared the adjusted energy consumption circuit data recorded by standard socket meters and cumulative data recorded by the NLCs with the respective unmetered energy consumption calculations. This comparative analysis resulted in unexplained result discrepancies. Following an investigation by RIDOT, it was determined that each of the camera locations also had thermostatically controlled 500

watt cabinet heaters connected. Unfortunately, significant project schedule time had been expended and all testing had been completed. The Company determined that it would be impossible to accurately determine the periodic energy consumption of the heaters, because they independently varied with outdoor ambient temperature changes during the test period. As a result, the only site that correctly met the Pilot's initial circuit selection criteria was the Park and Ride site.

Q. What is the adopted ANSI standard for street light NLC accuracy?

A. Development of industry standards associated with NLC metrology accuracy testing continues. However, as Mr. Woodbury and the Company have explained, an approved ANSI accredited standard on NLC metrology testing has not been issued. In the absence of NLC-specific ANSI standards, the Company used the current revenue grade metering standards as a baseline and supplemented additional custom testing protocols. In consultation with industry participants associated with the NLC ANSI standards development process, such as the Pacific Northwest National Laboratory, the Company elected to use the existing ANSI C12.20 standards for revenue grade meter accuracy testing.

Q. Do you agree with Mr. Woodbury's opinion that meters should be appropriate and accurate for the expected range of measurements?

A. The Company agrees that meters should be appropriate and accurate for the expected range of measurements. The Company tested within an expected operating range as defined by the ANSI C12.20 testing protocols. As previously discussed, the Company expanded that operating range to observe metrology accuracy results associated with electrical loading conditions, which may exceed the present ANSI C12.20 parameters. It is anticipated that the industry will appropriately determine the electrical loading criteria based upon a broader expectation of NLC metering application and, therefore, define the new NLC ANSI testing standard accordingly.

Q. What is the approved deviation standard for residential meter accuracy?

A. The Company complies with the Rhode Island Division of Public Utilities and Carriers' Standards for Electric Utilities, 815-RICR-30-00-1. Under Section 1.7 of the Standards for Electric Utilities, the tolerance for poly-phase meters tested at 100 percent meter capacity and having a power factor of 1.0 is plus/minus 1 percent. However, the Company maintains compliance with the minimum meter accuracy tolerance standard defined within any of the Company's regulated service territories which it serves. For this reason, the Company's required meter accuracy tolerance for revenue grade residential meters is 0.5 percent.

Q. What is the Company's understanding of Pacific Gas and Electric Company (PG&E), Georgia Power, and a utility in Oslo, Sweden, using NLCs for billing purposes?

A. At this time, the Company is aware of three domestic investor-owned utilities that utilize NLC meter data transmitted through a proprietary communication network to a head-end system in some form to facilitate street light energy consumption billing. This level of information awareness is achieved through attendance, participation, or other form of communication related to industry conferences, trade shows, and utility lighting forums and is only relevant as hearsay knowledge.

PG&E has managed a limited pilot of no greater than five municipalities, each having a minimum of 300 network controlled street lights, since inception on October 24, 2013. In general, PG&E's pilot utilizes a customer specified fixed dimming schedule per light for an annual period that defines dimming rates on a half-hour basis during a typical dusk-to-dawn operating schedule. The energy saved during the dimming periods is determined and compared against the calculated energy at the full illumination level to determine a credit per half-hour increment, which is then aggregated and applied to the standard monthly bill. PG&E utilizes the compiled unqualified customer-owned NLC meter data captured over a specific period as an audit of the actual energy consumption for comparison against the unmetered calculation value for the same period. Audits identifying a 5 percent quantity of missing, inaccurate, or otherwise unusable meter

reading data will result in forfeiture of the program or, within 15 days, require the deficiency to be remedied and presentation of evidence regarding the system solution preventing the same deficiency from reoccurring. PG&E's pilot does not address (a) customer-owned NLC meter accuracy quality, and (b) the use of a non-linear 0-10V power dimming curve to determine the estimated energy consumption during the dimming periods.

Georgia Power has an approved pilot tariff schedule, TOU-EOL-3, limited to a maximum 100 customers having company-owned outdoor lighting with company-owned smart lighting control devices. This time-of-use rate utilizes distinct energy rates for each of three defined "peak" periods. Whereas the utility specifies, procures, owns, operates, and maintains the NLCs, the utility is responsible for the communication platform and all associated information systems through the data management and billing process, meter data accuracy, data communication, data management, and data security. Georgia Power manages the NLC not as a lighting control device, but as a meter, thereby requiring all the same life cycle management and testing protocols as typical standard socket meters.

Additionally, San Diego Gas & Electric Company (SDG&E) has a recently approved tariff schedule, LS-2 DS, for customer-owned dimmable installations using a SDG&E approved street light control module. SDG&E's tariff utilizes the captured metered energy data per light to designate a corresponding five watt range to define the LED lamp

rate (amount per month). The customer is responsible for a one-time participation charge, NLC meter accuracy validation testing, and energy data reporting in compliance with utility requirements. Meter data requirements, NLC meter accuracy, random sampling, and the billing remedy for missing, erroneous, or unusable data are also defined in the tariff. Ancillary connected devices are not eligible for this SDG&E tariff service.

The Company has no knowledge of utility based network controlled street lighting in Oslo, Norway.

Q. Mr. Woodbury devotes much of his testimony to addressing the Benefit-Cost Framework from Docket No. 4600. Did the Company include a benefit-cost analysis as part of its Final Report?

A. No, the Company did not include a benefit-cost analysis as part of the Final Report. Although the Final Report may include relevant benefit-cost information, the Final Report does not include a benefit-cost analysis using the Rhode Island Benefit-Cost Framework adopted by the PUC in Docket No. 4600[3] for the following reasons: (a) the Report and Order and subsequent testing for the Final Report in this docket pre-dates Docket No. 4600; (b) with the suspension of the study regarding the NLC meter data accuracy, security, and integration issues into the Company's meter data management and associated billing systems, it is premature to include any benefit-cost analysis at this

[3] *See* Report and Order No. 22851 (July 31, 2017), Docket No. 4600.

time; and (c) the Final Report provides responses to the questions raised by the PUC in the Report and Order, which did not require the development of a benefit-cost analysis.

Q. Does the Company intend to address a benefit-cost analysis as part of this proceeding?

A. Yes; however, the completion of the study to integrate NLC meter data with the Company's meter data management and associated billing systems is required prior to addressing a benefit-cost analysis. At the appropriate time, the Company will conduct a benefit-cost analysis.

Q. What is the Company's response to the benefits mentioned in Mr. Woodbury's testimony?

A. As previously stated, the NLC and network communication technologies continue to advance. Industry standards for these technologies are still being developed, which will eventually align products and promote consistent application deployments within the industry. The value proposition associated with the ancillary devices and services referenced by Mr. Woodbury are outside the scope of this Final Report except for consideration of their additional electrical load to be measured with the NLC metering capability. However, the Company concurs with Mr. Woodbury's position that the network communication platform has the potential to be expanded and, if the technology works as defined, utilized to provide additional future technological benefits to society.

This envisioned development growth supports the Company's position regarding the use of this metering technology to measure consumed energy by these new ancillary devices.

Q. Mr. Woodbury's testimony attaches as Exhibit A test results from The Eastern Specialty Company (TESCO) dated March 22, 2018. What is your reaction to the updated test results from March 22, 2018?

A. Exhibit A to Mr. Woodbury's testimony represents meter accuracy testing of NLCs in compliance with applicable ANSI C12.20 standards that were completed by TESCO in 2018. The tested NLCs in the Exhibit A to Mr. Woodbury's testimony are from a manufacturer that provided NLCs for testing in the Pilot. It can only be assumed that such 2018 tested NLCs are a newer vintage than the circa 2016 NLCs tested during the Pilot. If this assumption is correct, the Company is pleased to learn that meter accuracy test results presented in Exhibit A to Mr. Woodbury's testimony indicates that improvements to NLC technology have been made since the Pilot testing of circa 2016 NLCs. However, it is reasonable to assume that NLCs manufactured and placed into service prior to 2018 are considered to have similar performance to the NLCs tested during the Pilot. This logic would be consistent with many of the NLCs currently installed in customer-owned street light systems in Rhode Island.

V. Response to Pre-Filed Testimony of William A. White III on behalf of CIMCON

Q. Please summarize Mr. White's concerns regarding the Final Report.

A. Many of the issues and concerns raised by Mr. White are consistent with those raised by Mr. Woodbury, such as criticisms regarding the NLC test protocols; adoption of NLCs for billing purposes; the scope of the Pilot; the accuracy of the calculations, data, and inventory under the existing S-05 Tariff; the use of NLCs for billing purposes by other utilities; use of the ANSI C12.20 standard as a basis for testing; influence of non-street lighting loads during field testing; that testing was biased and pre-disposed to report NLC meter accuracy failure; and that meter ownership influenced the outcome of the Pilot. To the extent these issues have been addressed in the Company's reply to Mr. Woodbury's testimony above, the Company's replies to these issues in Mr. White's testimony remain the same.

Q. Has Mr. White and/or CIMCON previously intervened in this proceeding?

A. No. To date, the Company has no knowledge of either Mr. White or CIMCON having filed a motion to intervene in this docket. Additionally, Mr. White does not state that his testimony is being submitted on behalf of any current active party to this proceeding.

Q. What was CIMCON's role in the Pilot?

A. At the invitation of the Company, CIMCON was an active participant leading into the testing for the Pilot, having provided various products and network services in support of

the Pilot's scope. In December 2015 and prior to the commencement of any laboratory or field testing, the Company and CIMCON executed a Memorandum of Understanding (MOU). A copy of the MOU is attached as Attachment JEW-1. The MOU sets forth the parties' understanding of their roles based on the Pilot project plans at that time. The MOU clearly identified TESCO as the testing laboratory and other participants, such as the United States Department of Energy/Pacific Northwest National Laboratory and RIDOT. In December 2015, the Company requested via email that CIMCON submit to the Company and TESCO all technical specification documentation and full meter accuracy test results supporting performance claims of their NLCs. A copy of the Company's December 22, 2015 email is attached as Attachment JEW-2. Subsequently, after not receiving a timely response, the Company made several follow-up telephone calls to CIMCON to remind them of the Company's need for independent, third-party laboratory test results; however, CIMCON never supplied the requested information. In March 2016, prior to TESCO beginning the bench testing, the Company provided a copy of its intended Bench Testing Plan to CIMCON. A copy of the Company's March 14, 2016 email to CIMCON is attached as Attachment JEW-3; a copy of the Bench Testing Plan is attached to the Final Report as Attachment 2. CIMCON offered no comments or feedback regarding the Bench Testing Plan before the commencement of bench testing later in March 2016. Bench testing continued through June 2016, during which the Company continued to keep CIMCON informed, including specific inquiries regarding CIMCON's products during testing, but no CIMCON feedback was provided. In July

2016, the Company sent each participating vendor, including CIMCON, its individual product test results for review and invited each vendor, including CIMCON, to review the testing results with the Company and TESCO. A copy of the Company's July 28, 2016 email to CIMCON is attached as Attachment JEW-4. In December 2016, the Company finally received, for the first time, a response from CIMCON raising a concern regarding the testing process.

Therefore, given the collaborative approach the Company attempted to foster with the vendors and other participating entities, including CIMCON, Mr. White has no basis to challenge the following:

- TESCO's role in the Pilot as the independent third-party testing firm, given that the executed MOU clearly identified TESCO's participation and role in the Pilot.
- The inaccuracy of CIMCON product technical specifications presented, given that the Company provided ample opportunity for CIMCON to provide exact technical documentation before bench testing began.
- The Bench Testing Plan, given that the Company provided ample opportunity for CIMCON to comment on the Bench Testing Plan before testing began in March 2016.
- The concerns CIMCON first raised to the Company regarding the Pilot in December 2016, one year after executing the MOU and nine months after the start of the bench testing.

Q. What products and network services did CIMCON provide to support the Pilot?

Following CIMCON's commitment to participate in the Pilot, the Company purchased 90 NLCs from CIMCON in early 2016, which were shipped directly to TESCO. The Company also purchased a hand-held configuration device for use by TESCO during laboratory testing. CIMCON also provided 10 additional NLCs and loaned a cellular-Ethernet enabled gateway for the laboratory testing. Specific quantities of the NLCs were equipped with CIMCON network interface cards to communicate with the CIMCON network communication platform while the other NLCs were furnished with proprietary network interface cards to function with the other network service provider. Certain NLCs had specified metrology accuracy calibration at 0.5 percent, while the other NLCs were specified at 2.0 percent. As part of the field testing, the Company also captured data from CIMCON NLCs that were owned by RIDOT.

In regard to services, CIMCON provided Customer Meter Services Web Based Software Services for the duration of the laboratory testing. As set forth in its MOU, CIMCON provided information, advice, and training on its products and services to both the Company and TESCO during the project, especially during the laboratory testing.

Q. Is Mr. White correct that the Company has made false claims and/or misstatements regarding product specifications and testing?

A. The Company refutes any allegation of misrepresentation of any product specification or testing information. Similar to Mr. Woodbury's testimony, Mr. White challenges the range of ANSI C12.20 testing and the Company-specified custom testing, despite the Company providing opportunities for comment and feedback from CIMCON prior to executing the Bench Testing Plan. For example, Mr. White's testimony states that Section 4.1.1.7 of the Company's Final Report is incorrect, and he provides a specification data sheet for a "CIMCON's iSLC 3100 which notes a limitation of 960 watts." *See* White Testimony at page 50. However, the Company has documentation from CIMCON from 2015 that does not provide such limitation. A copy of this document is attached as Attachment JEW-5. In another example, Mr. White's testimony states "CIMCON's . . . operating temperature limit of -40 F to +158 F . . . ." *See* White testimony at page 51. However, the Company has documentation from CIMCON from 2015 that offers different technical specifications from what Mr. White is reporting. *See* Attachment JEW-5. Additionally, Mr. White infers throughout his testimony that the NLCs, network communication platform, and head-end software technology provide a seamless, consistent, and reliable mode of obtaining accurate energy consumption meter data for utility billing purposes. However, the Company's experiences associated with the RIDOT field testing required numerous interventions with Brian Woodbury, Vice President of Operations at LightSmart, who was under contract as the field service

representative by the network service provider for RIDOT. These engagements were required to remedy a variety of technical issues related to improper NLC operation, faulty network communications, and/or data transmission/configuration conditions that caused testing interruptions.

Q. On several occasions, Mr. White criticizes the Company for not including an assessment of cost for changes to billing practices. Why did the Company not include in the Final Report an assessment of cost for changes to billing practices?

A. On March 10, 2017, the PUC suspended the Information Systems portion of the Pilot, including changes to the billing system, pending the completion of the testing results. Thus, Mr. White's comments regarding the billing system impacts of the Pilot are premature and inaccurate. The Company reserves its right to respond to Mr. White's comments regarding the billing system impacts at the appropriate time.

Q. Mr. White points out that the NLCs are not identified by vendor, which he suggests is to lead the reader to believe that CIMCON's metering does not meet ANSI C12.20. Why does the Company not identify the specific vendors with the test results?

Due in large part to budget limitations, time restrictions, and the proprietary nature of NLC compatibility with specific network communication service providers, the Company was limited on the potential NLC manufacturer products available to use for Pilot testing.

For this reason, the Company desired to maintain NLC vendor anonimity, which was explicitly stated to each participating vendor at the time the MOU and NDAs were executed.

Q. Mr. White asserts that certificates from certifying agencies should be given appropriate deference. Does the Company concur with Mr. White's position?

A. To the extent that the Company is a consumer of metering equipment required to meet specific standards and operating tolerances, Mr. White's proposal to require meter equipment testing to be certified and, as such, provide certificates of compliance appears to be a rational position.

Q. On several occasions, Mr. White indicates that only meter accuracy was relevant to the Pilot. Does the Company agree?

A. No. As the Final Report and earlier reports have demonstrated, the Company and TESCO experienced numerous challenges throughout the Pilot, which are relevant in the assessment of NLCs and their associated communication networks providing useful energy consumption data for potential billing use. The Company experienced NLC connectivity and communication network infrastructure challenges, in addition to varied issues associated with data retrieval during the testing programs. Additionally, RIDOT communicated deployment and operations challenges to the Company, which were experienced during RIDOT's LED retrofit program, and other technical and

communication issues with the NLCs that were addressed by TESCO during its laboratory testing.

Further examples of the challenges identified in the Final Report include, but are not limited to, the following:

- While conducting field testing, during installation of different NLCs and changing schedules at the RIDOT Park and Ride site, the Company experienced situations where NLCs did not follow the programmed dimming schedule. This required additional intervention from LightSmart, acting as the local field network service agent, who on occasion had to consult with and engage the services of the network service provider.

- During field testing, visual site inspections determined that lights were on and operating, but the NLCs reported data through the network showing zero energy consumption.

- After agreeing to a schedule to supply the Company's laboratory with energy consumption data over a defined period, one network service provider struggled to meet that agreement. The data was ultimately delivered all at once for the entire testing period, mitigating fears that it would all be subjected to a schedule that rolled data off of the service provider's server and

perhaps become lost. Similar concerns were experienced with capturing and delivering field test data to the Company.

- Installation and NLC change outs were difficult. One vendor requested to send NLCs delivered to the Company's testing laboratory back to the network service provider to "re-flash the firmware", as a new network interface card that could cause metrology accuracy errors was initially included. During field testing, the Company encountered several programming issues requiring the intervention of the NLC manufacturer, local network servicing agent, and the network service provider to remedy the issues. These experiences were prevalent throughout the field testing of NLCs.

- Field inspections of some RIDOT field test sites by the Company prompted calls to RIDOT to inform them of conditions that were not being accurately reported through the network, such as day burners not reporting and lights out that were reporting as normal operations.

Ignoring the above-referenced experiences would result in an incomplete analysis of the Pilot, leaving the reader to assume the equipment and/or communication networks operate flawlessly. It would be inappropriate to dismiss these challenges as "non-fact based" and "anecdotal", as Mr. White suggests.

Q. Mr. White challenges the value of the load characterization analysis performed on LED luminaire dimming rates. Is the dimming load characterization analysis worthwhile?

A. Yes. The Company believes the value associated with the 0-10V dimming load analysis is related to the general awareness of the nonlinear load curve and the relative magnitude of load at different dimming rates. Although Mr. White recognizes the testing is not in the ANSI C12.20 requirements and also professes the load curve information should have been recognized as a nonlinear physical process, it is a common misconception that LED luminaire dimming reflects a linear power reduction curve. Therefore, while not within the intended scope of the Pilot, the Company presented the load characterization analysis on page 13 of the Final Report as a worthwhile observation for utilities, regulators, and customers. Additionally, such information can be useful in justifying an alternate power consumption determination for unmetered energy calculations incorporating dimming factors.

Q. Mr. White questions TESCO's certifications and suitability for its role in the Pilot. Are Mr. White's concerns valid?

A. The Company is unfamiliar with the "certifications" referenced by Mr. White and has no knowledge of the requirements to achieve them. However, as described in the Final Report at Section 3.2 and Attachment 1, the Company conducted an international search of qualified testing laboratories having the capacity to perform the ANSI C12.20 meter

testing on NLCs. TESCO was determined to be the best qualified and well positioned to support the goals and objectives of the Pilot project at the time. CIMCON has been aware of TESCO's role in the Pilot since December 2015. If CIMCON believed TESCO to be unqualified or impartial to conduct the meter testing, CIMCON should have communicated its concerns to the Company prior to testing. In addition, Mr. Woodbury's testimony appears to credit TESCO in its role in the Pilot, as Exhibit A to Mr. Woodbury's testimony relies on subsequent testing from TESCO to demonstrate the advances in technology since the Company's testing in 2016.

Q. On several pages of his testimony, Mr. White indicates that attachments to the Final Report were missing and/or not available. What is the Company's response to these assertions?

A. On November 21, 2017, the Company filed the complete Final Report, including all attachments, with the PUC.

VI. Conclusion

Q. Does this conclude your rebuttal testimony?

A. Yes.

MEMORANDUM OF UNDERSTANDING

METERING PILOT PROJECT

This **Memorandum of Understanding** (this "MOU") is effective as of November 1, 2015 ("Effective Date"), by and between CIMCON Lighting, Inc. ("CIMCON") and The Narragansett Electric Company d/b/a National Grid ("National Grid" or "Company"). Each referred to herein as a "Party" and collectively as the "Parties".

RECITALS

WHEREAS, in compliance with the Rhode Island Public Utilities Commission ("RI PUC") Docket No.4513 National Grid will execute an evaluation plan which is detailed in a document entitled "Street Light Metering Pilot" dated, and submitted to the RI PUC on, July 27, 2015 and proposes to evaluate new metering technology for its compatibility with street lighting applications ("Project"); and

WHEREAS, the Rhode Island Department of Transportation ("RI DOT") pilot project changes include utilizing Silver Spring Networks, Inc. ("SSN") as its sole network communications service provider and SSN compatible street light control devices manufactured by CIMCON Lighting, Inc. ("CIMCON") which incorporate integrated circuit ("IC") meter technology, manufactured by Cirrus Logic, Inc.; and

WHEREAS, for the Project: (i) the Company intends to work with the RI DOT for the field testing portion of the Project, leveraging RI DOT's relationship with SSN and CIMCON; (ii) for Project testing purposes, the Company may temporarily substitute (unless otherwise agreed upon by the Parties) other manufactures' IC metering technology at select field locations, permitted by RI DOT; and (iii) during the Project laboratory testing, the Company intends to test both SSN and CIMCON's network communications platforms as well as several manufactures' IC meter technology; and

WHEREAS, National Grid currently offers street lighting as an unmetered service that relies on fixed operating schedules and industry standard light source wattage ratings to determine energy consumption; and

WHEREAS, under the Street Lighting Metering Pilot National Grid will review the accuracy and capabilities of various IC meter technologies available for street lights which may be helpful in providing the Company with various forms of location specific meter data, such as actual time-of-use energy consumption, to test meter accuracy.

NOW, THEREFORE, in consideration of the mutual covenants set forth herein the Parties have the following understanding:

1. Purpose. The purpose of this MOU is to set forth the Parties' mutual understanding of the of the roles, responsibilities, and commitments associated with achieving the Objectives in connection with the Project as well as to continue to develop and expand a framework of cooperation and collaboration between the Parties to facilitate the successful completion of this Project in compliance with RI PUC Commission Docket # 4513.

- The Project is an effort by the Company to execute the evaluation plan set forth under Street Light Metering Pilot document which is comprised of four key components: (i) laboratory testing, (ii) field testing, (iii) information system integration study and (iv) metered/unmetered bill comparison.

- As part of the laboratory testing component of the Project, the Company proposes to engage a specialty meter testing firm in order to establish a controlled laboratory environment. The laboratory will be used to conduct a complete technical evaluation of CIMCON IC metering devices as well as an end-to-end performance evaluation of the

network communication platform. A functional "meter farm" laboratory test environment will be established to facilitate end-to-end testing.

- As a part of the field testing component of the Project, the Company proposes to engage the RI DOT in order that the Company may utilize the street lighting infrastructure for the purpose of observing operational information of the street lighting system to be provided by the RI DOT's vendor, CIMCON. CIMCON will collect and/or manage energy consumption data from the IC meters located at specific individual street light luminaires.

- As part of the information system integration study component of the Project, the Company plans to assess the information system and billing-related impacts associated with adopting the CIMCON IC meter technology and networked communications platform. To that end, this MOU proposes to engage CIMCON, as necessary, in order to obtain information from laboratory and field testing. The Company also will work with CIMCON network solution architects and other necessary CIMCON resources. Doing so will help the Company to identify the requirements necessary to scope the information system interfaces and ensure compatibility with Company data management and billing systems.

- The objectives of the Project are to: (i) review the accuracy, reliability, and other capabilities of various IC meter technologies available for street lights which may be helpful in providing the Company with various forms of location specific meter data; (ii) monitor and assess related data transmission functionality of the networked intelligent wireless street lighting control equipment installed as part of the RI DOT pilots; and (iii) use the information obtained from laboratory and field testing to identify the requirements necessary to scope the information systems interfaces (collectively, the "Objectives").

2. Scope of Work. The Company and CIMCON will work together in good faith to execute the Project in order to meet the Objectives. The RI DOT will allow National Grid to perform field testing on street lights at various RI DOT locations including, but not limited to the following:

(i) DOT Pilot Phase 1 (I 295 / Rt 44 – Exit 7 Smithfield)
(ii) DOT Pilot Phase 2 (I 295 / Rt 146 North & South Project)
(iii) DOT Pilot Phase 3 ("Park and Ride Locations")

The Company plans to use the services of a specialty meter testing firm, such as The Eastern Specialty Company (TESCO) to provide consultation as well as physically conduct the laboratory testing (IC meter test program development, execution, and oversight). Although CIMCON will not create the laboratory testing environment, CIMCON will create the plan/model for an end-to-end system application within the laboratory environment. The actual laboratory environment will be created by the designated meter testing firm.

The Company will use the technical knowledge and research capabilities of the Battelle Memorial Institute, Pacific Northwest Division (the "BATTELLE"), under its own right and under the authority of Contract No. DE-AC05-76RL0 1830 for the management and operation of the Pacific Northwest National Laboratory for the U.S. Department of Energy ("PNNL") to provide independent consultation, supervision and oversight during the laboratory and field testing components of the project. Subject to Section 14 below, the Parties understand that for PNNL's participation, PNNL plans to utilize knowledge, data and information gained from this Project in its industry reports and publications.

3. Intent of the Parties.

The Company will work with the RI DOT, and its vendor, CIMCON, for the field testing portion of the Project. The field testing will utilize street lighting infrastructure and network-control applications that are currently being evaluated in various separate RI DOT pilots. The Company will monitor and assess the independent IC meter technology performance, communication network operation, and related data

transmission functionality of the networked intelligent wireless street lighting control equipment installed as a part of the RI DOT pilots.

Further, the Company will work with CIMCON, for the laboratory testing and information systems integration portions of the Project. The Company will test CIMCON's IC meter technology as well as CIMCON's network services in the laboratory environment.

To that end:

(i) For the field testing portion of the Project, the RI DOT will have, or will procure, IC metering devices from CIMCON and to allow National Grid to request, access and use, Data obtained from CIMCON which includes but is not limited to, the energy consumption meter data, operating characteristics and system wattage.

Roadway Locations. The RI DOT will allow National Grid to place its own CIMCON meter devices on street lights at various RI DOT roadway locations including the RI DOT Pilot Phase 1 and RI DOT Pilot Phase 2 Roadway Locations.

Park and Ride Locations. The RI DOT will further allow National Grid to place its own meter devices on street lights at various RI DOT Park and Ride locations including the RI DOT Pilot Phase 3 Park and Ride Locations.

(ii) The Company will procure its own CIMCON meter devices, where needed, for installation and use on street lights for the laboratory and field and laboratory portions of the Project.

(iii) CIMCON will provide, on a temporary basis, loan to the Company, all components necessary to establish the network communications platform, including CIMCON hardware, software, and an estimated 10 meter devices, etc., for the test farm application in the laboratory testing environment. CIMCON will assist and advise the Company as necessary to ensure its proper installation, set-up, and use.

(iv) The Company and CIMCON will cooperate and collaborate in good faith to simulate various conditions in the laboratory and field and/or alternate performance levels/operating schedules to test the full spectrum of operations and functionality of the metering devices and associated communications networks.

(v) To ensure the proper evaluation of information systems compatibility, integration/interface requirements, network communications/data transmission, security, etc., Cimcom will cooperate and collaborate in good faith with the Company. CIMCON will provide network solution architects and other necessary resources to work with the Company's information systems (IS) resources to scope the integration efforts required to fully assimilate the metering head-end system for meter data transmission with the Company's back-office systems.

(vi) CIMCON will provide all necessary training, coaching and counselling on the proper use and set up of its products (equipment, hardware, software, networks, etc.) to Company and its specialty meter testing contractor (e.g. TESCO) to facilitate successful completion of this Project.

4. Resources. The Parties will allocate the necessary business resources for the implementation of the Project. National Grid will allocate one program manager and an appropriate team which will be under the direction of National Grid. CIMCON will allocate an appropriate team and designate a primary contact having appropriate Project related decision authority which shall be under the direction of CIMCON.

5. Costs. All costs and expenses incurred by a Party in connection with the Project shall be borne solely by the Party that incurred such costs or expenses, unless otherwise agreed upon in writing by the Parties.

6. Term and Termination. The term of this MOU will commence on the Effective Date and end on the latter of September 30, 2016 or National Grid's filing date of final findings and conclusions after completion of the Project ("Term"). This MOU may be terminated at any time, for any reason, by the Company or CIMCON, after providing to the other Party at least sixty (60) days advance written notice of intent to terminate.

7. No Joint Venture. By execution of this MOU, the Parties are not creating any joint venture, agency, partnership or fiduciary obligations between the Parties. Rather, the Parties are independent contractors and neither Party has any power to bind the other Party for any purpose.

8. Amendments. This MOU may only be amended or modified by a written memorandum of understanding signed by both Parties.

9. Legal Effect. This MOU is a written commitment between the Parties to execute the Project. The MOU (including specifically the Recitals) is not intended to, and does not, create any legally binding obligations or liabilities on the Parties of this MOU.

10. Notices. Any notice, request or other communication required or permitted to be given under this MOU must be in writing and will be sent by one of the following means: electronic mail, facsimile transmission, hand delivery or courier to the other Party at the addresses set forth below:

CIMCON: CIMCON Lighting, Inc.
Attn: Tod Riedel
234 Littleton Road, Westford MA, 01886Contact:
Phone: (978) 692-9868 ext. 235
Email: tod.riedel@cimconlighting.com

National Grid: National Grid
Outdoor Lighting and Attachments
Attn: John Walter
144 Kensington Ave.,
Buffalo NY 14214
Phone: (716) 831-7739
Email: John.Walter@nationalgrid.com

Any such notice, request or other communication shall be deemed to have been duly given or made and to have become effective at the time of receipt thereof if received during normal business hours in the place of receipt, or otherwise at the opening of business on the business day in the place of receipt, immediately following the day of receipt. Notices given hereunder by electronic mail or facsimile will be deemed to have been effectively given the day indicated on the confirmation accompanying the electronic submission or facsimile. Any Party may, by written notice to another Party, change the referenced responsible contact and/or address to which notices, requests or other communications to such Party are to be delivered.

11. Headings. The headings of the Sections of this MOU are inserted for convenience only and do not constitute a part hereof or affect in any way the meaning or interpretation of this MOU.

12. Entire MOU. This MOU constitutes the entire understanding between the Parties hereto with respect to the subject matter herein and supersede and cancel any prior written understandings or MOUs, whether oral or written, between the Parties relating to the subject matter herein.

13. Assignment. This MOU may not be assigned by either Party without the express written consent of the other Party, except that National Grid may assign this MOU to an Affiliate without consent. For the purposes of this MOU *"Affiliate"* means any person controlling, controlled by, or under common control with, any other person; "control" shall mean the ownership of, with right to vote, 50% or more of the outstanding voting securities, equity, membership interests, or equivalent, of such person.

14. Publicity. The Parties understand that PNNL will not issue any press release, publish any reports or other documents or otherwise make any publication in connection with this MOU, the Project or Street Light Metering Pilot without the review and prior written consent of National Grid, RI DOT, CIMCON and/or SSN if and to the extent that any press release, reports, documents or publication contains the information of National Grid, RI DOT, CIMCON and/or SSN.

IN WITNESS WHEREOF, this MOU has been executed by authorized representatives of the Parties as of the Effective Date.

CIMCON Lighting Inc.

By: _____
Name:
Title: TOD RIEDEL
VP, BUSINESS DEVELOPMENT

The Narragansett Electric Company d/b/a National Grid

By: _____
Name: Edward Lombard
Title: MANAGER OUTDOOR LIGHTING & ATTACHMENTS
12/1/2015

From: Bonetti, Edward
Sent: Tuesday, December 22, 2015 3:54 PM
To: Tod Riedel (Tod.Riedel@cimconlighting.com)
Cc: Durante, Larry G.; John Williams; Walter, John E.; 'john.greenewald@tescometermanager.com'; 'John.williams@tescometering.com'
Subject: Documentation Request

Hello Tod:

Thank you again for helping us specify, and place the orders, for your equipment. Keep us posted on when you expect shipment to TESCO.

Now that the ordering process is underway, I want to again touch on our request for comprehensive documentation.

As I mentioned during our conversations, National Grid requires all technical documentation be submitted. Technical Documentation being all equipment performance specifications and full test reports supporting performance specification claims. Test reports must Include test procedures for equipment tested, test results, and documentation supporting the performance and NIST traceability for all reference test equipment used to derive the test results. It is important that this also include all performance validation testing documentation from the Metrology Manufacturer used within your equipment (I.e. Independent Meter Accuracy Test Reports).

All Technical documentation must be submitted both to National Grid's Larry Durante and TESCO's John Williams. TESCO being under contract to National Grid with applicable NDA's in place. Technical documentation as well as test results derived by National Grid and TESCO will remain confidential.

So, if you have any questions about this request, or would like to discuss it further, please let me know. I would be happy to set up a conference call with you, Larry Durante, John Williams and John Water if necessary.

Thank you in advance for your help with this.

Ed Bonetti|Contractor|
Outdoor Lighting & Attachments
H: (401) 231-0067 | C: (401) 524-0253
Email: Edward.Bonetti@nationalgrid.com

From: Bonetti, Edward
Sent: Monday, March 14, 2016 9:58 AM
To: Tod Riedel (Tod.Riedel@cimconlighting.com)
Cc: Walter, John E.; John Williams; John Greenewald; Durante, Larry G.; ebonetti1@cox.net
Subject: FW: CONFIDENTIAL - National Grid Laboratory Testing Plans - RI Street Light Metering Pilot Project

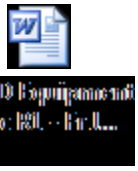
Sensitivity: Confidential

Hello Tod –

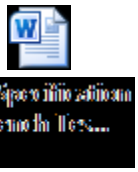
Per our discussions I have attached the latest versions of three laboratory testing documents, prepared by TESCO's John Williams, to support the captioned project.

1. The first file depicts drawings of the "Meter Farm Test Panel" designs.

2. The second file defines the operational and performance specifications for the "Meter Farm Testing Panel" construction.



3. The third and last file presents the "Bench Testing" plan.

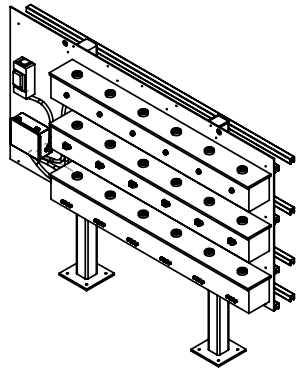


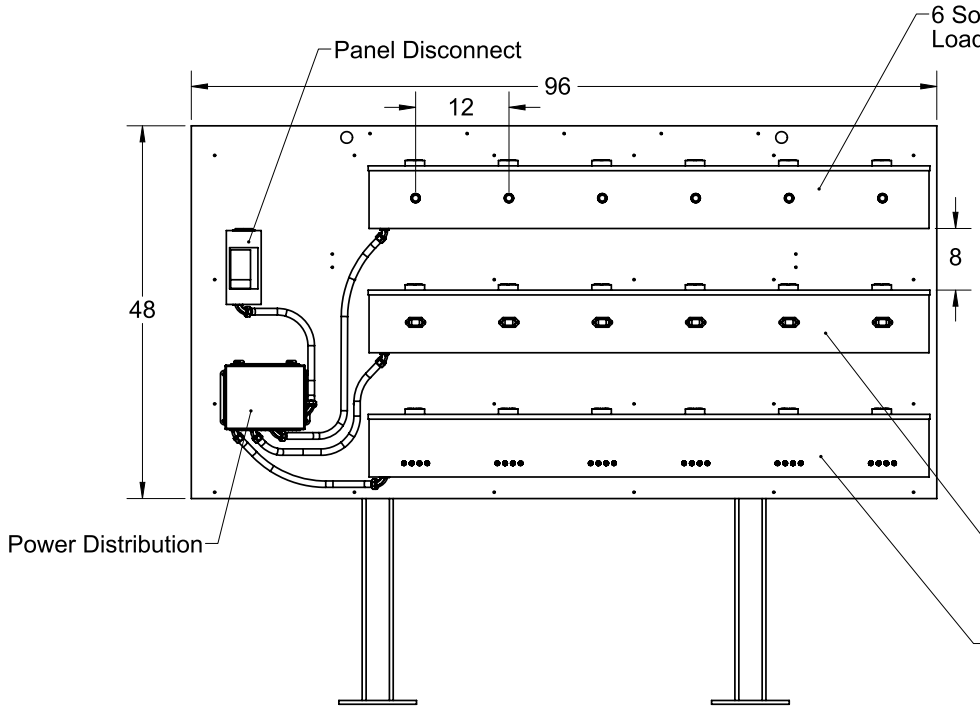
We are still in the process of developing the "Meter Farm Testing" plan.

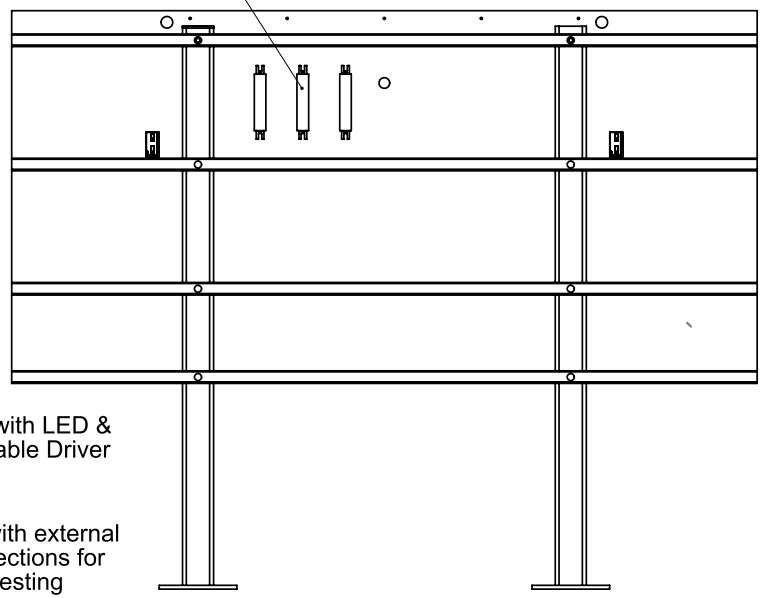
While we understand that you may review these documents with select personnel within your organization on a "need to know" basis we ask that you keep them CONFIDENTIAL, and use utmost discretion on any further distribution.

Sincerely,
Ed Bonetti|Contractor|Project Manager – RI Street Light Metering Pilot|
Outdoor Lighting & Attachments
H: (401) 231-0067 | C: (401) 524-0253
Email: Edward.Bonetti@nationalgrid.com

REV	DESCRIPTION	DATE	APPR.
A	National Grid Panel	02/16/2016	







GEOMETRIC TOLERANCE UNLESS OTHERWISE SPECIFIED		
FORM	MACHINED	OTHER
▱ — ⌒ ⌓	.001"/1", TIR	1/16"/FT, TIR
∠ ⌭ // ⊥	.002"/1", TIR	1/8"/FT, TIR
◎	1/2 SUM OF DIAMETRAL TOLS., TIR	
SURFACE FINISH UNLESS SPECIFIED:	250 FOR FRACTIONAL DIM. 125 FOR 0.00 DIM. 63 FOR 0.000 DIM.	

DIMENSION TOLERANCE (UNLESS OTHERWISE SPECIFIED)	
FRACTION	± 1/32
0.00	± 0.015
0.000	± 0.005
0.0000	± 0.0005

CAD GENERATED DRAWING.
DO NOT MANUALLY UPDATE.

CUSTOMER:	8594
DRAWN: XS	DATE: 2/16/2016
CHECKED: -	DATE: -
USED ON DWG NO:	8594-1000

TESCO
an ADVENT DESIGN company
CANAL STREET & JEFFERSON AVE.
BRISTOL, PA. 19007
800-762-8211

TITLE: National Grid Panel

SEE NOTES FOR MATERIAL AND FINISH | DWG. NO.: 8594-1000

SIZE: B | SCALE: 1:16 | SHEET: 1 OF 1 | REV: A

ORIGINATING GROUP:	ORIGIN DATE:	REVISION DATE:	NO. OF SHEETS:
TESCO ENGINEERING	**16-02-2016**	**04-03-2016**	**6**

Equipment Specification
for
National Grid
Photo Cell Meter Test Equipment

SHEET NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
REVISION	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**--**	**-**									

APPROVED: DATE: 2/16/16
Originator: Michael Guilfoyle

APPROVED: DATE: 2/16/16
Engineering Manager: John Williams

APPROVED: DATE: 2/16/16
Project Management: Bill Troutman

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3 SCOPE 3

4 OPERATIONAL REQUIREMENTS AND PANEL SPECIFICATIONS 4

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6 REVISION RECORD 6

1 Purpose

Define the operational and performance specifications for the National Grid Meter Farm panel construction.

2 Definitions, Acronyms and Abbreviations

Abbreviation	Definition
A	Amperes
AC	Alternating Current
CT	Current Transformer
FAT	Factory Acceptance Test
FQTP	Final Qualification Test Plan
kVA	Kilovolt-Ampere
kVAR	Kilovolt-Ampere Reactive
kW	Kilowatt
kWh	Kilowatt-hour
MTB	Meter Test Board
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Agency
OSHA	Occupational Safety and Health Administration
QA	Quality Assurance
RMS	Root Mean Square calculation method
S (S_1)	Sensor
SAT	Site Acceptance Test
UL	Underwriters' Laboratories, Inc.
V	Volt
VA	Volt-Ampere
VAR	Volt-Ampere Reactive
VT	Voltage Transformer
Wh	Watt-hour

3 Scope

3.1 This document will cover all operational specifications for streetlight photocell controller/meter test panel design.

4 Operational Requirements and Panel Specifications

The construction and operation of the meter farm panels will be as follows:

4.1 BASIC PANEL CONFIGURATIONS and OPERATIONS (for all Meter Farm types)

4.1.1 Each panel will be powered separately.

4.1.2 Each panel will include a circuit breaker housed in a NEMA 3R enclosure. This circuit breaker will also serve as a local disconnect for the panel.

4.1.3 Each panel configuration will have all meter sockets and controls mounted to one side. Load resistors are mounted to the back side of panels.

4.1.4 Standard TESCO Meter Farm Panel Assemblies are designed to be mounted to a custom 4 inch steel tubing frame with farm panels on both sides.

4.1.5 The meter farm panels will be 4 foot high by 8 foot wide. The panels will be made of 5052 aluminum with clear anodize.

4.1.6 The panels will include two one-inch holes to be used for rigging the panel for mounting. Panel weight is estimated at 500 pounds.

4.1.7 The panels have ¼" clearance holes for mounting, with self-tapping screws, to horizontal structural steel strut channels. The strut is fastened to the custom frames.

4.1.8 Panels with components mounted on the back must be mounted on a frame with an adjoining panel without back side mounted components.

4.1.9 Panels with components mounted on the back include a top cover vent and side panels which will enclose and protect the components. These are mounted during installation of the panel. Covers and side plated are designed for use with Tesco custom mounting frame assemblies.

4.1.10 Panels with components mount on back side must be arranged so adjacent panel on frame does NOT have components mounted on the back side, or a blank panel is required.

5 Panel Details

5.1 TYPE ONE PANEL: NGRID Streetlight Photocell / Meter Test Panel.

5.1.1 Build Quantity: (4) panel assemblies, total socket test positons (72).

5.1.2 Size: 4ft high x 8ft wide x 1ft deep, 350 lbs.

5.1.3 Each panel will contain three test assemblies to perform three types of testing.

5.1.3.1 Load metering.

5.1.3.2 Photo cell control testing.

5.1.3.3 Streetlight luminaire testing.

5.1.4 Each test assembly will comprised of a NEMA 3R enclosure and contain six ANSI C136.41 7-pin photo control receptacles. There will 18 total sockets per panel. Socket will be spaced on 12.0 inch centers.

5.1.5 Test Socket Assembly Configurations:

5.1.5.1 Top row, load metering: the six sockets will be configured with a loading resistor and status indicator light for long term load testing of the meter. The resistive load will be comprised of a single 125 ohm, 250 watt power resistors. Load current is estimated at 0.96 amps. Each socket position will have a resistor load and LED lamp connected to the output line of the photocell

5.1.5.1.1 Loading resistors will be arranged so two panels can be mounted to Tesco custom frames without interference issues.

5.1.5.2 Middle row, photo cell control testing: the six sockets will be configured for testing photocell output control, 0-10V dimming controls, and communications. Each socket will be wired to a downward facing white LED light mounted to the front of the assembly. Each socket position will contain a LED driver with 0-10V dimming capability compatible with IEC 60929:2006 (0-10V ballast controls).

5.1.5.3 Bottom row, luminaire testing: The six sockets will be configured for Streetlight Luminaire testing. Each socket will be wired to the 120VAC supply. The neutral, the photocell output line, and the two 0-10V connections will be wired to binding post connectors on the front panel of the socket assembly for easy connection to test luminaires.

5.1.6 Power Requirements: 120VAC, 15 Amps, single phase

6 REVISION RECORD

REV	ECN:	REVISION DESCRIPTION:	APPR:	REL:
-	N/A	Initial Release	JFW	2/16/16
1	N/A	Modified Title	JFW	3/4/16

ORIGINATING GROUP:	ORIGIN DATE:	REVISION DATE:	NO. OF SHEETS:
TESCO ENGINEERING	**19-Feb-2016**	**3-Mar-2016**	**9**

Test Specification
for

nationalgrid

Photocell Node Bench Testing
Project 8594

SHEET NO.	1	2	3	4	5	6	7	8	9	10											
REVISION	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**3**	**3**	**3**											

APPROVED: DATE: 19-Feb-16
Originator: John Williams

APPROVED: DATE:
Electrical:

APPROVED: DATE: 19-Feb-16
Project Mgr.: John Williams

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6 REFERENCE DOCUMENTS 9

7 REVISION RECORD 10

1 Purpose

Define all test equipment, procedures, and documentation specifications for the photocell node bench testing to be performed by Tesco for National Grid - RI.

2 Definitions, Acronyms and Abbreviations

Abbreviation	Definition
A	Amperes
AC	Alternating Current
ANSI	American National Standards Institute
DPT	Digital Power Technologies (Power supply mfg.)
MTB	Meter Test Board
PF	Power Factor
THD	Total Harmonic Distortion
V	Volt
VT	Voltage Transformer
Wh	Watt-hour

3 Test Equipment Specifications

3.1 Meter Test Board (MTB)

The Tesco MTB is a four socket unit capable of simultaneously testing 4 meters. It is ANSI C12.20 compliant and uses a NIST traceable 3 phase reference standard.

3.1.1 Main Components

3.1.1.1 Digital Power Supply - DPT 024 Series 3 phase source.

3.1.1.1.1 Frequency Accuracy - +/-0.02Hz

3.1.1.1.2 Voltage Set point accuracy - 0.5%

3.1.1.1.3 THD <0.5% Linear load

3.1.1.1.4 Phase Resolution - 0.01 degree

3.1.1.1.5 Current Accuracy - 0.5%

3.1.1.2 Reference standard - Radian RD-30-201

3.1.1.2.1 .04% accuracy class

3.1.1.2.2 Serial Number 301510

3.1.1.2.3 Calibration date: 04/20/15

3.1.1.2.4 Calibration certificate detailing results and NIST traceability available upon request. (Internal Tesco Link to Cal Cert)

3.1.1.3 Programmable Logic Controller – Automation Direct, Productivity 3000 series

3.1.1.3.1 Main unit controller that is responsible for setting up the power supply, monitoring voltages and currents, and counting reference standard energy pulses.

3.1.1.4 Socket adapter – by Tesco

3.1.1.4.1 This unit adapts a 7 pin standard photocell socket to a standard metering socket.

3.1.1.4.2 Design details available upon request.

3.1.1.5 Silver Springs Field Service Unit (FSU) – communication adapter between PC and Cimcon, Sunrise, and SELC nodes.

3.1.1.6 Cimcon Handheld Configurator - communication adapter between PC and Cimcon nodes.

4 Test Specifications

4.1 This section is meant to adhere as closely as possible to ANSI C12.20.

4.2 For the purposes of these tests, the node meter function will be treated as an ANSI socket meter form 1S.

4.3 Test Conditions

4.3.1 Temperature: 23°C, +/- 2°C

4.3.2 Rated voltage (120VAC): +/- 1%

4.3.3 Rated frequency (60Hz): +/- 1Hz

4.3.4 Test Amperes (1.5/10AAC): +/- 1%

4.3.5 Unity Power factor (0°): +/- 2°

4.3.6 Nodes will be temperature stabilized before testing

4.4 Prior to each test set performed, the nodes will be energized for a 5 minute warm-up period.

4.5 Tests to be performed

4.5.1 ANSI C12.20 – Test number 1: No Load

4.5.1.1 The node with only the voltage circuit energized shall not register one equivalent rotation in watthours (for nodes with a metering pulse) or 1 watthour in 10 minutes.

4.5.2 ANSI C12.20 – Test number 2: Starting load

4.5.2.1 The node shall operate continuously with a load current of .01A at its lowest rated voltage.

4.5.3 ANSI C12.20 – Test number 3: Load performance

4.5.3.1 Each node will be tested at 120V and 10A. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.5.3.2 Each node will be tested at 120V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.5.4 ANSI C12.20 – Test number 4: Effect of variation of power factor for single element meters.

4.5.4.1 Each node will be tested at 120V and 10A, with 0.5 lagging power factor. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.6 Optional tests that can be performed (time permitting)

4.6.1 ANSI C12.20 – Test number 5: Effect of variation of voltage

4.6.1.1 Each node will be tested at 120V and 10A. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.1.2 Each node will be tested at 108V and 10A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.1.

4.6.1.3 Each node will be tested at 132V and 10A. The performance of each node will be documented under this condition. Comparison will be made in

each case to the reference accuracy listed in 4.6.1.1.

4.6.1.4 Each node will be tested at 120V and 1.0A. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.1.5 Each node will be tested at 108V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.4.

4.6.1.6 Each node will be tested at 132V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.4.

4.6.2 ANSI C12.20 – Test number 5: Effect of variation of frequency (note that all previous testing is done at 60Hz)

4.6.2.1 Each node will be tested at 120V, 10A and 60Hz. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.2.2 Each node will be tested at 120V, 10A and 58.8Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.1.

4.6.2.3 Each node will be tested at 120V, 10A and 61.2Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.1.

4.6.2.4 Each node will be tested at 120V, 1.0A and 60Hz. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.2.5 Each node will be tested at 120V, 1.0A and 58.8Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.4.

4.6.2.6 Each node will be tested at 120V, 1.0A and 61.2Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.4.

4.6.3 In addition to the ANSI specified tests, perform multiple accuracy tests per node type at +/-15% and +/-20% voltage variations.

4.6.4 In addition to the ANSI specified tests, perform multiple accuracy tests per node type at 0.5A and 15A.

4.7 Testing method

4.7.1 Silver Spring Communication method

4.7.1.1 This method will be used on all nodes for all tests listed in sections 4.5 and 4.6.

4.7.1.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.1.3 Each node will be energized with potential only.

4.7.1.4 Each node will be registered through the Silver Springs network using Silver Springs' Communication Tester software (version 6.10.25413).

4.7.1.5 An initial Wh query will be done on each node and recorded in the data collection spreadsheet.

4.7.1.6 The testing parameters will then be set in the MTB. The MTB will be set to run a Demand test, with the interval set to a value which should register at least 1,000Wh on both the nodes and the reference standard (i.e. for 120V, 1.00 PF, 10A test, the time interval will be set to (1,000*60)/(120*10) = 50 minutes).

4.7.1.7 At the end of the interval, the number of Wh from the reference standard will be recorded, along with the ending Wh readings from each of the four nodes.

4.7.1.8 The percent accuracy will then be given by the ratio of Node Wh/Reference Standard Wh.

4.7.2 Meter Pulse method

4.7.2.1 This method will only be used on nodes that have a metering IR pulse output on all the tests listed in sections 4.5 and 4.6, and will be done in addition to the method described in section 4.7.1

4.7.2.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.2.3 Each node will be energized with potential and load current so that the metering pulse will be activated.

4.7.2.4 Each node's metering pulse pickup assembly (part of the MTB) will be aligned with the metering pulse output.

4.7.2.5 The testing parameters will then be set in the MTB. The MTB will be set to run a Full Load, Light Load, or Power Factor test, depending on the requirements of the test.

4.7.2.6 At the end of the test, the registration value will be read directly from the MTB.

4.7.3 Cimcon Communication method

4.7.3.1 This method will be used on all Cimcon nodes fitted with the Cimon communication hardware for all tests listed in sections 4.5 and 4.6.

4.7.3.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.3.3 Each node will be energized with potential only.

4.7.3.4 Each node will be registered through the Cimcon network using Cimcon's Communication software (version ????).

4.7.3.5 An initial Wh query will be done on each node and recorded in the data collection spreadsheet.

4.7.3.6 The testing parameters will then be set in the MTB. The MTB will be set to run a Demand test, with the interval set to a value which should register at least 1,000Wh on both the nodes and the reference standard (i.e. for 120V, 1.00 PF, 10A test, the time interval will be set to (1,000*60)/(120*10) = 50 minutes).

4.7.3.7 At the end of the interval, the number of Wh from the reference standard will be recorded, along with

the ending Wh readings from each of the four nodes.

4.7.3.8 The percent accuracy will then be given by the ratio of Node Wh/Reference Standard Wh.

5 Documentation

5.1 The results of each of the aforementioned tests will be documented in a fashion that will first sort the information based on the test performed.

5.2 Each test result will be further sorted by node manufacturer.

5.3 Each test result will be listed and if multiple tests were performed based on the same criteria, due to a test procedural fault, or due to a repair required to the testing equipment; those tests will be listed together, with a notation as to the reasons why the additional test was required.

5.4 Each test result will (at a minimum) list the following information:

5.4.1 Test name and description (as listed in sections 4.5 and 4.6 above)

5.4.2 Test conditions (as listed in section 4 above)

5.4.3 Manufacturer name

5.4.4 Node serial number or other identifying information.

5.4.5 Expected test result or acceptable result.

5.4.6 Actual result

5.4.7 Units

5.4.8 Notes – this will be a section that will be used in the case where the tester observes a notable condition that existed prior to, during, or after the test was performed.

5.5 Each section will be followed by an additional notes section that will be used to summarize the findings and will be kept to observable facts.

5.6 Finally, the report will contain a summary of all testing performed, observed information not included in the otherwise presented data, and a clearly indicated section for opinions and recommendations.

6 Reference Documents

6.1 ANSI C12.20 Specification – see Link to ANSI webstore

7 Revision Record

Revision Record

REV	ECN:	REVISION DESCRIPTION:	APPR:	REL:
-	N/A	Draft	JFW	2/17/16
1	N/A	Added section 6 – reference documents Added section 4.6.3 – additional voltage variations	JFW	3/3/16
2	N/A	Revised section 3.1; added (MTB) reference Revised section 3.1.1.2.4; changed displayed text for internal hyperlink Revised section 3.1.1.5; was FTU Revised section 4.3.4; was 15AAC Added section 4.6.4	JFW	3/4/16
3	N/A	Added section 3.1.1.6 Added section 4.7.3	JFW	3/10/16

From: Bonetti, Edward
Sent: Thursday, July 28, 2016 12:38 PM
To: Tod Riedel (Tod.Riedel@cimconlighting.com); David Vatalaro (David.Vatalaro@cimconlighting.com)
Cc: Durante, Larry G.; Walter, John E.; John Williams; 'ebonetti1@cox.net'
Subject: Subject: CONFIDENTIAL - RI Street Light Metering Pilot Project – Laboratory Testing Results – BENCH TEST (DRAFT)

Sensitivity: Confidential

Hello – Tod and David

National Grid is pleased to inform you that the Bench Testing phase of our Rhode Island Street Light Metering project has been completed by TESCO at their facility in Bristol, PA. As previously discussed, National Grid is providing you with the draft meter quality test results specific to your products. For your reference, attached is a copy of the BENCH TEST PLAN used to achieve the stated results.

The attached EXCEL file containing the test data provides seven (7) "tabbed" sheets separating the results based upon test/performance criteria. All resultant data sheets provide the "Test #" as a reference to the corresponding test procedure described in the BENCH TEST PLAN. Hopefully the layout and contents of the workbook is self-explanatory and the linkage to the test plan is clear. However, should you have any questions regarding the presentation of the test results, please feel free to give me a call.

National Grid requests that you review these test results and we invite your feedback. We would appreciate receiving your initial questions and comments in writing. After our review of your feedback, we will be pleased to coordinate a follow-up conference call to provide informative responses to your questions and discuss your comments as necessary. Should the conclusion of these discussions lead to more in-depth inquiries regarding the meter testing, it may be necessary to consider working directly with TESCO.

National Grid and our testing partner TESCO very much appreciate all of the help and cooperation that you have provided this project to date. Perhaps some of this information will be useful toward the continuing development of your products. We look forward to receiving your thoughts and feedback on the attached testing results.

Sincerely,
Ed Bonetti|Contractor|Project Manager – RI Street Light Metering Pilot|
Outdoor Lighting & Attachments
H: (401) 231-0067 | C: (401) 524-0253
Email: Edward.Bonetti@nationalgrid.com

Attachment JEW-4

See Excel File on USB Flash Drive

ORIGINATING GROUP:	ORIGIN DATE:	REVISION DATE:	NO. OF SHEETS:
TESCO ENGINEERING	**19-Feb-2016**	**3-Mar-2016**	**9**

Test Specification
for

nationalgrid

Photocell Node Bench Testing
Project 8594

SHEET NO.	1	2	3	4	5	6	7	8	9	10
REVISION	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**3**	**3**	**3**

APPROVED: DATE: 19-Feb-16
Originator: John Williams

APPROVED: DATE:
Electrical:

APPROVED: DATE: 19-Feb-16
Project Mgr.: John Williams

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4 TEST SPECIFICATIONS 4

5 DOCUMENTATION 9

6 REFERENCE DOCUMENTS 9

7 REVISION RECORD 10

1 Purpose

Define all test equipment, procedures, and documentation specifications for the photocell node bench testing to be performed by Tesco for National Grid - RI.

2 Definitions, Acronyms and Abbreviations

Abbreviation	Definition
A	Amperes
AC	Alternating Current
ANSI	American National Standards Institute
DPT	Digital Power Technologies (Power supply mfg.)
MTB	Meter Test Board
PF	Power Factor
THD	Total Harmonic Distortion
V	Volt
VT	Voltage Transformer
Wh	Watt-hour

3 Test Equipment Specifications

3.1 Meter Test Board (MTB)

The Tesco MTB is a four socket unit capable of simultaneously testing 4 meters. It is ANSI C12.20 compliant and uses a NIST traceable 3 phase reference standard.

3.1.1 Main Components

- 3.1.1.1 Digital Power Supply - DPT 024 Series 3 phase source.
  - 3.1.1.1.1 Frequency Accuracy - +/-0.02Hz
  - 3.1.1.1.2 Voltage Set point accuracy - 0.5%
  - 3.1.1.1.3 THD <0.5% Linear load
  - 3.1.1.1.4 Phase Resolution - 0.01 degree
  - 3.1.1.1.5 Current Accuracy - 0.5%
- 3.1.1.2 Reference standard - Radian RD-30-201
  - 3.1.1.2.1 .04% accuracy class
  - 3.1.1.2.2 Serial Number 301510
  - 3.1.1.2.3 Calibration date: 04/20/15

3.1.1.2.4 Calibration certificate detailing results and NIST traceability available upon request. (Internal Tesco Link to Cal Cert)

3.1.1.3 Programmable Logic Controller – Automation Direct, Productivity 3000 series

3.1.1.3.1 Main unit controller that is responsible for setting up the power supply, monitoring voltages and currents, and counting reference standard energy pulses.

3.1.1.4 Socket adapter – by Tesco

3.1.1.4.1 This unit adapts a 7 pin standard photocell socket to a standard metering socket.

3.1.1.4.2 Design details available upon request.

3.1.1.5 Silver Springs Field Service Unit (FSU) – communication adapter between PC and Cimcon, Sunrise, and SELC nodes.

3.1.1.6 Cimcon Handheld Configurator - communication adapter between PC and Cimcon nodes.

4 Test Specifications

4.1 This section is meant to adhere as closely as possible to ANSI C12.20.

4.2 For the purposes of these tests, the node meter function will be treated as an ANSI socket meter form 1S.

4.3 Test Conditions

4.3.1 Temperature: 23°C, +/- 2°C

4.3.2 Rated voltage (120VAC): +/- 1%

4.3.3 Rated frequency (60Hz): +/- 1Hz

4.3.4 Test Amperes (1.5/10AAC): +/- 1%

4.3.5 Unity Power factor (0°): +/- 2°

4.3.6 Nodes will be temperature stabilized before testing

4.4 Prior to each test set performed, the nodes will be energized for a 5 minute warm-up period.

4.5 Tests to be performed

4.5.1 ANSI C12.20 – Test number 1: No Load

4.5.1.1 The node with only the voltage circuit energized shall not register one equivalent rotation in watthours (for nodes with a metering pulse) or 1 watthour in 10 minutes.

4.5.2 ANSI C12.20 – Test number 2: Starting load

4.5.2.1 The node shall operate continuously with a load current of .01A at its lowest rated voltage.

4.5.3 ANSI C12.20 – Test number 3: Load performance

4.5.3.1 Each node will be tested at 120V and 10A. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.5.3.2 Each node will be tested at 120V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.5.4 ANSI C12.20 – Test number 4: Effect of variation of power factor for single element meters.

4.5.4.1 Each node will be tested at 120V and 10A, with 0.5 lagging power factor. The performance of each node will be documented under this condition. Comparison will be made in each case to the stated accuracy specification (0.5% or 2.0%).

4.6 Optional tests that can be performed (time permitting)

4.6.1 ANSI C12.20 – Test number 5: Effect of variation of voltage

4.6.1.1 Each node will be tested at 120V and 10A. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.1.2 Each node will be tested at 108V and 10A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.1.

4.6.1.3 Each node will be tested at 132V and 10A. The performance of each node will be documented under this condition. Comparison will be made in

each case to the reference accuracy listed in 4.6.1.1.

4.6.1.4 Each node will be tested at 120V and 1.0A. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.1.5 Each node will be tested at 108V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.4.

4.6.1.6 Each node will be tested at 132V and 1.0A. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.1.4.

4.6.2 ANSI C12.20 – Test number 5: Effect of variation of frequency (note that all previous testing is done at 60Hz)

4.6.2.1 Each node will be tested at 120V, 10A and 60Hz. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.2.2 Each node will be tested at 120V, 10A and 58.8Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.1.

4.6.2.3 Each node will be tested at 120V, 10A and 61.2Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.1.

4.6.2.4 Each node will be tested at 120V, 1.0A and 60Hz. The performance of each node will be documented under this condition. This will be given as the reference accuracy.

4.6.2.5 Each node will be tested at 120V, 1.0A and 58.8Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.4.

4.6.2.6 Each node will be tested at 120V, 1.0A and 61.2Hz. The performance of each node will be documented under this condition. Comparison will be made in each case to the reference accuracy listed in 4.6.2.4.

4.6.3 In addition to the ANSI specified tests, perform multiple accuracy tests per node type at +/-15% and +/-20% voltage variations.

4.6.4 In addition to the ANSI specified tests, perform multiple accuracy tests per node type at 0.5A and 15A.

4.7 Testing method

4.7.1 Silver Spring Communication method

4.7.1.1 This method will be used on all nodes for all tests listed in sections 4.5 and 4.6.

4.7.1.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.1.3 Each node will be energized with potential only.

4.7.1.4 Each node will be registered through the Silver Springs network using Silver Springs' Communication Tester software (version 6.10.25413).

4.7.1.5 An initial Wh query will be done on each node and recorded in the data collection spreadsheet.

4.7.1.6 The testing parameters will then be set in the MTB. The MTB will be set to run a Demand test, with the interval set to a value which should register at least 1,000Wh on both the nodes and the reference standard (i.e. for 120V, 1.00 PF, 10A test, the time interval will be set to (1,000*60)/(120*10) = 50 minutes).

4.7.1.7 At the end of the interval, the number of Wh from the reference standard will be recorded, along with the ending Wh readings from each of the four nodes.

4.7.1.8 The percent accuracy will then be given by the ratio of Node Wh/Reference Standard Wh.

4.7.2 Meter Pulse method

4.7.2.1 This method will only be used on nodes that have a metering IR pulse output on all the tests listed in sections 4.5 and 4.6, and will be done in addition to the method described in section 4.7.1

4.7.2.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.2.3 Each node will be energized with potential and load current so that the metering pulse will be activated.

4.7.2.4 Each node's metering pulse pickup assembly (part of the MTB) will be aligned with the metering pulse output.

4.7.2.5 The testing parameters will then be set in the MTB. The MTB will be set to run a Full Load, Light Load, or Power Factor test, depending on the requirements of the test.

4.7.2.6 At the end of the test, the registration value will be read directly from the MTB.

4.7.3 Cimcon Communication method

4.7.3.1 This method will be used on all Cimcon nodes fitted with the Cimon communication hardware for all tests listed in sections 4.5 and 4.6.

4.7.3.2 Each test will be performed on the Tesco MTB, four nodes at a time.

4.7.3.3 Each node will be energized with potential only.

4.7.3.4 Each node will be registered through the Cimcon network using Cimcon's Communication software (version ????).

4.7.3.5 An initial Wh query will be done on each node and recorded in the data collection spreadsheet.

4.7.3.6 The testing parameters will then be set in the MTB. The MTB will be set to run a Demand test, with the interval set to a value which should register at least 1,000Wh on both the nodes and the reference standard (i.e. for 120V, 1.00 PF, 10A test, the time interval will be set to (1,000*60)/(120*10) = 50 minutes).

4.7.3.7 At the end of the interval, the number of Wh from the reference standard will be recorded, along with

the ending Wh readings from each of the four nodes.

4.7.3.8 The percent accuracy will then be given by the ratio of Node Wh/Reference Standard Wh.

5 Documentation

5.1 The results of each of the aforementioned tests will be documented in a fashion that will first sort the information based on the test performed.

5.2 Each test result will be further sorted by node manufacturer.

5.3 Each test result will be listed and if multiple tests were performed based on the same criteria, due to a test procedural fault, or due to a repair required to the testing equipment; those tests will be listed together, with a notation as to the reasons why the additional test was required.

5.4 Each test result will (at a minimum) list the following information:

5.4.1 Test name and description (as listed in sections 4.5 and 4.6 above)

5.4.2 Test conditions (as listed in section 4 above)

5.4.3 Manufacturer name

5.4.4 Node serial number or other identifying information.

5.4.5 Expected test result or acceptable result.

5.4.6 Actual result

5.4.7 Units

5.4.8 Notes – this will be a section that will be used in the case where the tester observes a notable condition that existed prior to, during, or after the test was performed.

5.5 Each section will be followed by an additional notes section that will be used to summarize the findings and will be kept to observable facts.

5.6 Finally, the report will contain a summary of all testing performed, observed information not included in the otherwise presented data, and a clearly indicated section for opinions and recommendations.

6 Reference Documents

6.1 ANSI C12.20 Specification – see Link to ANSI webstore

7 Revision Record

Revision Record

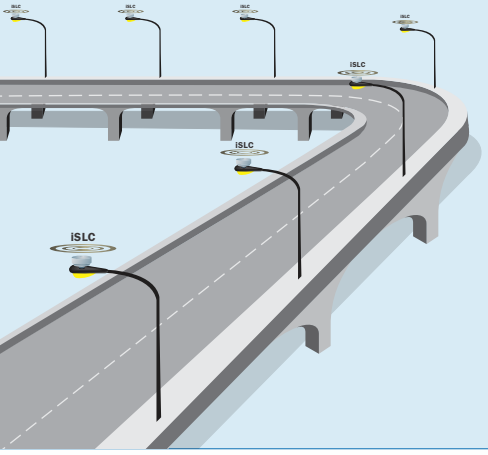
REV	ECN:	REVISION DESCRIPTION:	APPR:	REL:
-	N/A	Draft	JFW	2/17/16
1	N/A	Added section 6 – reference documents Added section 4.6.3 – additional voltage variations	JFW	3/3/16
2	N/A	Revised section 3.1; added (MTB) reference Revised section 3.1.1.2.4; changed displayed text for internal hyperlink Revised section 3.1.1.5; was FTU Revised section 4.3.4; was 15AAC Added section 4.6.4	JFW	3/4/16
3	N/A	Added section 3.1.1.6 Added section 4.7.3	JFW	3/10/16

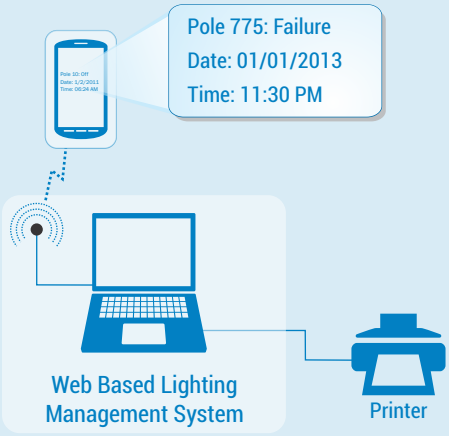
CIMCON Lighting, Inc.
Controls Simplified

iSLC-3100-7P

Plug & Play Wireless Lighting Controller

Plug & Play Wireless Lighting Controller with Dimming Capabilities





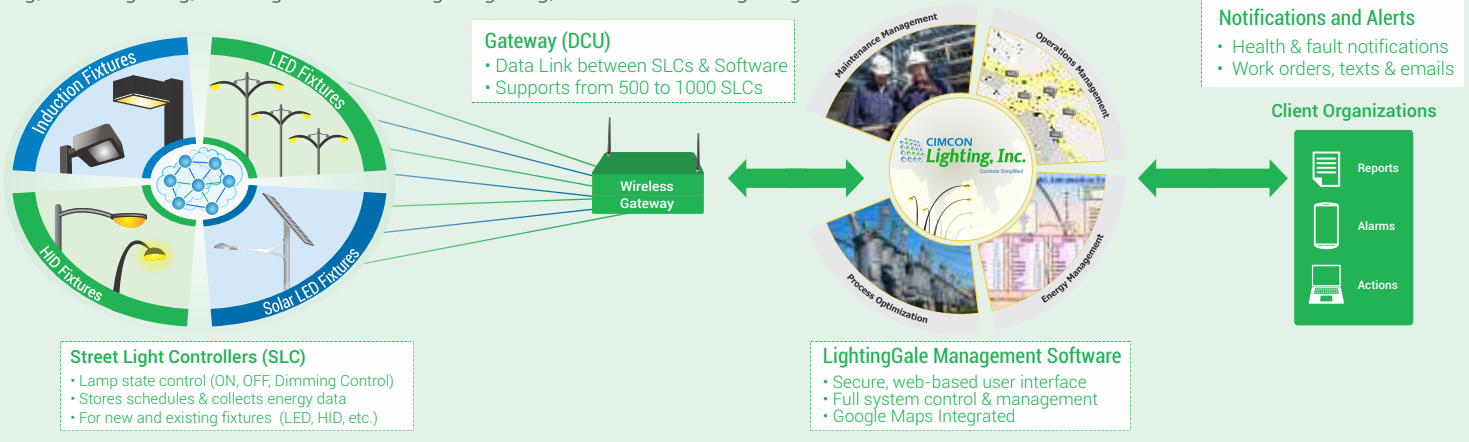
The iSLC-3100-7P is an intelligent wireless controller that uses a highly robust and reliable self-forming and self-healing RF mesh network, and is economical for use on individual light fixtures for remote control and operations. Each iSLC-3100-7P provides intelligent on/off switching, dimming control, accurate power metering and health monitoring of the light fixture. Support is also included for inputs from motion or light sensors for control of groups or individual light fixtures.

Key Features of the SLC-3100-7P

- **Robust and Reliable:** Reliably operates over large distances.
- **Wireless Technology:** The controller utilizes the latest developments in wireless RF technology that is self-forming and self-healing.
- **Light-agnostic support:** Works with any lamp type or manufacturer.
- **Simple and Easy Remote Monitoring:** The controller monitors various assets of the lighting fixture and updates the LightingGale Management Software.
- **Remote Control and Scheduling:** The controller supports five lamp control modes. Control can be based on user configurable ON/OFF/DIM schedules programmed on a daily / monthly / yearly / special events basis or can be controlled locally using a built-in astro-clock that calculates sunset and sunrise times using location and time zone data throughout the year.
- **Dimming Control:** The controller supports dimming of any lamp with a 0-10V or PWM input dimmable ballast with up to 10 dimming schedules.
- **Power Metering:** The controller can monitor electrical parameters such as Current, Voltage, Frequency, Power Factor, KW and Kwh.
- **Fault Monitoring:** Extensive fault monitoring is provided that reports lamp burn outs, lamp cycling, ballast failure, over/under voltage, abnormal power consumption, low power factor, communication failure and more. All faults are sent to the LightingGale Management System that generates alarms for visualization and fault rectification.
- **Alarm Call Service:** Alarms can be sent directly to relevant users via Emails or Text Messages (SMS) when they occur. Messages are time stamped and contain key parameters associated with the fault/alarm.
- **Burn Hours:** The controller keeps track of lamp burn hours for predictive maintenance, allowing pro-active lamp replacement.
- **Plug and Play Installation:** iSLC 3100-7P uses the latest 7pin NEMA interface for a true plug and play installation that includes dimming and motion based controls.

Intelligent Wireless Outdoor Lighting Control System

CIMCON's lighting control system is made up of Outdoor Lighting Controllers (SLC units), Wireless Gateways (DCU Units) and LightingGale Web-based Management and Control Software. CIMCON's control system is available for Traditional HID Fixtures, Induction Fixtures, LED and Solar-based Light Fixtures, and can be utilized in a wide variety of outdoor applications, including but not limited to: Street Lights, Roadway Lighting, Area Lighting, Parking Lot and Garage Lighting, and Industrial Lighting.



iSLC-3100-7P

Plug & Play Wireless Lighting Controller

Technical Specifications

Controller	Powerful 32 bit Microcontroller
Real Time Clock	Battery Backed RTC
Storage Memory	192kB Flash and 12kB RAM
Power Metering	Parameters Measured: Voltage, Current, Power Factor, Frequency, KW and Kwh
Switching Capacity	15 Amp Max
Power Supply	Universal AC input 85-305V, 50/60Hz, 0.07A
Radio Communication	2.4GHz, IEEE 802.15.4 RF Data Rate: 250 kbps — Transmit Power: +20 dBm Receiver Sensitivity: -104dBm — Network Type: Self-forming mesh network Network Fault Tolerance: Self-healing mesh — Open Field Range: 5000 ft/1.5 km Data Protection: 128 bit AES encrypt Hardware: IEEE 802.15.4-2003 CSMA-CA algorithm
GPS Module Specifications (Optional)	Receiver Type: 22 Tracking/66 Acquisition Channel GPS Receiver GPS L1, C/A Code Max. Update rate: 10Hz Sensitivity: Tracking: -165 dBm Reacquisition: -160 dBm Cold starts: -147 dBm Time-To-First-Fix: Cold starts: 31s (typical) Warm starts: 30s Hot starts: <1s EPO Assist: 13s(CTTFF) Accuracy: Automatic Position3: 2.5m CEP Speed: 0.1m/s Operation temperature: -40°C to +85°C
Dimming Interface	Control Voltage: 0-10V — Maximum Current: 10mA With Short Circuit protection or PWM Dimming: 10V p-p, 400Hz — Maximum Current: 10mA (Sink) or DALI
Optional Features	Provision of One Digital input and one Analog input that can be used for motion based lighting controls, adaptive lighting or advanced lighting controls
Standard Surge Protections	320 Joule CAT B or (700 Joule CAT C Optional)
Operating Conditions	-20°C to +70°C / -4°F to +158°F (-40°C optional), 20% to 90% Rh non-condensing
LightingGale Management Software	Web-based software allows remote configuration, monitoring, control, and reporting

iSLC-3100-7P

Plug & Play Wireless Lighting Controller

Ordering Information

iSLC-3100-7P-A-G-ET-IO-CATB-05

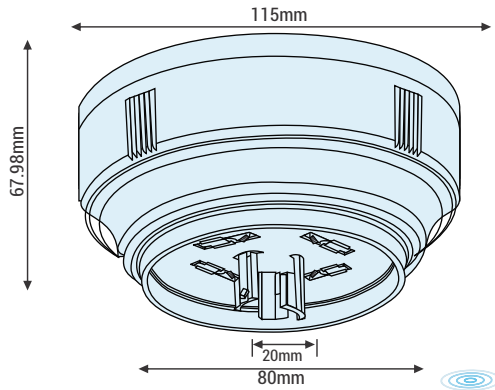
- **NEMA-7-Pin SERIES**
- **DIMMING INTERFACE**
  - 'A' - ANALOG
  - 'P' - PWM
  - 'D' - DALI
- **GPS**
  - 'G' - WITH GPS
  - ' ' - WITHOUT GPS
- **OPERATING TEMPERATURE**
  - 'ET' - (-40°C TO +70°C) #
  - ' ' - (-20°C TO +70°C)
- **ADDITIONAL IO #**
  - 1 - DIGITAL INPUT
  - 1 - ANALOG INPUT
- **SURGE PROTECTION**
  - CATB
  - CATC # !
- **ENERGY METERING ACCURACY**
  - 05 - 0.5%
  - 20 - 2%

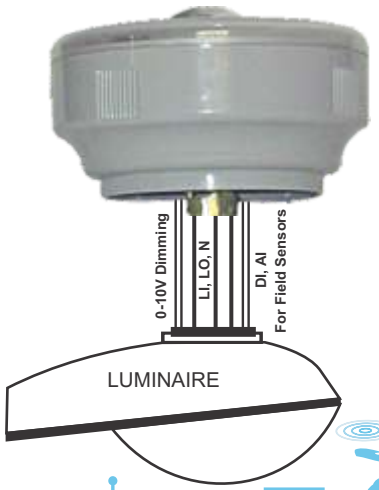
Ordering Code

iSLC3100-7P A-CATB-xx*	iSLC3100-7P A-IO-CATC-xx*	iSLC3100-7P P-G-ET-CATB-xx*
iSLC3100-7P A-IO-CATB-xx*	iSLC3100-7P A-ET-CATC-xx*	iSLC3100-7P P-G-ET-IO-CATB-xx*
iSLC3100-7P A-ET-CATB-xx*	iSLC3100-7P A-ET-IO-CATC-xx*	iSLC3100-7P P-CATC-xx*
iSLC3100-7P A-ET-IO-CATB-xx*	iSLC3100-7P P-CATB-xx*	iSLC3100-7P P-IO-CATC-xx*
iSLC3100-7P A-G-CATB-xx*	iSLC3100-7P P-IO-CATB-xx*	iSLC3100-7P P-ET-CATC-xx*
iSLC3100-7P A-G-IO-CATB-xx*	iSLC3100-7P P-ET-CATB-xx*	iSLC3100-7P P-ET-IO-CATC-xx*
iSLC3100-7P A-G-ET-CATB-xx*	iSLC3100-7P P-ET-IO-CATB-xx*	iSLC3100-7P D-CATB-xx*
iSLC3100-7P A-G-ET-IO-CATB-xx*	iSLC3100-7P P-G-CATB-xx*	iSLC3100-7P D-G-CATB-xx*
iSLC3100-7P A-CATC-xx*	iSLC3100-7P P-G-IO-CATB-xx*	

Note: * xx indicates Energy Metering accuracy
Feature not available for DALI version model
! Feature not available for GPS version model

Mechanical Dimensions





iSLC-3100-7P

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