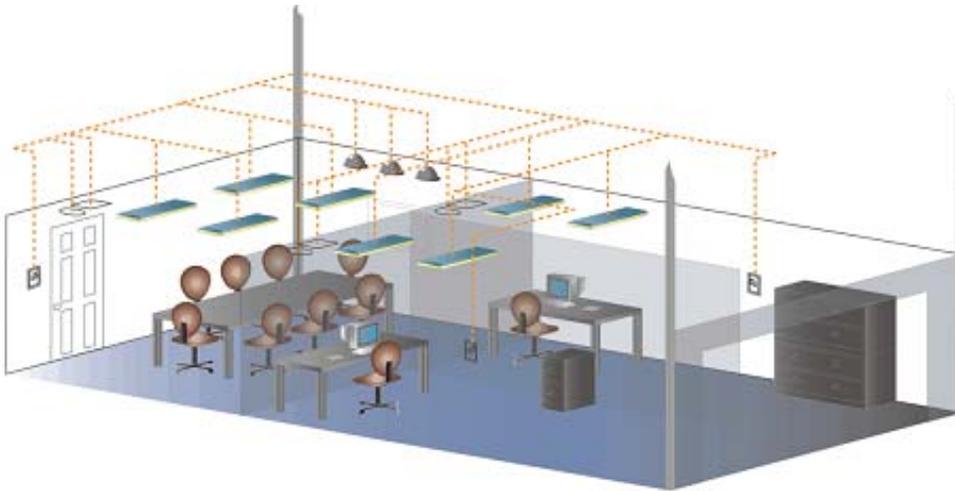


LIGHTING RESEARCH PROGRAM

Project 5.4 DALI Lighting Control Device Standard
Development
FINAL REPORT



Prepared For:
California Energy Commission
Public Interest Energy Research Program



Arnold Schwarzenegger, *Governor*

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Consultant Report

CALIFORNIA ENERGY COMMISSION

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NEMA Members: Ron Runkles, NEMA Staff; Wally Creer, Universal Lighting Technologies; Robert Erhardt, Advance Transformer Co.; Pekka Hakkarainen, Lutron Electronics Co.; Al Lombardi, Leviton Manufacturing Co., Inc.; Mike Stein, Universal Lighting Technologies; Guido Walther, Tridonic, Inc.; Howard Wolfman, OSRAM SYLVANIA; Howard Yaphe, Lightolier Canlyte Division of Genlyte-Thomas.

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PREFACE

The *PIER LRP DALI Lighting Control Device Standard Final Report* is a part of the *PIER Lighting Research Program (LRP)*, a Public Interest Energy Research (PIER) program. It was funded by California ratepayers through California's System Benefit Charges administered by the California Energy Commission (Commission) under PIER contract No. 500-01-041, and managed by the Architectural Energy Corporation. The PIER program supports public interest energy research and development that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The PIER Program, managed by the California Energy Commission (Commission), annually awards up to \$62 million to conduct the most promising public interest energy research by partnering with Research, Development, and Demonstration (RD&D) organizations, including individuals, businesses, utilities, and public or private research institutions.

PIER funding efforts are focused on the following six RD&D program areas:

- Buildings End-Use Energy Efficiency
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Renewable Energy
- Environmentally-Preferred Advanced Generation
- Energy-Related Environmental Research
- Strategic Energy Research.

The PIER LRP consisted of 6 Elements; Elements 1 through 5 each had 3-5 projects that developed an energy efficient lighting system, fixture, protocol, or controls product. The *DALI Lighting Control Device Standard Final Report* is the result of a two-year research effort by The Watt Stopper for Project 5.4 under Element 5 – Lighting Performance Metrics, Codes & Standards. The goal of this project was to develop an enhanced DALI lighting ballast control standard to allow for the operation and control of a complete lighting system.

The key deliverables for each project, in the form of guidelines and technical reports, are attachments to this report and are listed and described at the start of the attachment section. Due to market dynamics and the normal passage of time between the completion of research and the publication of research results, products anticipated for market delivery in this report may not necessarily reflect the actual array of products as delivered, or planned for delivery, by manufacturers. Therefore, the reader is advised to contact the lighting product manufacturers directly to ascertain the current status of products.

For more information about the PIER program, or to obtain the Final Report and other publications produced by this project, please visit www.energy.ca.gov/pier or contact the Commission's Publications Unit at 916-654-5200. All research products are also available through the PIER LRP website at www.archenergy.com/lrp/products/codes.htm.

ABSTRACT

The *PIER LRP DALI Lighting Control Device Standard Final Report* is the result of a two year cooperative effort with the National Electrical Manufacturers Association (NEMA) and The Watt Stopper (TWS), and the California Energy Commission Public Interest Energy Research (PIER) Program under the Lighting Research Program. The goals are to help bring together a NEMA-facilitated working group of major manufacturers to develop an open standard for lighting controls, conduct roundtables to gain input from designer and end-user groups, and provide a demonstration of the enhanced protocol.

The main objective of this project was to develop an enhanced DALI lighting ballast control standard to allow for the operation and control of a complete lighting system. The enhanced DALI open standard enables different manufacturers control devices to operate on the same control system. The lighting system includes the ballast and the peripheral lighting control devices (such as occupancy sensors, scene switches, centralized network monitoring and photosensors).

This report identifies successes of the PIER LRP in the development of the DALI Lighting Control Device Standard.

EXECUTIVE SUMMARY

The DALI Lighting Control Device Standard Development (Project 5.4) is part of the Lighting Research Program (LRP), a Public Interest Energy Research (PIER) program, consisting of 15 lighting research projects and three market connection projects. The *DALI Lighting Control Device Standard Final Report* is the result of a two-year research effort of project 5.4 under Element 5 – Lighting Performance Metrics, Codes & Standards. The goal of this project was to develop an enhanced DALI lighting ballast control standard to allow for the operation and control of a complete lighting system. The enhanced DALI open standard enables different manufacturers control devices to operate on the same control system. The lighting system includes the ballast and the peripheral lighting control devices (such as occupancy sensors, scene switches, centralized network monitoring and photosensors).

This report shows the result of a cooperative effort with the National Electrical Manufacturers Association (NEMA), The Watt Stopper (TWS), and the California Energy Commission Public Interest Energy Research (PIER) Program funded under the Lighting Research Program. The goals are to help bring together a NEMA-facilitated working group of major manufacturers to develop an open standard for lighting controls, conduct roundtables to gain input from designer and end-user groups, and provide a demonstration of the enhanced protocol. The following key concepts were supported in this project:

1. Control devices using the standard 2-byte message structure communicated successfully with ballast from different ballast manufacturers. Control devices also received and transmitted 3-byte messages, which added communications to the control devices without impacting the ballasts.
2. Impressive energy and demand savings were shown in two demonstrations with 28 percent in general office areas with aisles, 41 percent savings in open offices excluding aisles, and 62 percent in the laboratory. Private offices showed a power reduction of approximately 40 percent.
3. Occupants indicated they were satisfied with the scene settings with the DALI systems. To gain the most from the DALI installation, individual users should be part of the decision process when pre-setting light levels and selecting scenes.

The following documents are referenced in this final report:

- Summary letter from The Watt Stopper,
- DALI Lighting Control Device Standard proposed by NEMA,
- DALI Technical Assessment report, and
- DALI Site Demonstrations Report.

As a part of this project, focus groups were conducted with facility managers and manufacturers. The findings from the focus groups are available at www.archenergy.com/lrp/lightingperf_standards/project_5_4_reports.htm.

SUMMARY LETTER FROM THE WATT STOPPER

October 30, 2004

Judie Porter
Architectural Energy Corporation
2540 Frontier Avenue, Suite 201
Boulder, Colorado 80301

RE: PIER Project 5.4...DALI Lighting Control Device Standard Development Final Report

Dear Judie,

The attached NEMA Draft Standard 243 constitutes our final report for PIER Project 5.4.

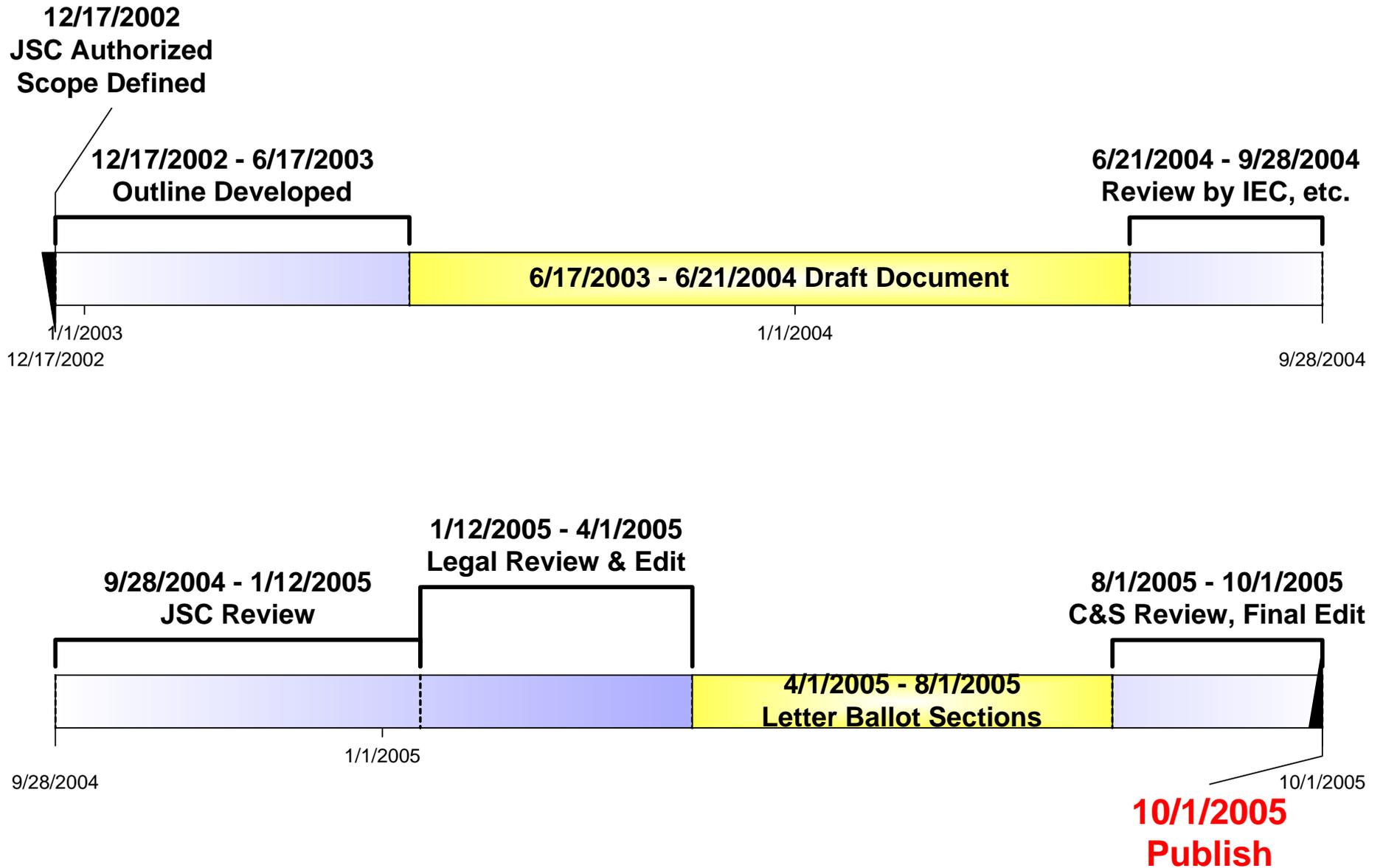
The National Electrical Manufacturer's Association and the California Energy Commission have worked cooperatively over the past two years to develop an open standard for controls working with DALI ballasts. The goal is to accelerate the penetration of fluorescent dimming ballasts, which will make lighting a controllable load.

An open controls standard is a critical step in making this happen since it promotes compatibility of devices from multiple manufacturers, encourages competitive bidding and ensures future availability.

Working with NEMA has accelerated the standards development process. The NEMA standard is expected to be adopted by the IEC (International Electrical Commission) and combined with IEC 60629 (DALI ballast standard) to create a complete DALI systems standard. PIER funding has supported the research and writing of the draft standard and the verification of the concepts in two working demonstration sites.

The overall timeline for completion and adoption of the controls standard is attached. Again, thank you for the support and guidance which has made this possible.

David Peterson
Project lead



DALI LIGHTING CONTROL DEVICE STANDARD PROPOSED BY NEMA

The proposed standard is available for download and review from the below url.
www.archenergy.com/lrp/lightingperf_standards/project_5_4_reports.htm

TECHNICAL ASSESSMENT REPORT

The report is available for download and review from the below url.

www.archenergy.com/lrp/lightingperf_standards/deliverable_5.4.2b_DALI_Technical_Assess.pdf

DEMONSTRATION REPORT

The report is available for download and review from the below url.

www.archenergy.com/lrp/lightingperf_standards/deliverable_5.4.6_DALI_demo_report.pdf