2008 Title 24
Nonresidential CASE
Indoor Lighting Proposal

Integrated Lighting Concepts

In support of
PG&E, SCG and SDG&E
Codes & Standards Programs
Proposal Scope

- Reduce Lighting Power Density (LPD)
- Target - Nonresidential Buildings
- Reduce daily lighting power consumption…
  …while meeting visual performance criteria
- Focus on the Tailored Method of Title 24
  - Reduce lighting power allowances
  - Increase enforceability
- Some area category recommendations too
Focus & Highlights

- Accent & Wall Display – Reduced LPD
- Eliminate Mounting Height Factors for Retail
- Redefine Wall vs. Floor Lighting Criteria
- Trade-off between wall and floor display
- Wall Display – Multiple Shelf Component
- Mandate Expanded Lighting Controls
- Expand Daylight Harvesting Requirement
- Reduce ambiguity in general lighting calc.
Benefits

- Energy Benefits – Yearly Savings
- Non-energy Benefits
  - Reduced Air emissions
  - Enhanced Lighting Quality
  - Improved Lighting Performance
Technology Issues

- Fixtures and Lamps Now Available
- Major Lamp Technology Improvements
- Increased First Cost of New Technology
  - Fixtures More Costly – Prices are dropping
  - Lamps More Costly – Prices are dropping
  - Analysis based on current costs
- First Cost Offset by Energy and Operational Cost Reductions
Methodology

- Interviews with Designers, Contractors
- Life Cycle Cost Analysis of Efficient Designs
- Visual Observation of Current Spaces
- Computer Modeling of Retail Spaces
  - Big Box Retail
  - High Center Atrium
  - Precious Jewelry
  - Designer Furs and Dresses
Survey results – What are your top recommendations to save energy?

- 47 interviews with Designers, Contractors, Manufacturers, and End Users

![Bar Chart]

- Most/more efficient lamp/fixture: 26 responses
- Use controls: 16 responses
- Appropriate level & need: 6 responses
- Did not reply to item on survey/said had not time to reply: 4 responses
- Metal halide: 4 responses
- Longer-life bulbs: 3 responses
- Combo: 3 responses
Survey – Is CMH a feasible alternative to halogen by 2008?

- Ceramic Metal Halide lighting feasible alternative to halogen lighting for commercial/retail by 2008?
- 69% saying CMH is “good or better”
Survey – Energy savings in T-24 by reducing exceptions?

- 67% consider this a poor or unacceptable idea

Eliminate or at minimum substantially reduce most exemptions for special applications

- Excellent: 0%
- Very Good: 4%
- Good: 11%
- Fair: 18%
- Poor: 16%
- Not Acceptable: 51%
Survey – Controls means of saving energy in T-24

- 72% think expanding the use of controls is a good or better way of increasing savings

Expand control requirements & use of controls, especially in tailored compliance

- Excellent 51%
- Very Good 11%
- Good 20%
- Fair 10%
- Poor 3%
- Not Acceptable 2%

3%
Life Cycle Costing 20W and 39W Ceramic Metal Halide versus Halogen

- LCC with 75W Halogen Reference
- LCC with 120W Halogen Reference

CMH 7 YEAR LIFECYCLE COST ANALYSIS - 75 WATT REFERENCE

CMH 7 YEAR LIFECYCLE COST ANALYSIS - 120 WATT REFERENCE
New Mall use of Efficient Technology - Survey of 70 Stores
1 - None, 5 - Most Advanced
Analysis Tools

- AGi32 lighting software – Lighting design models
  - Detailed lighting analysis
  - Comprehensive lighting modeling

- Excel Spreadsheets
  - Set power densities by space/task with current technologies. Build on spreadsheets used in the developing the 2005 standards.
  - Evaluate models under 05 versus proposed 08 standard
  - Analysis/comparisons - cost effectiveness and benefits
Model B
large store with a high center atrium

LPD Recap
General Lighting: 1.02W
Floor Display: 0.33W
Wall Display: 11.8W
Ornamental: 0.39W

Area Method: 1.69W (1.70W)
Model C
high end jewelry store

LPD Recap
General Lighting: 0.52W
Floor Display: 0.30W
Wall Display: 6.2W
Valuable Display: 11.0W
Model D designer shop within a larger store

LPD Recap
General Lighting: 0.57W
Floor Display: 0.85W
Wall Display: 10.5W
**LPD: T-24/05 versus Proposed T-24/08**

Comparison of proposed Title 24-2008 using new technology and current Title 24-2005 compliance

### DESIGN COMPARISON OF TITLE 24-2005 and PROPOSED TITLE 24-2008 OF RETAIL STORE MODELS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TITLE 24-2005 DESIGN LIGHTING POWER DENSITY</th>
<th>TITLE 24-2005 MAXIMUM ALLOWED POWER DENSITY FOR EACH MODEL GEOMETRY</th>
<th>TITLE 24-2008 DESIGN LIGHTING POWER DENSITY</th>
<th>TITLE 24-2008 (Proposed) MAXIMUM ALLOWED POWER DENSITY FOR EACH MODEL GEOMETRY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Watts Square Feet W/SqFt</td>
<td>Watts W/SqFt</td>
<td>Watts Square Feet W/SqFt</td>
<td>Watts W/SqFt</td>
</tr>
<tr>
<td>Big Box Area</td>
<td>218,134 124,222 1.76*1</td>
<td>186,333 1.70</td>
<td>150,039 124,222 1.21</td>
<td>186,333 1.24</td>
</tr>
<tr>
<td>High Center Atrium</td>
<td>51,121 30,227 1.69</td>
<td>80,300 2.66</td>
<td>48,675 30,227 1.61</td>
<td>62,047 2.05</td>
</tr>
<tr>
<td>High End Jewelry</td>
<td>20,301 3,940 5.15</td>
<td>25,556 6.49</td>
<td>7,995 3,940 2.03</td>
<td>17,826 4.52</td>
</tr>
<tr>
<td>Designer (High End Retail)</td>
<td>4,535 932 4.87*2</td>
<td>4,013 4.31</td>
<td>2,470 932 2.65</td>
<td>3,236 3.47</td>
</tr>
<tr>
<td>Location Average:</td>
<td>73,523 39,830 3.37</td>
<td>74,051 3.74</td>
<td>52,295 39,830 1.87</td>
<td>67,361 2.82</td>
</tr>
</tbody>
</table>

*1: Control credits not included, design complies with control credit
*2: 13% over as stand-alone, complies however when averaged with other space within the project and total project control credits applied
2005 versus 2008 Wall Model Results – with options

- 60W/55W/HIR advanced and MR16/IRC models
- Maximum Efficiency CMH & T5 Model

<table>
<thead>
<tr>
<th>Design</th>
<th>Illumination</th>
<th>Lineal LPD</th>
<th>Cost Adder</th>
<th>Cost Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>60/HIR &amp; T8-2005</td>
<td>Base Level</td>
<td><strong>30.0W (21.0W)</strong>*</td>
<td>Base Level</td>
<td>Base Level</td>
</tr>
<tr>
<td>55/HIR &amp; T5-2008</td>
<td>Equivalent</td>
<td><strong>25.0W (17.5W)</strong>*</td>
<td>Low</td>
<td>Less than 2 yr</td>
</tr>
<tr>
<td>55/HIR &amp; T5 (alt. 1)</td>
<td>(10%)</td>
<td><strong>23.7W (16.5W)</strong>*</td>
<td>Low</td>
<td>Less than 2 yr</td>
</tr>
<tr>
<td>50MR/IR &amp; T5 (alt. 2)</td>
<td>(10%)</td>
<td><strong>23.7W (16.5W)</strong>*</td>
<td>Low</td>
<td>Less than 5 yr</td>
</tr>
<tr>
<td>20W/CMH &amp; T5</td>
<td>Equivalent</td>
<td><strong>15.4W (10.8W)</strong>*</td>
<td>High</td>
<td>Limited -7 yr +</td>
</tr>
</tbody>
</table>

*Allowed wall LPD per lineal foot based on 70% of actual (modeled) merchandised wall lighting
Wall Display
LPD Recommendation

- Wall Display LPD lowered from 21.0W to 16.5W

- Logic for recommendation
  - Achievable with use of high efficiency T5 and latest IR/IRC lamping with only a 10% (minor) light loss
  - Alternate light loss designs still comply with IES-RP-2 standards for display lighting.
  - CMH not required to reach compliance in lower ceilings and/or at lower light levels

- Designs desiring significantly higher illumination or with high ceilings can use CMH
Floor Display Model
Compact Triple Tube with 55W/HIR accent

- 0.90W General & 1.35W Accent = 2.25W
- Ambient: 44FC  Average: 75FC  Accent: 360FC

IESNA RP-2 Compliant Design – 2005 Model Upscale Retail
Floor Display Model
2x4 T8 Troffer with 55W/HIR accent

- 0.60W General & 1.35W Accent = 1.95W
- Ambient: 40FC  Average: 72FC  Accent: 362FC

IESNA RP-2 Compliant Design – 2008 Model – Ma & Pop
Floor Display
LPD Recommendation

- Floor Display LPD lowered from 1.5W to 1.05W

- Logic for recommendation
  - 2008 Model (Mom & Pop) allows for RP-2 compliant lighting without use of CMH
  - 2008 Model more representative of typical strip/independent retail space.
  - Lower General lighting LPD in 2008 model can supplement accent allowing 55W/IR versus CMH

- Designs with less efficient general lighting and desired higher light levels can use CMH
Lighting Controls Cost-effectiveness

ADVANCED LIGHTING CONTROLS ANALYSIS MODEL

Store Type: 2500 Square Foot Soft Merchandising
Lighting Controls
Cost-effectiveness

- Advanced Controls Versus Basic Time Clock
  - Modeled 2500 foot (Mom & Pop) retail space
  - Includes multi task/zone and multi level control with sensors and load shed ability

- Cost-effectiveness Recap and Summary

<table>
<thead>
<tr>
<th>Annual Savings Using Advanced Controls</th>
<th>$1,946.22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost over Minimum Control (Time Cock)</td>
<td>$4,200.00</td>
</tr>
<tr>
<td>SIMPLE PAYBACK PERIOD</td>
<td>2.2 Years</td>
</tr>
</tbody>
</table>
## Proposed Code Language – LPD’s

### Retail Merchandise Sales

<table>
<thead>
<tr>
<th>Tailored LPD’s</th>
<th>T24-05</th>
<th>T24-08</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Lighting</td>
<td>0.90W sq. ft.</td>
<td>0.90W sq. ft.</td>
</tr>
<tr>
<td>Floor Display</td>
<td>1.50W sq. ft.</td>
<td>1.05W sq. ft.</td>
</tr>
<tr>
<td>Wall Display</td>
<td>21.0W lin. ft.</td>
<td>16.5W lin. ft.</td>
</tr>
<tr>
<td>Effects Lighting</td>
<td>0.70W sq. ft.</td>
<td>0.60W sq. ft.</td>
</tr>
<tr>
<td>Valuable Mech. Area</td>
<td>1.30W sq. ft.</td>
<td>0.90W sq. ft.</td>
</tr>
<tr>
<td>Valuable Mech. Tops</td>
<td>20.0W sq. ft.</td>
<td>15.0W sq. ft.</td>
</tr>
</tbody>
</table>

Proposed Code Language

Mandatory Controls for Tailored Spaces

- **Egress & Security** – All lights off except egress/security
- **Housekeeping Controls** – Uniform lighting with LPD no greater than allowed general lighting LPD for space
- **Demand Response** – Turn off selective lights as governed by local utility
- **Display Window Lighting** – Separately controlled with potential to respond to daylight and evening conditions
Acknowledgements

Sponsored by California Ratepayers though Codes & Standards programs at:

- Pacific Gas & Electric Company
  - Steve Blanc  SLB4@pge.com

- Southern California Gas Company & San Diego Gas & Electric Company
  - Jerine Ahmed  jahmed@semprautilities.com

- Project management by Heschong Mahone Group
  - Jon McHugh  mchugh@h-m-g.com