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2008 Title 24 Non Residential CASE Proposal

Demand Response Controls for Indoor Lighting

Integrated Lighting Concepts
In support of

PG&E Codes & Standards Program

Pacific Gas and Electric Company

Codes & Standards Enhancement Project

Proposal Scope

- Require Automated Demand Responsive Lighting Controls
- Target Selected Nonresidential Spaces Over 100,000 SQ. FT.
- Provide both Voluntary (economic) and Mandatory Curtailment Scenarios
  - Economic scenario – 4 hour curtailment during ten highest valued days PV$250/kW
  - Mandatory curtailment – 2.5 h/yr
  - Economic + Mandatory - PV$661/kW

Focus & Highlights

- Primary Objective – Turn Off Non Essential Lighting Loads to Avoid Blackouts
- Secondary Objective – Reduce selective lighting loads for Economic Reward and Reduce Strain on Power Grid
- Two Approaches to Compliance
  - Low Cost Bare Bones ON/OFF Control *(non-uniform)*
  - Costlier Comprehensive Control (*uniform*)

Benefits

- Energy Benefits
  - LPD Curtailment to Avoid BLACK-OUTS
  - Uniform System Contains Night Adaptive Potential
- Non-energy Benefits
  - Cost Avoidance/Savings for Users & Utilities
  - Minimize Potential Damages/Losses associated with a BLACK-OUT

Proposed Approaches and Costs for Demand Response in Spaces w/EMS

- **Bare Bones Control** *(non-uniform)*
  - Basic ON/OF Switching
  - Low Cost Implementation **$0.05 to $0.10** Square Foot
  - Temporary Loss In Lighting Quality
  - Comprehensive Controls Not Required
- **Comprehensive Control** *(uniform)*
  - Multi Level Switching, Stepped Illumination, Etc.
  - Higher Cost Implementation **$0.20 to $0.25** Square Foot
  - Minimal Loss In Lighting Quality
  - Requires Multi Level Control Prerequisite

Costs and Approach to Demand Response in Spaces without EMS

- **Spaces without Energy Management System**
  - Smaller spaces
  - Offices with occupancy sensor rather than time sweep
  - Warehouse with no bi-level control
- **Bare Bones Control** *(non-uniform)*
  - Same as previous slide
  - Low Cost Implementation **$0.20 to $0.25** Square Foot
- **Comprehensive Control** *(uniform)*
  - Same as previous slide
  - Higher Cost Implementation **$1.00 to $1.25** Square Foot

Building Types –Partial List

Retail Spaces

- Grocery/Markets
- Electronics & Sports
- Big Box & Discount
- Super Centers
- Drug & Convenience
- Medium Retail
- High End Retail

Utility Spaces

- Warehouse
- Sales & Services

Office Spaces

- Large Office Complex
- Small Office Suite
- Government Buildings

Hospitality

- Hotel/Motel
- Movie Theaters
- Resorts & Entertainment
- Conference Centers

Potential Load Shed
Building Types – 100,000 Sq. Ft.

Type	Load	DR *(non uniform)*	DR *(uniform)*
Warehouse	60 KW	1.8 KW *(03%)*	3.0 KW *(05%)*
Large Office	110 KW	15.5 KW *(15%)*	22.0 KW *(20%)*
Big Box A	170 KW	5.1 KW *(03%)*	8.5 KW *(05%)*
Big Box B	**170 KW**	**25.5 KW** *(15%)*	**34.0 KW** *(20%)*
Anchor Store	**170 KW**	**34.0 KW** *(20%)*	**42.5 KW** *(25%)*

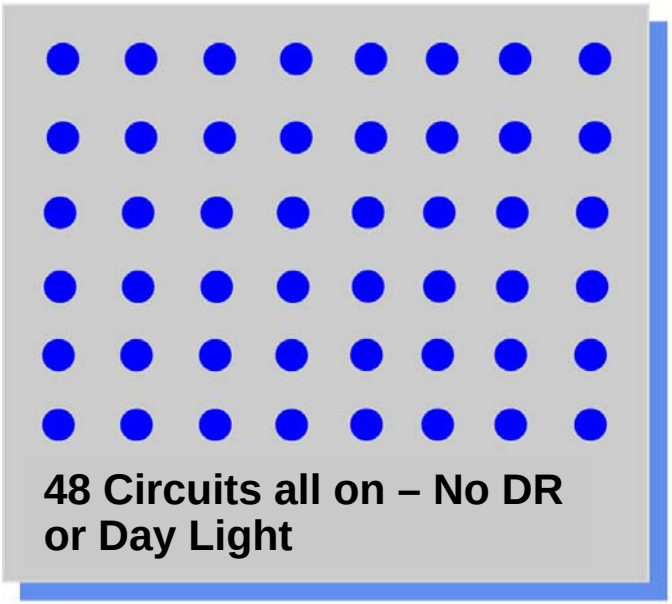
Potential Load Shed
Building Types – 25,000 Sq. Ft.

Type	Load	DR *(non uniform)*	DR *(uniform)*
Small Office *(5000 Feet)*	5.1 KW	0.77 KW *(15%)*	1.2 KW *(20%)*
Drug & Service	**42.5 KW**	**4.25 KW** *(10%)*	**8.5 KW** *(20%)*
Medium Retail	**50.0 KW**	**7.5 KW** *(15%)*	**12.5 KW** *(25%)*
High End Retail	**55.0 KW**	**11.0 KW** *(20%)*	**16.5 KW** *(30%)*

Economic & Societal Values of Demand Response Participation

- Economic Value PV$/kW = $250.00
- Emergency Value PV$/kW = $366.00
- **Combined Emergency & Economic Value PV$/kW = $616.00**

Big Box Retail A & B
Prototype Lighting Layout – 100,000 Sq. Ft.



48 Circuits all on – No DR or Day Light

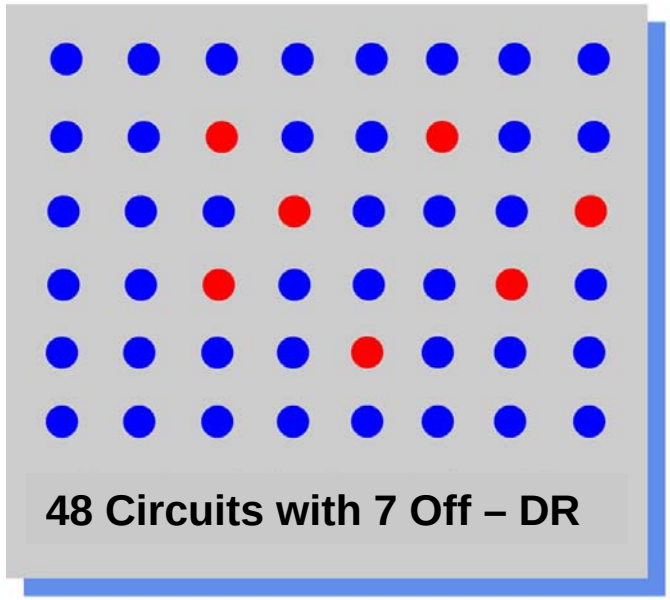
Lighting Criteria & Specifications

- 75 FC *(maintained ave. target)*
- 400-400W Metal Halide Luminaires
  (425W per luminaire – electronic ballast – 277V)
- Lighting Power: 170,000W *(170 KW)*
- Total Lighting Load on 48 Circuits
  (8-9 fixtures per circuit)

Demand Response Performance

- Demand Response: 0
- Maintained Light Level: 75 FC
- KW Curtailed: 0
- Maintained Uniformity: NA
- Implementation Cost: $0.00
- B/C Ratios: NA

Big Box - B *(no daylight)*
Non Uniform Demand Response Control



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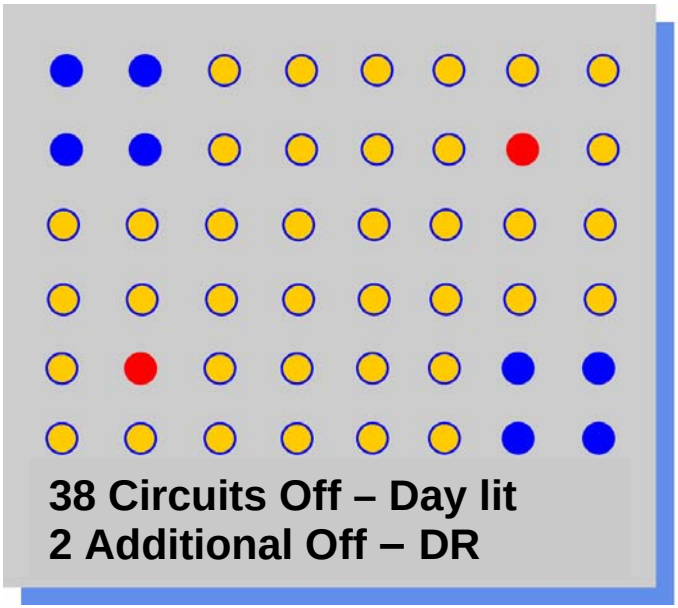
- Total Lighting Load on 48 Circuits
  (8-9 fixtures per circuit)

Demand Response Performance

- Demand Response: 15%
- Maintained Light Level: 64 FC
- KW Curtailed: 25.5
- Maintained Uniformity: Potential Poor
- Implementation Cost: $5,000.00
- Economic B/C Ratio: **1.28**
- Combined B/C Ratio: **3.14**

Big Box – A *(Day lit)*
Non Uniform Demand Response Control



Note: Most general lighting already turned off during hot summer afternoons

Lighting Criteria & Specifications

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- 400-400W Metal Halide Luminaires
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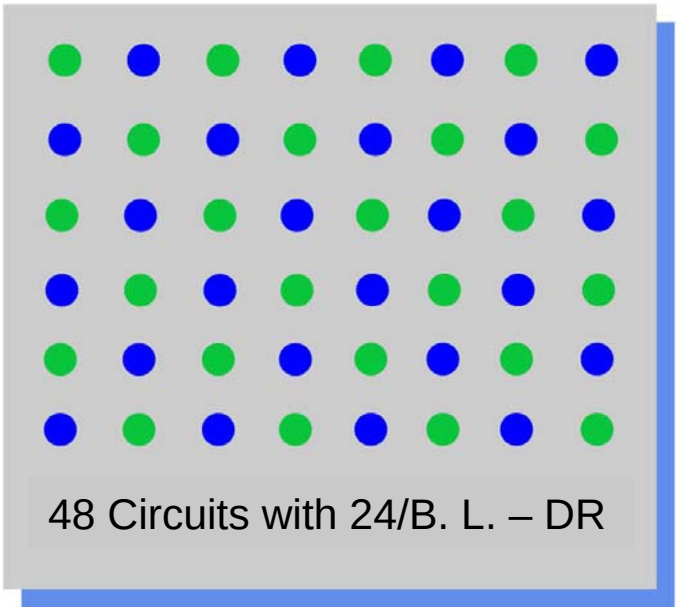
- Lighting Power: 170,000W *(170 KW)*
- Total Lighting Load on 48 Circuits
  (8-9 fixtures per circuit)

Demand Response Performance

- Demand Response: 3%
- Maintained Light Level: 64 FC
- KW Curtailed: 5.1
- Maintained Uniformity: Potential Poor
- Implementation Cost: $5,000.00
- Economic B/C Ratio: **0.26**
- Combined B/C Ratio: **0.63**

Big Box - B Retail *(no daylight)*
Uniform Demand Response Control



Note: Uniform control design also suited to night-time adaptive lighting scheme

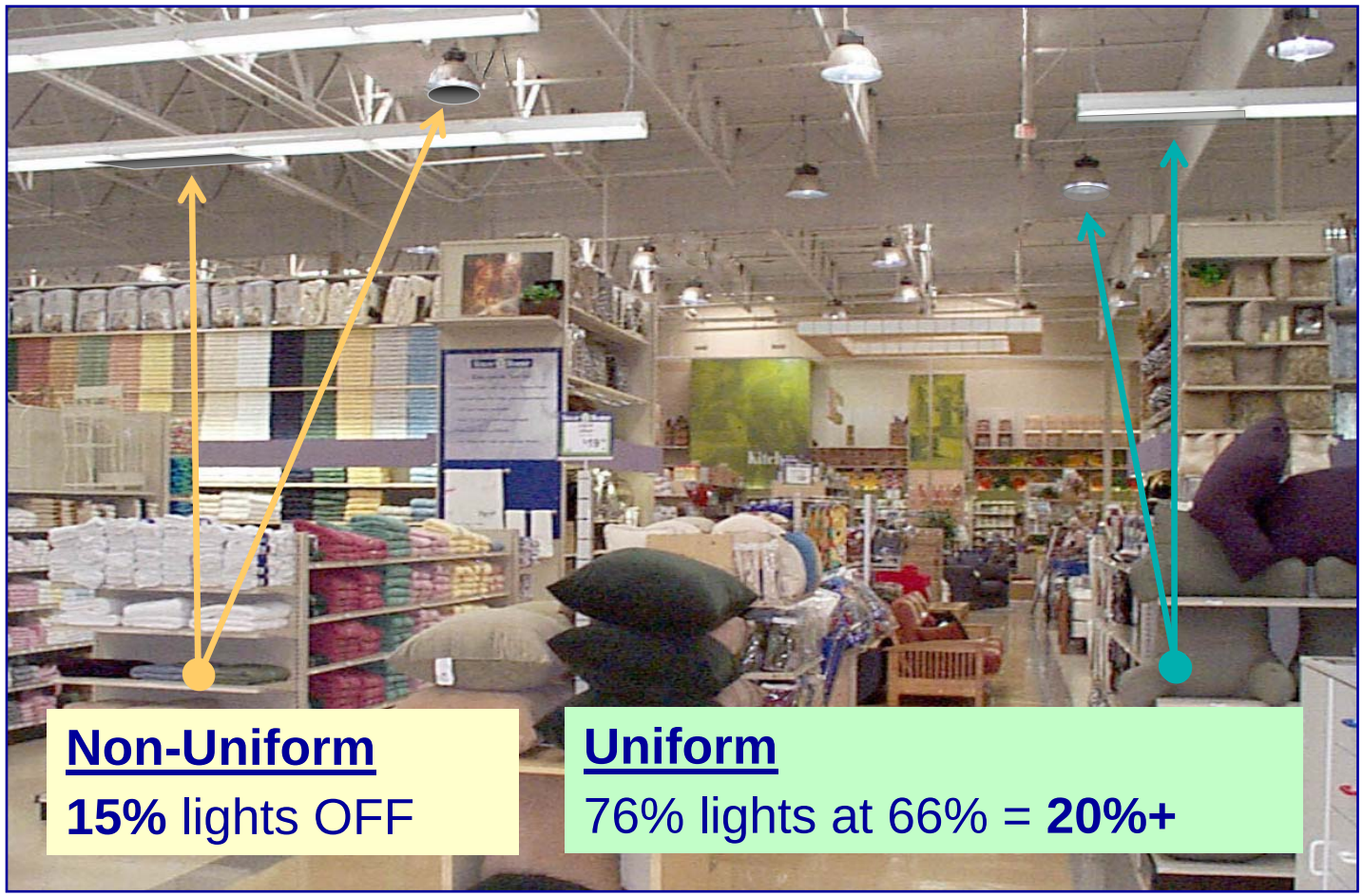
Lighting Criteria & Specifications

- 75 FC *(maintained ave. target)*
- 400-400W Metal Halide Luminaires
  (425W per luminaire – electronic ballast – 277V)
- Lighting Power: 170,000W *(170 KW)*
- Total Lighting Load on 48 Circuits
  (8-9 fixtures per circuit)

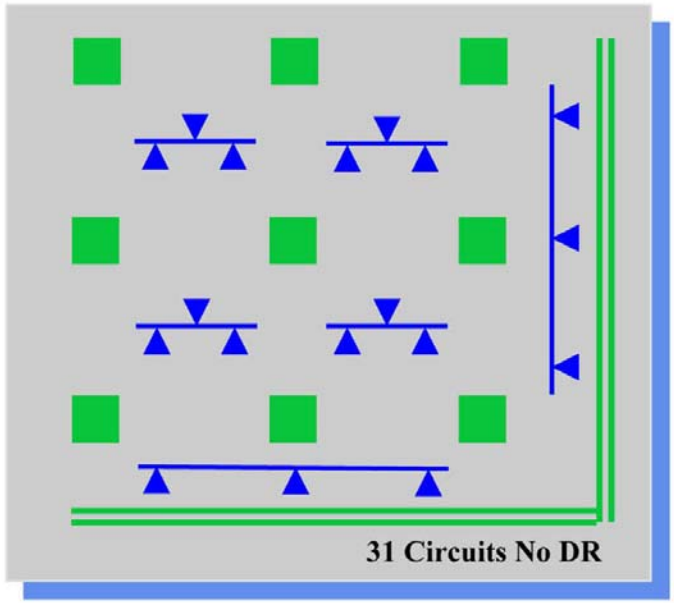
Demand Response Performance

- Demand Response: 20%
- Maintained Light Level: 60 FC
- KW Curtailed: 34.0
- Maintained Uniformity: Very Good
- Implementation Cost: $20,000.00
- Economic B/C Ratio**:** **0.43**
- Combined B/C Ratio: **1.05**

BIG BOX RETAIL-B
Control Potential: Non-Uniform & Uniform



Medium Retail
Prototype Lighting Layout – 25,000 Sq. Ft.



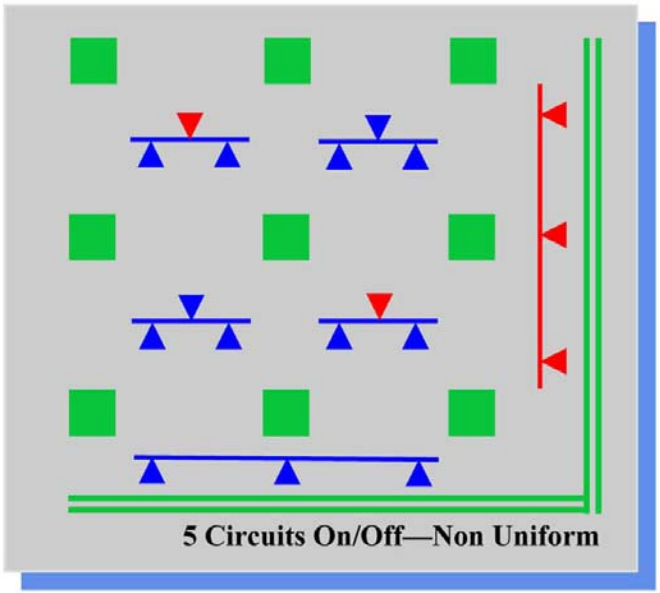
Lighting Criteria & Specifications

- 45 FC *(maintained ave. general lighting)*
- 150 FC – 175 FC *(accent & display)*
- 58W Fluorescent & 60W Halogen/IR
- Lighting Power: 50,000W *(50 KW)*
- Total Lighting Load on 31 Circuits
  (30-32 fixtures per circuit)

Demand Response Performance

- Demand Response: 0
- Maintained Light Level: 80 FC
- KW Curtailed: 0
- Maintained Uniformity: NA
- Implementation Cost: $0.00
- B/C Ratios: NA

Medium Retail
Non Uniform Demand Response Control



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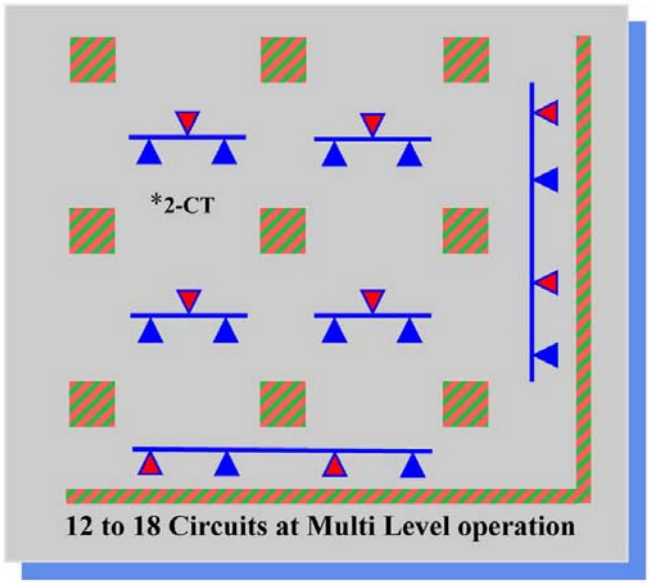
- 58W Fluorescent & 60W Halogen/IR
- Lighting Power: 50,000W *(50 KW)*
- Total Lighting Load on 31 Circuits
  (30-32 fixtures per circuit)

Demand Response Performance

- Demand Response: 15%
- Maintained Light Level: 68 FC
- KW Curtailed: 7.5
- Maintained Uniformity: Potential Poor
- Implementation Cost: $2,500.00
- Economic B/C Ratio: **0.75**
- Combined B/C Ratio: **1.85**

Medium Retail
Uniform Demand Response Control



*Note: 2-circuit track used in this scenario

Lighting Criteria & Specifications

- 45 FC *(maintained ave. general lighting)*
- 150 FC – 175 FC *(accent & display)*
- 58W Fluorescent & 60W Halogen/IR
- Lighting Power: 50,000W *(50 KW)*
- Total Lighting Load on 31 Circuits
  (30-32 fixtures per circuit)

Demand Response Performance

- Demand Response: 25%
- Maintained Light Level: 60 FC
- KW Curtailed: 12.5
- Maintained Uniformity: Excellent
- Implementation Cost: $5,000.00
- Economic B/C Ratio: **0.50**
- Combined B/C Ratio: **1.23**

MEDIUM RETAIL
Control Potential: Non-Uniform & Uniform

Non-Uniform

15% lights OFF

Uniform

Selected lights off, others with step illumination = **25%+**

Proposed Code Language

SECTION 101 – DEFINITIONS AND RULES OF CONSTRUCTION

- **DEMAND RESPONSE PERIOD** is a period of time during which the local utility is curtailing electricity loads by sending out a demand response signal.
- **DEMAND RESPONSE SIGNAL** is an electronic signal sent out by the local utility indicating a request to their customers to curtail electricity consumption.
- **DEMAND RESPONSIVE LIGHTING CONTROL** is a control that reduces lighting power consumption in response to a demand response signal.

Proposed Code Language

SECTION 131 – INDOOR LIGHTING CONTROLS THAT SHALL BE INSTALLED

- **(f) Demand responsive lighting controls.** If a retail building has a floor area greater than 100,000 sf and is provided a demand response signal by the local utility, demand responsive lighting controls shall be installed that reduces lighting power consumption by 15% while enabling occupied space activities albeit at lower illumination levels.
- **Exception to 131(f)**: Buildings where more than 50% of the lighting power is controlled by daylighting controls.

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