

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*

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



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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*)



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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



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

■ Bare Bones Control (*non-uniform*)

- Basic ON/OFF 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



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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



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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



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

Type	Load	DR <i>(non uniform)</i>	DR <i>(uniform)</i>
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 <i>(non uniform)</i>	DR <i>(uniform)</i>
Small Office <i>(5000 Feet)</i>	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%)



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Economic & Societal Values of Demand Response Participation

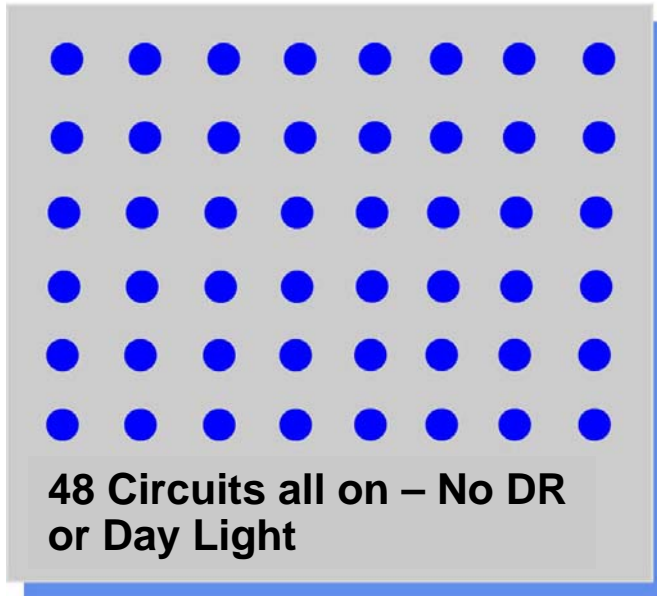
- Economic Value PV\$/kW = \$250.00
- Emergency Value PV\$/kW = \$366.00
- **Combined Emergency & Economic Value PV\$/kW = \$616.00**



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Big Box Retail A & B

Prototype Lighting Layout – 100,000 Sq. Ft.



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

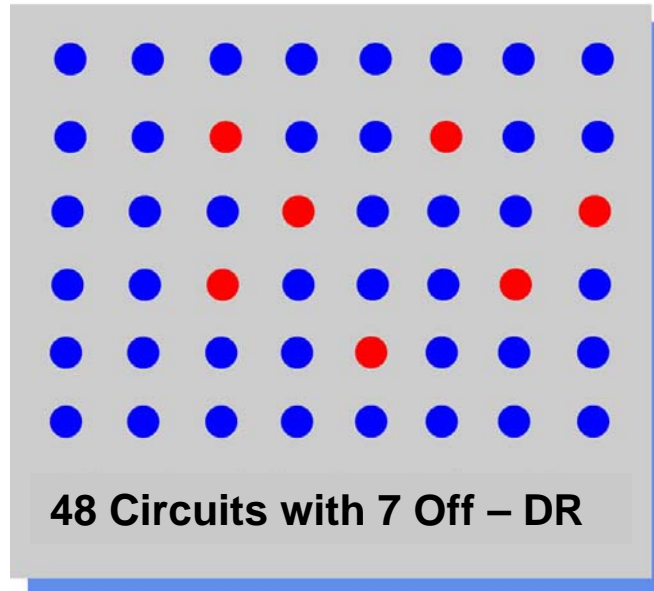
- Demand Response: 0
- Maintained Light Level: 75 FC
- KW Curtailed: 0
- Maintained Uniformity: NA
- Implementation Cost: \$0.00
- B/C Ratios: NA



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Big Box - B *(no daylight)*

Non Uniform Demand Response Control



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

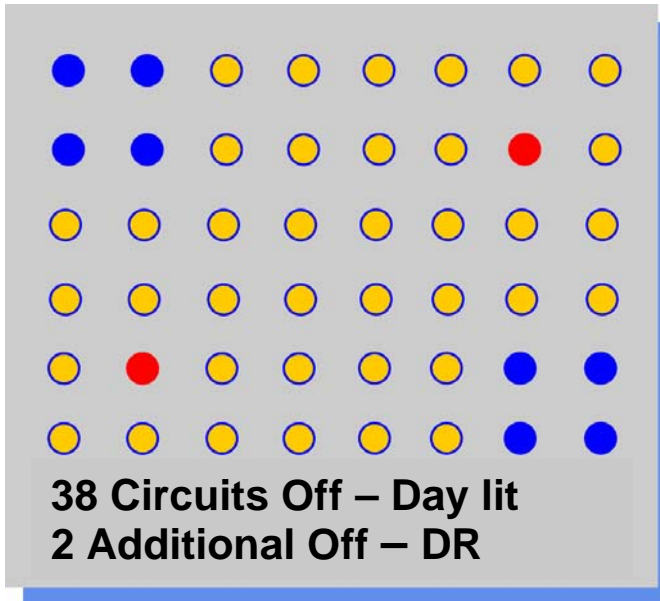
- Demand Response: 15%
- Maintained Light Level: 64 FC
- KW Curtailed: 25.5
- Maintained Uniformity: Potential Poor
- Implementation Cost: \$5,000.00
- Economic B/C Ratio: **1.28**
- Combined B/C Ratio: **3.14**



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Big Box – A *(Day lit)*

Non Uniform Demand Response Control



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

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

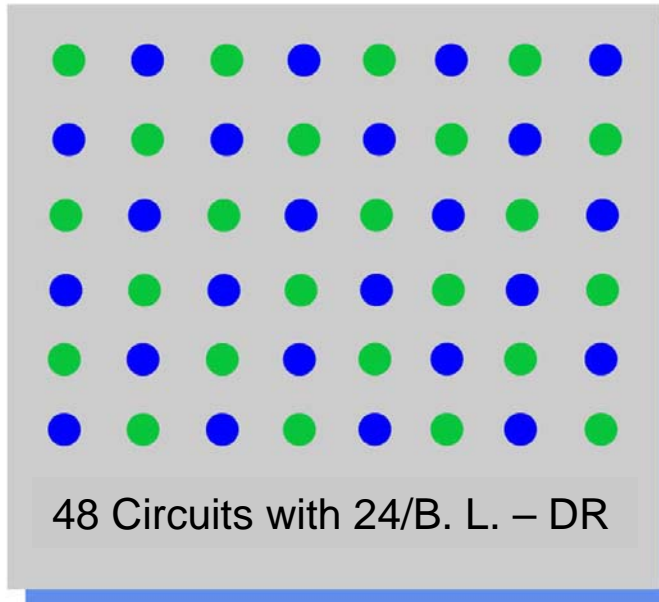
- Demand Response: 3%
- Maintained Light Level: 64 FC
- KW Curtailed: 5.1
- Maintained Uniformity: Potential Poor
- Implementation Cost: \$5,000.00
- Economic B/C Ratio: **0.26**
- Combined B/C Ratio: **0.63**



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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

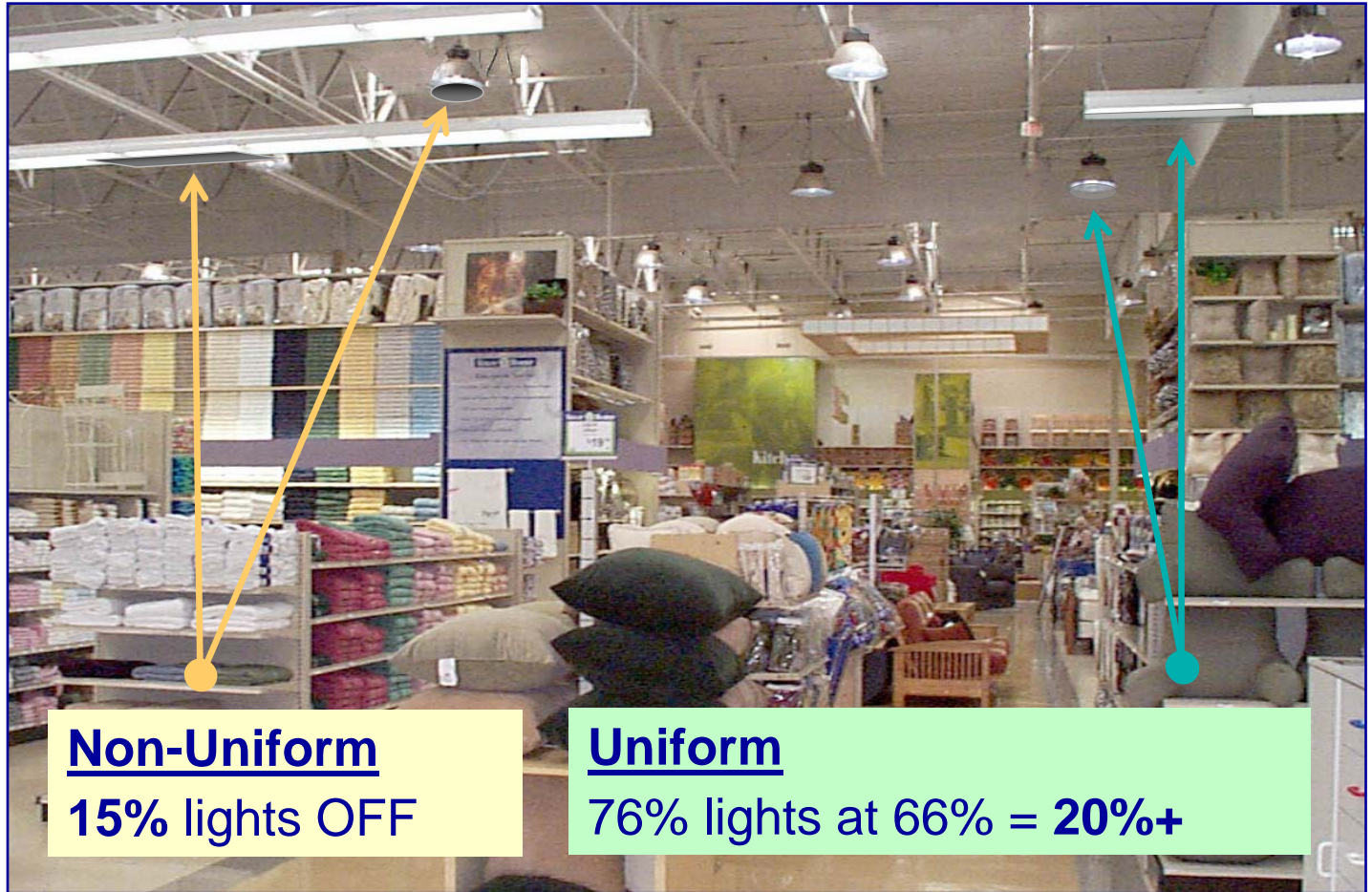
- Demand Response: 20%
- Maintained Light Level: 60 FC
- KW Curtailed: 34.0
- Maintained Uniformity: Very Good
- Implementation Cost: \$20,000.00
- Economic B/C Ratio: **0.43**
- Combined B/C Ratio: **1.05**



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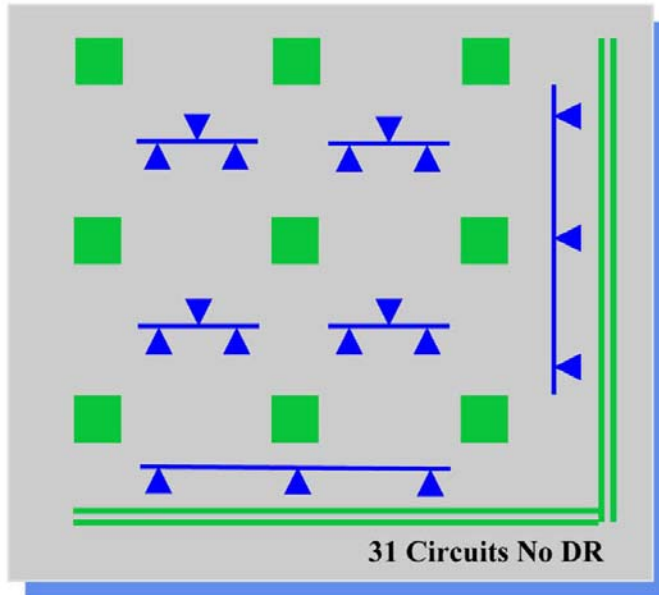
BIG BOX RETAIL-B

Control Potential: Non-Uniform & Uniform



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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

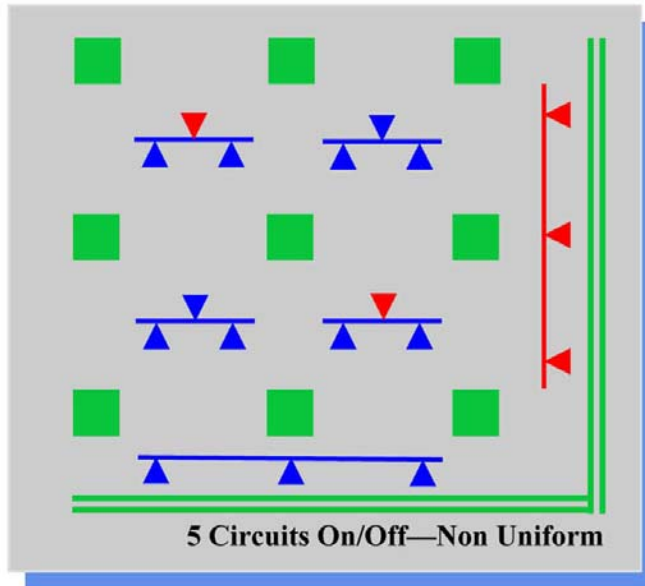
- Demand Response: 0
- Maintained Light Level: 80 FC
- KW Curtailed: 0
- Maintained Uniformity: NA
- Implementation Cost: \$0.00
- B/C Ratios: NA



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Medium Retail

Non Uniform Demand Response Control



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*)

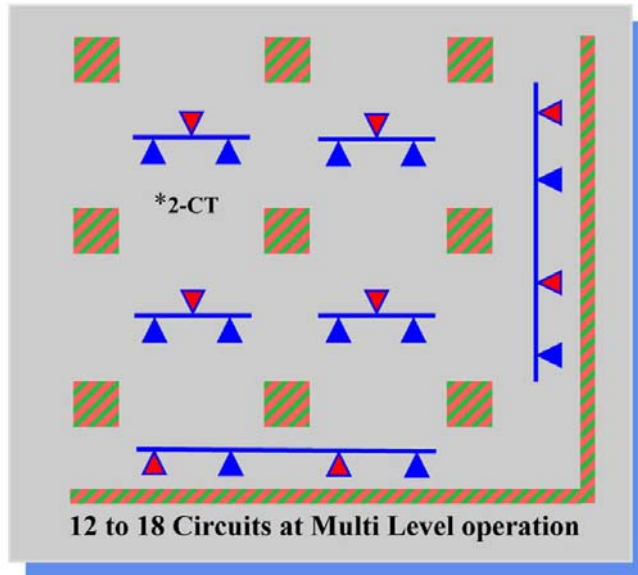
Demand Response Performance

- Demand Response: 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**



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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**



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MEDIUM RETAIL

Control Potential: Non-Uniform & Uniform



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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.



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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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