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TDV Lighting Controls

2008 Title 24 Codes and Standards Enhancements
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For:

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**Pacific Gas and
Electric Company.**

Codes & Standards Enhancement Project

Background

- 2005 Title 24 allows Power Adjustment Factors (PAF) for various lighting controls
 - Bi-level enabled occupancy sensors
 - Manual Dimming and Multi-scene Programmable
 - Daylighting Controls
- PAFs listed in table 146-A
- PAF taken as a fixed reduction in wattage for all hours of occupancy in space
 - No accounting for timing of energy savings
 - Important with Time Dependent Valuation (TDV)

CASE Scope and Workplan

- Account for the effect of TDV on lighting controls
 - TDV used to calculate prescriptive PAF's
 - Determine the need to change PAF's based on TDV effects
- Propose Hourly control credits for performance method
 - Based on best available monitoring data
 - Hourly credits to be implemented through reduction in hours of lighting system operation
 - Placeholders for controls without reliable data

Data Collection

- Data collected from literature review and researchers
 - Good data for occupancy sensors in small areas from published studies
 - Small Private Offices
 - Classrooms
 - Manufacturer data on Warehouses, Libraries
 - No data on hallway occupancy sensor, manual dimming, multi-scene programmable controls
 - Daylighting controls not included in this CASE
- TDV spreadsheet model created
 - Compare savings from controls to prescriptive PAF's

Analysis Terminology

Term	Abbrev.	Explanation
Raw hourly adjustment factor	$rHAF_{h,d}$	From the raw research data, savings as a proportion of baseline consumption for each hour and each day type (note, this value is the same whether TDV-weighted or not)
Raw daily adjustment factor	$rDAF_{TDV,d}$	From the raw research data, average savings as a proportion of baseline for each day type (Saturday, Sunday, weekday), weighted by the varying TDV value of each hour
Raw power adjustment factor (kWh)	$rPAF_{kWh}$	From the raw research data, average savings as a proportion of baseline for the whole week (note, this is not TDV-weighted)
Raw power adjustment factor (TDV-weighted kWh)	$rPAF_{TDVkWh}$	From the raw research data, average savings as a proportion of baseline for the whole week, weighted by the varying TDV value of each hour
Hourly adjustment factor	$HAF_{h,d}$	Final, smoothed and adjusted hourly adjustment factors for each hour and each day type, proposed for use in Title 24 2008
Power adjustment factor (kWh)	PAF_{kWh}	Power adjustment factor based on total energy consumption.
Power adjustment factor (TDV-weighted kWh)	PAF_{TDVkWh}	Power adjustment factor based on TDV-weighted energy consumption; can be compared with PAFs in table 146-A of Title 24 2005

PAF Comparison

		Raw Data from Research		PAFs from T24 2005
		kWh	TDV-weighted kWh	
Spaces <250 sq ft	rDAF _{Saturday}	no data	no data	0.20
	rDAF _{Sunday}	no data	no data	0.20
	rDAF _{weekday}	0.37	0.36	0.20
	PAF	0.27	0.27	0.20
Hallways of hotels/motels	rDAF _{Saturday}	insufficient data	insufficient data	0.25
	rDAF _{Sunday}	insufficient data	insufficient data	0.25
	rDAF _{weekday}	insufficient data	insufficient data	0.25
	PAF	insufficient data	insufficient data	0.25
Commercial and industrial storage rack areas	rDAF _{Saturday}	0.26	0.26	0.15
	rDAF _{Sunday}	0.27	0.27	0.15
	rDAF _{weekday}	0.29	0.29	0.15
	PAF	0.28	0.28	0.15
Library stacks	rDAF _{Saturday}	0.30	0.30	0.15
	rDAF _{Sunday}	0.24	0.24	0.15
	rDAF _{weekday}	0.33	0.31	0.15
	rPAF	0.31	0.30	0.15

Results Summary

- Current PAF values adequate and appropriate
 - Spaces with good data, PAF's are 60% of raw savings
 - Insufficient data on most controls to justify change in PAF
 - Less longevity/reliability than electric lighting
 - DEER database: occupancy sensor life 8 – 10 years
- Prescriptive Compliance: TDV weighted PAF's to have same value as current PAF's
- Performance Method: Hourly Adjustment Factors for lighting schedule
 - Annual savings from HAF's same as Prescriptive PAF

ACM Changes

- Add Controlled Lighting Schedules
 - Table N2-5: Nonresidential Occupancy Schedules (Other than Retail)
 - Controlled lighting schedule calculated as
 - Hourly uncontrolled lighting schedule x (1- HAF)
- Add 24-Hour lighting schedule for Hallways
 - Controlled lighting schedule for hallways based on this 24-hour schedule
- Method also applied to controls with no research data on savings
 - HAF's are constant for all hours of day

Multiple controls in single space

- DOE-2.1E (reference program) allows only two schedules per space
 - Lighting
 - Task-Lighting (cannot use daylighting command)
- More than two controls – divide up into two spaces with separate lighting schedules
 - Divide spaces relative to wattage on each control
 - Floor area, wall area, fenestration area
- In daylit areas, create wattage weighted schedules
 - Non-daylit areas – Task-Lighting
 - Daylit area - Lighting

Combined Occupancy and Daylighting Controls

- When occupancy based controls used in conjunction with photocontrols
 - Occupancy control results in change in schedule
 - Daylighting control modeled using DAYLIGHTING command in reference program (DOE-2.1E)
 - Savings a function of daylight availability
- Methods of modeling daylighting in PG&E Sidelighting and Skylighting CASE studies

Summary of Changes

- Has no effect on prescriptive method
 - PAF's are the same as in 2005
- Little change in the performance method
 - Savings balanced across peak and off-peak periods
- Sets the framework in place to credit controls that primarily reduce peak consumption
- Compatible with TDV
 - Lighting savings vary with respect to time of day

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