WORKPAPER DISPOSITION FOR
Lighting Occupancy Sensor Controls
California Public Utilities Commission, Energy Division
September 6, 2013 (revised)

Revision Notes, May 3, 2013: The embedded workbook containing savings values for all measures was revised to correct errors where incorrect annual hours of use were being used to calculate savings.

Revision Notes, May 31, 2013: The embedded workbook containing savings values for all measures was revised to correct the following errors:

1. Refrigerated Warehouse values were not available in previous versions. Those values are not included in the workbook.

2. The weighted commercial values (Com) were incorrect. The previous values were those that appeared in the DEER 2005 database for measure (D03-03 Occupancy Sensor Small Area <200 Square Feet). The Com value for this measure consisted of weighted results for Primary School, Hospital, Hotel, Motel, Nursing Home and Small Office only. The Com results in the revised embedded workbook include are weighted to consider results for all DEER building types. These include the non-simulated results as well as the results from the DEER simulations for D03-003 (small area sensors) and D03-004 (large area sensors). Refer to Table 3 for a listing of which building types are supported by DEER simulation results and which are supported by the alternative methods incorporated into the embedded workbook.

   NOTE: Savings values for individual building types have not changed from the previous versions of this disposition. Only the weighted results for the "Com" building type have changed. Electricity (kWh) savings values for the "Com" building type in the revised workbook are between 14% and 18% less, depending on IOU, compared to the previous workbook; demand savings are 20%-24% less, and; negative gas savings are reduced 9%-11%. Refer to Table A below for a comparison of original to revised savings for the "Com" weighted building type.

Table A - Comparison of Original to Revised Disposition

					Corrected Disposition			Original Disposition			Percent Reduction		
IOU	BldgType	BldgVint	BldgLoc	Control Wattage	Measure Savings (kWh)	Measure Demand Savings (kW)	Measure Gas Savings (Therms)	Measure Savings (kWh)	Measure Demand Savings (kW)	Measure Gas Savings (Therms)	Measure Savings (kWh)	Measure Demand Savings (kW)	Measure Gas Savings (Therms)
PGE	Com	Ex	IOU	1000	525	0.0918	-5.03	614	0.1200	-5.59	14%	24%	10%
SCE	Com	Ex	IOU	1000	539	0.0915	-3.62	630	0.1200	-3.99	14%	24%	9%
SDG	Com	Ex	IOU	1000	564	0.1052	-3.10	687	0.1320	-3.49	18%	20%	11%

Revision Notes, September 6, 2013: The embedded workbook containing savings values for all measures was revised in consideration of recent input from utilities.

Revision to direct impact demand savings:
The disposition calculates the direct impact demand savings for buildings not covered in DEER as:

$kW/kW_{controlled}$ = CDF * Reduction Factor * Weekday Open Fraction

where:

CDF is the DEER coincident demand factor

Reduction Factor is the DEER total hours of use reduction. For DEER building types not covered by the DEER measure, this reduction factor is based on Energy Division staff's best estimate of a reduction factor for a covered building type that would be equivalent to a non-covered building type.

Weekday Open Fraction is the DEER allocation of total usage reduction assigned to the weekday open period. The DEER methodology allocates the total usage reduction into for periods: *Weekday Open; Weekday Closed; Weekend Open; Weekend Closed.* Values for non-covered building types align with the same equivalent mappings of covered building types for determination of the *Reduction Factor* described above.

SCE staff recommended revising the demand savings calculation to not include the *Weekday Open Fraction.* Energy Division staff had a web meeting with utility staff and agreed to investigate further. Staff believes that removing the *Weekday Open Fraction* would like result in overestimation of savings for the non-covered DEER building types. Savings for the covered DEER building types were developed for the 2005 version of DEER through a modeling approach. This approach is fully described in the 2005 DEER documentation. The DEER approach assumes that, for all building types, not all areas of the building would benefit from the installation of occupancy sensors. For example, it is assumed for office buildings that no savings from occupancy sensors would occur in the lobby. In schools, no savings would occur in maintenance shops, kitchens or corridors.

In response to this concern, the ex ante review team developed a spreadsheet that calculates the overall building demand impact of occupancy sensors, for buildings not currently in DEER, that is similar to the approach used for DEER savings. The general approach is to weight together, across a single building type, the peak schedules and connected lighting loads, to determine a whole building peak direct impact peak reduction. The analysis shows that, for some building types, applying the "weekday open fraction" significantly underestimates peak demand impacts. However, there are some building types for which the new method results in lower demand impacts than were previously published in the disposition. The full development of the peak demand savings is included in the workbook "DEER2005+2008-EFLH+CDF+OccSensor_September2013-v2a.xlsx".

Ex Ante Savings Table Format
Utilities requested that the table of energy savings ex ante values included in the disposition be revised to match the format of ex ante values included with READI. The ex ante review team has updated the savings table to match the READI format. The revised table is included in the ex ante workbook,

"Occ_Sens_Savings_Revised_6September2013.xlsx", embedded at the end of this disposition.

Refer to Table 1 for a list of currently submitted IOU workpapers that cover lighting occupancy sensor controls.

Table 1 – Lighting Control Workpapers

Workpaper ID	Workpaper Title	Date
SDG&E		
WPSCNRLG0016	Occupancy Sensors: Wall or Ceiling Mounted	06/5/2012
SCE		
SCE13LG076	Integrated Linear Fluorescent Occupancy Sensor	05/24/2012
SCE13LG025	Occupancy Sensors, Wall or Ceiling Mounted	04/10/2012
SCE13LG107	Battery- and Self-Powered Wireless Occupancy Sensors – Ceiling or Wall Mounted	04/12/2012
SCE13LG020	Wall Mounted Occupancy Sensors – Multifamily and Hospitality	04/25/2012
PG&E		
PGECOLTG120	Wall or Ceiling Occupancy Sensors	08/28/2012
PGECOLTG134	Fixture Integrated Occupancy Sensors – Fixtures ≥ 150 W	08/28/2012
PGECOLTG135	Fixture Integrated Occupancy Sensors – Fixtures <150 W	08/28/2012
PGECOLTG130	Occupancy Sensors: Multifamily (Wall-box)	08/28/2012
PGE3PLTG187	Fixture Integrated Occupancy Sensors – Fixtures <150 W, Direct Install	08/30/2012
PGE3PLTG186	Fixture Integrated Occupancy Sensors – Fixtures ≥ 150 W, Direct Install	08/30/2012

Workpaper Disposition:

Disposition Summary

Energy Division staff recommends the following revisions:

1. Savings values for the DEER measures D03-003 or D03-004 shall be used when available. Values are not available for all building types. Savings values for other building types shall be the values specified in item 2, below.
2. The attached workbook contains the savings values for all building types not covered in READI by DEER measures D03-003 or D03-004.

Control Savings Estimation Summary

Where not listed in DEER, occupancy sensor savings shall be calculated according to staff direction provided to PG&E in review of the Modified Lighting Calculator[1] [2]. This review document has been embedded in this disposition at the end of the document. Table 3**Error! Reference source not found.** is taken from the Modified Lighting Calculator Disposition and lists the DEER space types that are covered in the DEER occupancy sensor measures along with their lighting use reduction factors. Table 3 also includes acceptable reduction factors for all other space types not covered by DEER.

Demand direct impact reductions have been determined by multiplying together the total usage reduction, the fraction of that reduction that occurs during the peak demand period and the DEER coincident demand factor for the DEER building type.

Occupancy sensor measures do have HVAC interactive effects, but DEER does not include interactive effects for occupancy sensor measures at this time. At this time, occupancy sensor measures shall use the DEER HVAC interactive effects for lighting power reductions.

NTG review

The NTG ratios of the workpapers of Table 1 present some inconsistencies. Energy Division staff wish to remind that the NTG ratios to be used by all IOUs are the ratios available in the READI database. They are presented in Table 2. In the case of a "Direct Install" measure ED recommends to use the "Com-Default>2yrs" ratio and not the "NonRes-sAll-mLtgCtrl-htr" which is for a hard to reach market.

Table 2 - NTG Ratios from READI

NTG ID	Measure Type	NTG	Measure delivery mechanism
NonRes-sAll-mLtgCtrl	Lighting controls	0.6	PreRebDown
NonRes-sAll-mLtgCtrl-htr	Lighting controls	0.89	DirInstall
NonRes-sAll-mOccSens	Occupancy Sensors	0.6	PreRebDown
Com-Default>2yrs	All other EEMs with no evaluated NTGR; existing EEM in programs with same delivery mechanism for more than 2 years	0.6	All
Res-Default>2	All other EEM with no evaluated NTGR; existing EEM with same delivery mechanism for more than 2 years	0.55	All

[1] MODIFIED_LIGHTING_CALCULATOR_V2 7.xlsx submitted by PG&E in September 2012
[2] PRELIMINARY REVIEW DISPOSITION FOR "Modified Lighting Calculator", CPUC, November 2012

Table 3 - Lighting Use Reduction Factors for Occupancy Sensor

DEER Building Type	Activity Area Type	DEER Occupancy Sensor?	Non-DEER Reference Building Type	Non-DEER Reference Activity Area Type	Reduction
Assembly	Auditorium	NO	Education - Secondary School	Classroom/Lecture	0.20
Assembly	Office	NO	Education - Community College	Office (General)	0.16
Assembly	All Other	NO	Education - Community College	Office (General)	0.16
Education - Primary School	Classroom/Lecture	YES			0.20
Education - Primary School	Dining Area	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education - Primary School	Exercising Centers and Gymnasium	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education - Primary School	Kitchen and Food Preparation	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education - Primary School	All Other	NO	Education - Community College	Office (General)	0.16
Education - Secondary School	Classroom/Lecture	YES			0.20
Education - Secondary School	Computer Room (Instructional/PC Lab)	YES			0.20
Education - Secondary School	Dining Area	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education - Secondary School	Exercising Centers and Gymnasium	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education - Secondary School	Kitchen and Food Preparation	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education - Secondary School	Office (General)	NO	Education - Community College	Office (General)	0.16
Education - Secondary School	All Other	NO	Education - Community College	Office (General)	0.16
Education - Community College	Classroom/Lecture	YES			0.20
Education - Community College	Computer Room (Instructional/PC Lab)	YES			0.20
Education - Community College	Dining Area	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education - Community College	Kitchen and Food Preparation	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education - Community College	Office (General)	YES			0.16
Education - Community College	All Other	NO	Education - Community College	Office (General)	0.16
Education – University	Classroom/Lecture	YES			0.20
Education – University	Comm/Ind Work (General Low Bay)	NO	Education - Community College	Office (General)	0.16
Education – University	Computer Room (Instructional/PC Lab)	YES			0.20
Education – University	Corridor (Dormitory)	NO	Health/Medical - Nursing Home	Corridor	0.16
Education – University	Dining Area	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education – University	Hotel/Motel Guest Room (Dormitory)	NO	Lodging – Hotel	Hotel/Motel Guest Room (incl. toilets)	0.10
Education – University	Kitchen and Food Preparation	NO	Health/Medical - Nursing Home	Dining Area	0.16
Education – University	Office (General)	YES			0.16
Education – University	All Other	NO	Education – University	Office (General)	0.16
Education - Relocatable Classroom	Classroom/Lecture	YES			0.20

DEER Building Type	Activity Area Type	DEER Occupancy Sensor?	Non-DEER Reference Building Type	Non-DEER Reference Activity Area Type	Reduction
Grocery	Comm/Ind Work (Loading Dock)	NO	Office – Large	Mechanical/Electrical Room	0.16
Grocery	Office (General)	NO	Office – Large	Office (Executive/Private)	0.30
Grocery	Refrigerated (Food Preparation)	NO	Office – Large	Mechanical/Electrical Room	0.16
Grocery	Refrigerated (Walk-in Cooler)	NO	Office – Large	Mechanical/Electrical Room	0.16
Grocery	Refrigerated (Walk-in Freezer)	NO	Office – Large	Mechanical/Electrical Room	0.16
Grocery	Retail Sales Grocery	NO	- none -	- none -	0.00
Grocery	All Other	NO	Office – Large	Mechanical/Electrical Room	0.16
Health/Medical – Hospital	Dining Area	NO	Health/Medical - Nursing Home	Dining Area	0.16
Health/Medical – Hospital	Kitchen and Food Preparation	NO	Health/Medical – Hospital	Office (General)	0.16
Health/Medical – Hospital	Laboratory Medical	NO	Health/Medical – Hospital	Office (General)	0.16
Health/Medical – Hospital	Medical and Clinical Care (12 Hr)	NO	Health/Medical – Hospital	Office (General)	0.16
Health/Medical – Hospital	Medical and Clinical Care (24 Hr)	NO	Health/Medical – Hospital	Office (General)	0.16
Health/Medical – Hospital	Patient Rooms	NO	- none -	- none -	0.00
Health/Medical – Hospital	Office (General)	YES			0.16
Health/Medical – Hospital	All Other	NO	Health/Medical – Hospital	Office (General)	0.16
Health/Medical - Nursing Home	Corridor	YES			0.16
Health/Medical - Nursing Home	Dining Area	YES			0.16
Health/Medical - Nursing Home	Patient Room	NO	- none -	- none -	0.00
Health/Medical - Nursing Home	Kitchen and Food Preparation	NO	Health/Medical - Nursing Home	Dining Area	0.16
Health/Medical - Nursing Home	Office (General)	YES			0.16
Health/Medical - Nursing Home	All Other	NO	Health/Medical - Nursing Home	Office (General)	0.16
Lodging – Hotel	Bar Cocktail Lounge	NO	Lodging – Hotel	Office (General)	0.16
Lodging – Hotel	Corridor	YES			0.16
Lodging – Hotel	Dining Area	NO	Lodging – Hotel	Office (General)	0.16
Lodging – Hotel	Hotel/Motel Guest Room (incl. toilets)	YES			0.10
Lodging – Hotel	Kitchen and Food Preparation	NO	Lodging – Hotel	Office (General)	0.16
Lodging – Hotel	Laundry	NO	Lodging – Hotel	Office (General)	0.16
Lodging – Hotel	Lobby (Hotel)	NO	Lodging – Hotel	Office (General)	0.16
Lodging – Hotel	Office (General)	YES			0.16
Lodging – Hotel	All Other	NO	Lodging – Hotel	Office (General)	0.16
Lodging – Motel	Corridor	YES			0.16
Lodging – Motel	Hotel/Motel Guest Room (incl. toilets)	YES			0.10
Lodging – Motel	Laundry	NO	Lodging – Motel	Office (General)	0.16
Lodging – Motel	Office (General)	YES			0.16
Lodging – Motel	All Other	NO	Lodging – Motel	Office (General)	0.16

DEER Building Type	Activity Area Type	DEER Occupancy Sensor?	Non-DEER Reference Building Type	Non-DEER Reference Activity Area Type	Reduction
Manufacturing - Bio/Tech	Comm/Ind Work (High Tech Bio Tech Lab)	NO	Office – Large	Office (Open Plan)	0.15
Manufacturing - Bio/Tech	Computer Room (Mainframe/Server)	NO	Office – Large	Office (Open Plan)	0.15
Manufacturing - Bio/Tech	Conference Room	NO	Office – Large	Conference Room	0.16
Manufacturing - Bio/Tech	Corridor	NO	Office – Large	Corridor	0.10
Manufacturing - Bio/Tech	Dining Area	NO	Office – Large	Office (Open Plan)	0.15
Manufacturing - Bio/Tech	Kitchen and Food Preparation	NO	Office – Large	Office (Open Plan)	0.15
Manufacturing - Bio/Tech	Office (General)	NO	Office – Large	Office (Open Plan)	0.15
Manufacturing - Bio/Tech	All Other	NO	Office – Large	Office (Open Plan)	0.15
Manufacturing - Light Industrial	Comm/Ind Work (General High Bay)	NO	Office – Large	Office (Open Plan)	0.15
Manufacturing - Light Industrial	Storage (Unconditioned)	NO	Office – Small	Mechanical/Electrical Room	0.16
Manufacturing - Light Industrial	All Other	NO	Office – Large	Office (Open Plan)	0.15
Office – Large	Conference Room	YES			0.16
Office – Large	Copy Room (photocopying equipment)	YES			0.10
Office – Large	Corridor	YES			0.10
Office – Large	Lobby(Office Reception/Waiting)	NO	Office – Large	Corridor	0.10
Office – Large	Mechanical/Electrical Room	YES			0.16
Office – Large	Office (Executive/Private)	YES			0.30
Office – Large	Office (Open Plan)	YES			0.15
Office – Large	Restrooms	YES			0.26
Office – Large	All Other	NO	Office – Large	Office (Open Plan)	0.15
Office – Small	Conference Room	YES			0.16
Office – Small	Copy Room (photocopying equipment)	YES			0.10
Office – Small	Corridor	YES			0.10
Office – Small	Lobby (Office Reception/Waiting)	NO	Office – Small	Corridor	0.10
Office – Small	Mechanical/Electrical Room	YES			0.16
Office – Small	Office (Executive/Private)	YES			0.30
Office – Small	Restrooms	YES			0.10
Office – Small	All Other	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Sit-Down	Dining Area	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Sit-Down	Kitchen and Food Preparation	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Sit-Down	Lobby (Main Entry and Assembly)	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Sit-Down	Restrooms	NO	Office – Large	Restrooms	0.26

DEER Building Type	Activity Area Type	DEER Occupancy Sensor?	Non-DEER Reference Building Type	Non-DEER Reference Activity Area Type	Reduction
Restaurant - Sit-Down	All Other	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Fast-Food	Dining Area	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Fast-Food	Kitchen and Food Preparation	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Fast-Food	Lobby (Main Entry and Assembly)	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Fast-Food	Restrooms	NO	Office – Large	Office (Open Plan)	0.15
Restaurant - Fast-Food	All Other	NO	Office – Large	Restrooms	0.26
Retail - 3-Story Large	Office (General)	NO	Office – Large	Office (Open Plan)	0.15
Retail - 3-Story Large	Retail Sales and Wholesale Showroom	NO	- none -	- none -	0.00
Retail - 3-Story Large	Storage (Conditioned)	NO	Office – Large	Mechanical/Electrical Room	0.16
Retail - 3-Story Large	All Other	NO	Office – Large	Office (Open Plan)	0.15
Retail - Single-Story Large	Auto Repair Workshop	NO	- none -	- none -	0.00
Retail - Single-Story Large	Kitchen and Food Preparation	NO	Office – Large	Office (Open Plan)	0.15
Retail - Single-Story Large	Office (General)	NO	Office – Large	Office (Open Plan)	0.15
Retail - Single-Story Large	Retail Sales and Wholesale Showroom	NO	- none -	- none -	0.00
Retail - Single-Story Large	Storage (Conditioned)	NO	Office – Large	Office (Open Plan)	0.15
Retail - Single-Story Large	All Other	NO	Office – Large	Office (Open Plan)	0.15
Retail – Small	Retail Sales and Wholesale Showroom	NO	- none -	- none -	0.00
Retail – Small	Storage (Conditioned)	NO	Office – Large	Office (Open Plan)	0.15
Retail – Small	All Other	NO	Office – Large	Office (Open Plan)	0.15
Storage – Conditioned	Storage (Conditioned)	NO	Office – Large	Mechanical/Electrical Room	0.16
Storage – Unconditioned	Storage (Unconditioned)	NO	Office – Large	Mechanical/Electrical Room	0.16
Storage - Refrigerated Warehouse	Comm/Ind Work (Loading Dock)	NO	Office – Large	Office (Open Plan)	0.15
Storage - Refrigerated Warehouse	Office (Executive/Private)	NO	Office – Large	Office (Open Plan)	0.15
Storage - Refrigerated Warehouse	Refrigerated (Cooled Storage)	NO	Office – Large	Office (Open Plan)	0.15
Storage - Refrigerated Warehouse	Refrigerated (Food Preparation)	NO	Office – Large	Office (Open Plan)	0.15
Storage - Refrigerated Warehouse	All Other	NO	Office – Large	Office (Open Plan)	0.15
All Non-DEER	All Non-DEER	NO	- none -	- none -	0.15

Reference(s):

1 - Control Savings Calculator (Revised September 6, 2013)

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2 – Occupancy Savings Demand Impact Calculations

DEER2005+2008-EFL
H+CDF+OccSensor_Se

3 - Modified Lighting Calculator Preliminary Disposition

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