Measure Information Template –

Load Shedding Ballasts

2008 California Building Energy Efficiency Standards

PIER Program - EnergySoft, LLC January 05, 2006

CONTENTS

Overview

Complete the following table, providing a brief sentence or two for each category of information.

Description	The load-shedding ballast enables lighting to be a cost-effective tool for electrical demand response. Building on the highly successful instant-start ballast platform, the load-shedding ballast is designed to keep costs low while maintaining the highest available energy efficiency among competing ballast types. The load-shedding ballast combines technology for dimming instant-start operated fluorescent lamps with a means of remote signaling that allows all such ballasts in an area to reduce power by 33% upon command. The ballast is signaled via a power line carrier so no additional wiring is required. The load shedding ballast must have a ballast efficacy factor (BEF) of equal to or greater than 1.48.
Type of Change	This change is proposed to be an addendum to Table 146-A, the Prescriptive Lighting Power Adjustment Factor table. It is proposed to add an additional entry in this table providing credit for use of this technology.
Energy Benefits	Lighting is a major electric load (20% of peak electric loads in commercial buildings) that can be dimmed without affecting worker productivity. The widespread use of the load-shedding ballast in the new building construction, remodeling, and replacement market can produce reductions in peak electric demands in California of 100 megawatts.
Non-Energy Benefits	There are no non-energy benefits that can be attributed to this product, other than the potential for reduced utility costs as part of participation in a utilities demand response program.
Environmental Impact	This product is merely an enhancement to existing ballast technology so it does not present any environmental impacts.
Technology Measures	Measure Availability and Cost The estimated incremental cost of this technology is $9.00 per ballast. The Lighting Research Center has been able to partner with a large ballast manufacturer to commercialize the load-shedding ballast, although there are no certain plans for commercialization of the product. Useful Life, Persistence and Maintenance This product will have a useful life equivalent to the ballast life. In addition, from lamp life experiments, power reductions of 33% for periods of time when load shedding is needed were shown to have virtually no effect on lamp life.
Performance Verification	Currently, the certificate of acceptance is used to verify correct installation and implementation of lighting controls. It is recommended that this same acceptance from be used for the load shedding ballasts.

Cost Effectiveness	Two economic analyses were conducted to determine the return on investment to the customer and the total resource cost test for California ratepayers. It was determined that a $9.00 incremental cost over that of a standard instant start ballast would give the customer a payback of approximately three years. Because, under the scenario that the ballast is being installed as part of new construction or remodeling or for other reasons such as energy efficiency, there is no added installation cost when installing a load-shedding ballast.
Analysis Tools	It is anticipated that the load shedding ballast be treated in a similar fashion to the load shedding dimming systems that are incorporated into Table 146-A.
Relationship to Other Measures	This measure does not impact other measures.

Methodology

The 2005 code includes a Power Adjustment Factor (PAF) credit in table 146-A for the use of dimming electronic ballasts combined with automatic load control. The load shedding ballast promoted in this report is a similar parallel to that technology. Although it does not dim the fixtures, it does achieve the load shedding intent of the technology. Clearly the current credit achieves energy savings not only from the load shedding, but also from dimming that will occur with occupant control at non-peak hours of the day. It would make sense to add an entry into table 146-A which would apply a credit for this technology.

Dimmers alone in this table achieve a 10% PAF, and the load shedding with dimmers achieves a 25% PAF, so it would make sense that the load shedding alone should achieve a 15% PAF as a separate line item in this table.

Note that the load shedding ballast will consume less than 0.5 watts of additional energy on the ballast, and that this will be accounted for in the final LPD calculations. However, it may be prudent to include language that will limit the additional energy usage of the product to prevent using more energy at the sake of reducing demand.

Also note that in the 2008 Standards both the dimming electronic ballast and the load shedding ballasts must have a BEF of 1.48 or greater.

Analysis and Results

This analysis examines the customer cost savings if the load-shedding ballast technology were applied compared to the incremental cost of the ballast or retrofit device installed as part of a new construction/renovation project or retrofitted into existing buildings. The savings are expressed on per light fixture/ballast basis. Firm, interruptible and load management rates of Southern California Edison (SCE), Pacific Gas and Electric (PG&E), San Diego Gas and Electric (SDG&E), Sacramento Municipal Utility District (SMUD) and Los Angeles Department of Water and Power (LADWP) were used to determine customer cost savings.

The customer cost for the retrofit device is estimated to be $9 and the load-shedding ballast has an incremental cost of $9 over an instant start ballast. These prices include the sharing of the cost for the signaling device. The installation cost of the retrofit device or the load-shedding ballast into an existing light fixture is estimated to be $10 per fixture. There is no incremental installation cost for new light fixture with the load-shedding ballast installed and used in new construction or as part a building's renovation.

Action	Rate	Annual Savings per Device
SCE		
Monthly Peak Demand Reduction	TOU-8	$3.48
Interruptible Rate	I-6-BIP	$2.52
Critical Peak Pricing Rate	TOU-8-CPP	pricing not available
PG&E		
Monthly Peak Demand Reduction	E-20S	$3.06
Interruptible Rate	E-BIP	$2.52
Demand Bidding	E-DBP	$1.05
Load Reduction	E-SLRP	$0.30
Critical Peak Pricing Rate	E-CPP	$3.96
SDG&E		
Monthly Peak Demand Reduction	AL-TOU	$3.08
Interruptible Rate	BIP	$2.52
Demand Bidding	DBP	$1.05
Load Reduction	SLRP	$0.30
Critical Peak Pricing Rate		pricing not available
SMUD		
Monthly Peak Demand Reduction	GS-TOU1	$1.51
Load Reduction	PowerNet	$0.75

Recommendations

The change to Table 146-A is included below.

TYPE OF CONTROL	TYPE OF SPACE	FACTOR
Automatic load control of load shedding ballasts With a BEF of 1,48 or greater.	All Space	0.15

Material for Compliance Manuals

Changes to the Nonresidential Manual are included below:

Other Control Credits

Table 146-A of the Standards also provides control credits for the following technologies and spaces:

- Occupant sensor controlled multi-level switches or dimming systems that reduce the lighting power at least 50% in hallways of hotel/motels, commercial and industrial storage stack areas (maximum two aisles per sensor), and library stacks (maximum two aisles per sensor). This can be accomplished by placing half of the lighting in these areas on an occupancy sensor and the remainder on a manual switch. Only the fraction of the lighting that is on the occupancy sensor qualifies for the credit (§146(a)4 "controlled watts of any luminaire…").
- Dimming systems including manual and multi-scene programmable systems in hotels/motels, restaurants, auditoriums, and theaters.
- Manual dimming with automatic load control of dimmable electronic ballasts, with a BEF of 1.48 or greater, in all building types. This control system allows load shedding (dimming lights) initiated by the utilities or other grid system operators in the event of an electricity shortage. To qualify for this credit the dimming system in the building must have a control system that is ready to respond to a load curtailment or real time pricing signal. Such a system is enabled to dim all lights receiving the control credit below a fixed setting or to a fraction of their setting at the time the signal is received.
- Automatic load control of load-shedding ballasts, with a BEF of 1.48 or greater, in all building types. This control system allows load shedding (dimming lights) initiated by the utilities or other grid system operators in the event of an electricity shortage. To qualify for this credit the building must have a control system that is ready to respond to a load curtailment or real time pricing signal. Such a system is enabled to dim all lights receiving the control credit. In addition, each light that qualifies for this credit must be equipped with a load shedding ballast that will respond to the signal to dim the lights, and provide a minimum 30% reduction in lighting input power upon receiving the signal.

Table 0-1 – Standards Table 146-A Lighting Power Adjustment Factors

TYPE OF CONTROL	TYPE OF SPACE	FACTOR
Occupant sensor with "manual ON" or bi-level automatic ON combined with multi-level circuitry and switching	Any space ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, corridor, conference or waiting room	0.20
Occupant sensor controlled multi-level switching or dimming system that reduces lighting power at least 50% when no persons are present	Hallways of hotels/motels	0.25
	Commercial and Industrial Storage stack areas (max. 2 aisles per sensor)	0.15
	Library Stacks (maximum 2 aisles per sensor)	0.15
Dimming system		
Manual	Hotels/motels, restaurants, auditoriums, theaters	0.10
Multiscene programmable	Hotels/motels, restaurants, auditoriums, theaters	0.20
Manual dimming with automatic load control of dimmable electronic ballasts with a BEF of 1.48 or greater.	All building types	0.25
A automatic load control of load-shedding ballasts with a BEF of 1.48 or greater..	All building types	0.15
Combined controls		
Occupant sensor With "manual ON" or bi-level automatic ON combined with multi-level circuitry and switching in conjunction with daylighting controls	Any space ≤ 250 square feet within a daylit area and enclosed by floor-to-ceiling partitions, any size classroom, corridor, conference or waiting room.	0.10 (may be added to daylighting control credit)
Manual Dimming with Dimmable Electronic Ballasts and Occupant sensor with "manual ON" or automatic ON to less than 50% power and switching	Any space ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, corridor, conference or waiting room	0.25

Automatic Daylighting Controls with Windows (Stepped Switching or Stepped Dimming/Continuous Dimmed) (Numbers on the left side of a slash apply to Stepped Switching or Stepped Dimming. Numbers on the right side of a slash apply to Continuous Dimming)			
	WINDOWS – Window Wall Ratio		
Glazing Type	< 20%	20% to 40%	> 40%
VLT ≥ 60%q	0.20/0.30	0.30/0.40	0.40/0.40
VLT ≥ 35 and < 60%	0/0	0.20/0.30	0.30/0.40
VLT < 35%	0/0	0/0	0.20/0.40

Automatic Multi-Level Daylighting Controls with Skylights	
Glazing Type - Skylights	Factor
Glazing material or diffuser with ASTM D1003 haze measurement greater than 90%	$10 \times \text{Effective Aperture} - \frac{\text{Lighting Power Density}}{10} + 0.2$ WHERE Effective Aperture is as calculated in the Equation 146-A. Lighting Power Density is the lighting power density of general lighting

Bibliography and Other Research

Information for this measure template has been taken from the PIER research project number 500-01-041-A6 report. This PIER report is available from the California Energy Commission's PIER group as an Adobe Acrobat file, and includes the detailed background and research related to this measure template proposal.

The hyperlink for this project is as follows:

http://www.archenergy.com/lrp/demandresp_lighting/project_3_2_reports.htm