



## PIER Lighting Research Program



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# Roundtable Load-Shedding Proceedings Report

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## **Roundtable Load-Shedding Proceedings Report**

### **Background**

The goal of task 3.2.1 is to obtain input from lighting manufacturers and lighting decision makers for the design and functionality of the load-shed ballast and associated control system. Lighting decision makers are defined as end users, utility representatives, regulatory officials, energy-efficiency program implementers and other lighting decision makers in California. Input from these groups was to be gathered through the use of roundtables. This detailed report listing the results of the roundtables and recommending load-shed ballast design necessities completes the task.

To achieve the stated goal, the Lighting Research Center (LRC) conducted two roundtables. The first roundtable involved a focus group of end users. Participants were non-residential building owners, managers and/or tenants of large buildings (100,000+ square feet). Fourteen customers were invited to the focus group and confirmed their participation. However, only four customers actually attended the meeting. The second roundtable included utility representatives, lighting consultants, manufacturers, lighting researchers and representatives of state agencies. Lists of the invitees and participants for each focus group are included at the end of this report.

Roundtables and focus groups provide qualitative market research. While valuable information was collected using this method, no statistically accurate measurement of the general population's feelings regarding the load-shed ballast can be made using qualitative research. However, the LRC believes the insight provided by end users and the lighting community in California provided substantial input as to the characteristics the load-shed ballast must include to be successful in the marketplace.

### **Report of Findings from Non-Residential Customer Focus Group**

As stated above, four of the fourteen invited and confirmed building owners, managers and/or tenants attended the focus group on March 5, 2003. These customers are responsible for the payment of the electric utility bills. They are non-residential customers with substantial buildings or complexes (greater than 100,000 square feet). While a small sample was present for the focus group, the LRC believes the group provided valuable insight into the characteristics the load-shed ballast must have to succeed. The LRC is comfortable that the issues raised by this focus group would have been similar to those raised by a larger sampling. However, less certainty is placed on the ranking of the importance of the issues provided by the participants. Four participants is insufficient to place confidence in the issue rankings. The LRC would suggest additional focus groups throughout California be conducted to improve the certainty of the results if the project budget will allow for such activities.

The focus group explored four issues.

1. Electric load management during times of high electric usage.
2. The use of lighting systems to reduce electric loads
3. The load-shed ballast
4. Communication issues

### ***General Load Management Issues***

Participants defined load management as controlling the amount of energy used to help the facility or the energy provider at peak times as defined by the utility or energy provider. Only one of the four participants is participating in a utility-sponsored load management program. In designing a load management program, customers indicated they wanted the program to have the following elements.

- Tangible customer benefits such as monetary payments. (What's in it for the customer approach.)
- Products to help control loads.
- A simplistic (easy to understand and use) load management program.
- A utility company to pay for part of the first cost to install any needed control systems.
- A financing program for any equipment that a customer installed to control loads.
- A short implementation period for participating in the program rather than a long period of time (six months) to have the utility or others install equipment and get all the paperwork completed.

Of these, customers ranked monetary compensation for participation as their number one reason to participate. This was followed by a financing program and the utility paying for part of the first cost.

When customers were asked what would cause them not to participate in a load management program, they listed the following:

- The cost to implement the program.
- No financial incentive for participation.
- Long payback.
- Difficulty in participation.
- Lack of support commitment from the program operator.
- Budget issues for the customer.
- Called upon too often to curtail load. (aided response)
- Penalty for not shedding load. (aided response)

Note: An "aided response" is one that the facilitator recommends to the group and the group agrees it is a concern and should be included with the other issues.

Clearly, not providing a monetary incentive would cause customers not to participate. The participants also felt the cost to implement the program must be in line with the benefits.

### *Use of Lighting to Reduce Electric Loads*

Three of the four participants believed using the lighting system to reduce electric loads during times of peak usage is a good way to reduce loads. When asked why it was a good load to control, they indicated the following.

- There is so much lighting in use.
- Simple to control.
- Little or no impact on building occupants or operations if done correctly.
- Takes less time to reduce lighting loads than other types of loads.
- Payback is quicker.

Customers were also asked why they would not use their lighting to reduce electric loads. Listed below are their responses.

- It is a small part of the electric load.
- Lighting is used less during times of longer daylight.
- Safety issues of people not being able to see what they are doing.
- Security issues.
- Changes in lighting change the appearance of the space.
- Lighting can only be reduced so much before it effects the productivity of building occupants.
- Expense of replacement lamps.

The LRC explored with customers how they do/would control lights to reduce electric loads. Customers indicated the following.

- Motion sensors.
- Timers.
- Manual switching.
- Control through a building's energy management system. (Note: Of the two customers who have EMS, neither customer's lighting systems are included in the building's EMS system.)

Customers were asked to list the characteristics of an ideal lighting control system to reduce electric loads. The following are their responses and a ranking of their importance.

- EMS to control the lighting from one location rather than having individuals physically go around the building to shut off lights
- A system that is easy to use on a computer.
- Remote access to the system for operation and maintenance.
- The system must be easy to use.
- The system must be able to grow as the customer grows.
- There must be support/assistance from the manufacturer to the customer.
- Maintenance free system. (aided response)
- Cost effective system. (aided response)
- System must be able to be installed by in-house people: no specialist needed. (aided response)
- Reliable. (aided response)

- If the system failed, it must fail in the on position. (aided response)

The most important issues regarding a lighting control system according to the focus group participants are the ability to have the lighting controlled by the building's EMS from a single location and the system must be user friendly.

### ***Attributes/Characteristics of the Load-Shed Ballast***

An explanation of the concept of the load-shed ballast was given to the focus group participants. They were then asked a series of questions regarding the characteristics of the ballast.

Participants were asked what attributes the load shed ballast had to have to be used by customers. The following are their comments.

- The ballast must be low maintenance.
- Longevity of the ballast is a concern.
- The ballast must be cost effective.
- The operation of the ballast must not flicker lights when dimming.
- If the ballast fails, the lights must fail in the on position. (100 percent output)
- The ballast must be easy to install.
- A UL listing must be included for the ballast.
- The ballast must be easy to purchase. (availability)
- The ballast must use a wireless signal.
- Other building signaling devices cannot interfere with the signal to the ballast.
- The ballast cannot reduce lamp life.
- The ballast must be compatible with other lighting equipment provided by other manufacturers.
- The ballast must fit into a standard light fixture.

Of these attributes, cost effectiveness is the most important to the focus group participants. Ease of installation is also important.

Participants were asked how aggressive the dimming could be as a percent of dimming. One participant believed light output could be dimmed 25 percent, two believed it could be dimmed 30 percent and one believed it could be dimmed 40 percent. All wanted a demonstration of the load-shed ballast in their own facility before they would commit to a full scale installation.

The LRC asked participants how they wished to control the load-shed ballast and how automated the process could be. Participants indicated:

- The preferred method of controlling the ballast was through an EMS with just one data entry required.
- Utilities could control the ballast from a remote location if the customer had the ability to override the dimming.
- A manual system with the ability to push just one button to achieve the dimming is also acceptable.

- The ability to have different parts of the building on different control zones is also desirable.

Participants would prefer to control the load-shed ballast directly but are willing to give up control to utilities if they retain the right to override.

Participants were asked where they would prefer purchasing the load-shed ballast and its control system.

- Authorized distributors.
- From a manufacturer.
- Utility.

In all cases, participants wanted the load-shed ballast to be manufactured by a recognizable brand name. They wanted the ballast and control system to be able to be installed by in house personnel or electrical contractors as opposed to specially trained (high priced) technicians.

### ***Communication Issues***

Participants were asked what information they would require to purchase and use the load-shed ballast system. The following are their responses.

- How it effects the bottom line.
- Specifics on how the system works.
- What are the dimming standards.
- How much of a rebate is available.
- What are the penalties for not shedding load.
- Warranty information.
- Case studies of other installations.
- References.
- Who will control the load.
- Who supports the technology.
- Length of required customer and utility commitment to the program.
- Clear utility communications when load shed events occur.
- Operating instructions. (aided response)

The most desired information is how the payment for shedding load will offset any costs to participate. Also specific information is required on how the system works.

Participants were also asked where or from whom they would expect to obtain this information.

- The utility.
- A distributor.
- The manufacturer.
- Other customers.
- Advertising.
- Seminars.
- The government.
- Trade shows.

- Trade associations.
- A web site. (aided response)
- Trade journals. (aided response)

Of these sources, participants preferred to have the information presented to them by their utility company or their trade associations.

### **Report of Findings from Utility Personnel, Energy-Efficiency Program Administrators, Lighting Consultants, LBNL and Others**

A second roundtable was conducted on March 6, 2003 with utility representatives, lighting consultants, lighting and control equipment manufacturers, lighting researchers, members of the PIER Lighting Research Program and representative from state agencies. A list of attendees is included at the end of this report.

The goals for the roundtable were to explore existing load management programs, discuss compatible lighting technologies being developed by others, talk about the use of lighting systems to reduce electric peak loads and, finally, discuss and demonstrate the load-shed ballast with this non end-user contingent.

Utility representatives from Southern California Edison (SCE), Sacramento Municipal Utility District (SMUD) and Pacific Gas and Electric (PG&E) were present. Each utility has a load management program for its customers. These programs are dissimilar and reflect the needs of each utility. SCE has programs for both residential and business customers with approximately 98,000 customers participating. The number of participants has been declining each year. Of the participants, only about 40 percent actually reduce load when called upon. PG&E concentrates its load management program efforts with business customers. SMUD operates a couple of load management programs with its customers. Descriptions of two SMUD programs (PowerNet and PowerDirect) are provided separately from this report.

The utility representatives were asked what would it take to include the load shed ballast in their load management programs.

- The decision to include the load shed ballast and its companion retrofit device is largely financially driven.
- The system must provide reliable and predictable load reductions to the utilities.
- Utility representatives present a portfolio of energy management tools and programs to their customers. This load-shedding technology would be just one of several offerings in their portfolio. The customer may be better served to re-lamp an entire facility and lower overall light levels rather than install the load-shed device and see energy savings only during peak periods.

Comments from other roundtable participants concerning utility-based load management programs included the following.

- Utilities still have generation capabilities that were not sold to third parties.
- It appears California governmental bodies and utilities are returning to a more vertically integrated (regulated business) model for planning purposes.

- The utility rate schedules should reflect/encourage load shedding capabilities.
- Utilities have the relationship with end-use customers.
- The required hours of load management are different throughout California and may be as high as 676 hours in some places to account for summer peak periods and meet tariff requirements.
- PG&E claims the peak load to average load gap is getting smaller. This may cause load shedding to be less acceptable.
- Two-way signaling is important to utilities so they may ensure the load has been shed.
- Lighting control manufacturers will not start a product line based on utility incentives.
- Load shedding is not a strategy in itself. It needs to be part of a larger program of energy management strategies.
- The Commission may want to look at a future research program that involves installing a switch on the “B” lighting circuit of a building. The switch would provide load-shedding during peak energy periods. It could be part of a Title 24 code requirement.
- A Critical Peak Pricing (CPP) rate is proposed for the three IOUs and could become effective in 2003. Information about the rate is available at <http://www.energy.ca.gov/demandresponse/index.html>.

The LRC discussed and demonstrated the load shed ballast technology. Since the current prototype is based on an instant start ballast platform, the number of hours per year that dimming could be achieved without noticeable lamp life loss is currently estimated to be 100 hours. A comment was made that an outcome of the research could be to approach lamp manufacturers to change lamp designs to maximize life when dimming. i.e. change the standard lamp current from 265 milliamps (the standard when using a magnetic ballast) to 180 milliamps (a more reasonable value with electronic ballasts). Other technical suggestions from the participants included keeping options open for two-way signaling and the use of existing utility notification systems to customers (phone call, web based, RF to residential customers and paging). Discussions also indicated that efforts should possibly be concentrated on the retrofit device rather than the ballast. The rationale for this suggestion is the large stock of existing buildings.

The group also discussed various cost issues and benefits to end-use customers. It appears the price of the load-shed ballast will be \$9 above the cost of an instant start ballast. The companion add-on load shed device will be approximately \$9. A \$10 installation fee for any retrofit situation must be added to the material costs. The LRC estimates the value to the customer to reduce load using the load-shed ballast is approximately \$3 per year based on a three lamp T8, electronic ballast light fixture. This savings is based on an average of utility rate structures across the country and is not specific to California. It was suggested that an economic model be developed for California utilities that could be used for marketing purposes as well as the development of the ballast. The ideal payback for business customers is between one and three years while governmental customers are willing to accept much longer paybacks.

Marketing should focus on owner-occupied buildings because decision making is centered in one organization. In tenant occupied buildings, building owners do not feel an obligation to install cost reducing devices because many times the tenant pays the electric bill and receives the benefits, not the building owner.

Roundtable participants were asked why customers participate in current load management programs.

- A clear price signal is given to customers to reduce load.
- Customers feel an obligation to be good corporate citizens and assist in maintaining the integrity of the electric system.

Customers do not participate in load management programs because rental space is considered “class A” space. Tenants pay a premium for this space.

Roundtable participants believe customers do not use their lighting systems exclusively to control loads because the control is not automated. Someone has to be sent to each lighting panel and manually turn off lights. When lights are reduced for load shedding purposes, customers use switches or breakers to manually turn the lights off. SMUD has a system that is web-based that can provide direct control of lighting systems.

All roundtable participants were asked to list the load-shed ballast characteristics they would require the ballast to have.

- Long ramp period for dimming to pre-set limit.
- Must not impede the productivity of the customer.
- Flexibility on how to control/send the signal from the utility.
- Must be compatible with future technologies.
- Must produce less than 20 percent total harmonic distortion.
- No interference with other customer equipment.
- A “good housekeeping” seal of approval beyond just UL listing (like Energy Star).
- Minimal impact on lamp life and no impact on manufacturer’s warranty.
- A device to limit number of hours per year in the dim mode.
- Clear economic payback to the customer.
- Lower lifecycle cost.

## **Conclusions and Recommendations Regarding the Load Shed Ballast Design**

### ***Conclusions***

- Utility sponsored load management programs must provide monetary payments to attract participating customers.
- Customer participation in utility based load management programs has declined in recent years.
- To attract customers to load management programs, the cost to participate must be in line with the benefits.
- Lighting is an excellent load to control because there is so much of it and there is little impact on building occupants or operations if done correctly. Lighting also provides a predictable amount of load shed.
- An ideal lighting control scheme must allow the lights to be dimmed from a single location and must be easy to use.
- The load shed ballast and its companion retrofit device must be cost effective and be easy to install.

- Other important characteristics the load shed ballast must have are: minimal impact on lamp life with no impact on manufacturer's warranty, a "good housekeeping" seal of approval beyond just a UL listing (like Energy Star), the signal to dim cannot create interference with other customer equipment and there must be technical support of the ballast and signaling equipment after installation.
- Thirty percent dimming of light output would be acceptable to customers.
- Customers would allow utilities to control the load shed ballast directly, if customers had override capabilities.
- Some type of cost/benefit analysis specific to the customer is required to achieve customer acceptance of the program.
- Customers want demonstrated proof that the load shed technology works.
- Customers would look, first, to their utility for information regarding the load shed ballast and a related load management program and, second, to their trade associations.
- Electronic communications regarding information on the load shed ballast or load management programs is not desired by customers.

### ***Recommendations***

- The cost for load shed ballast or the companion retrofit device cannot exceed more than three years worth of customer monetary benefits from participation in utility based load management programs. Equipment rebates may assist in increasing benefits to customers.
- The load shed ballast must encompass the characteristics of not reducing lamp life significantly and fail in the full on position. Signaling cannot interfere with other customer operations and the equipment must be easy to install by "in house" personnel without special training. The load must be able to be controlled from a single location.
- The LRC should concentrate its development efforts on the load shed retrofit device because of the substantial stock of existing commercial and industrial buildings.
- The LRC must find a manufacturer with customer name recognition and an established distribution network to produce and obtain, as a minimum, a UL listing for the load shed ballast and related signaling device. This manufacturer needs to provide follow on technical support to customers after installation.
- A customer financial model must be developed that includes utility rate structures, rebates and equipment costs to assist utility representatives in selling this load management program and to prove to customers the benefits of participating in such a program.
- Utilities should be allowed to market load management programs to customers including the load shed ballast program since they are the most trusted source of information in this area.
- Utilities or others should include demonstrations of the load shed ballast technologies in actual installations around California for interested customers to view.
- While not mandatory for the completion of Project 3.2 "Energy Efficient Load Shedding Technology", it is recommended additional customer focus groups be undertaken across California to develop a clearer strategy for the marketing of the load shed technology.

***Action Items***

- Prepare an economic model using the Critical Peak Pricing (CPP) rate for the three IOUs to gauge the potential energy cost savings for building owners.
- Focus on the retrofit load shedding device first.
- In conjunction with the Market Connection element, define applications of load shedding dimming capabilities that are limited to approximately 100 hours per lamp in the existing commercial building market.
- Work with the Market Connection element to gain greater utility commitment for the retrofit load-shedding device to be added to their portfolio of products offered to their customers. Utility commitment is critical to the successful launch of this product because of the emphasis end users place on receiving information regarding load management programs through their utility.

**Appendix A: Roundtable Attendees*****End User Roundtable***

<b>Name</b>	<b>Building Status</b>	<b>Company</b>	<b>Size of Building/Space</b>	<b>Invited/ Attended</b>
John Bowker	Manager	John Bowker & Assoc.	100,000+ sf	invited
Atlantis Dabalos	Owner	California Family Fitness Center, Inc.	500,000+ sf	attended
Sally Flynn	Owner	Sutter Senior Care Ctr.	100,000+ sf	invited
Dave Fox	Owner	Sacramento Bee	480,000 sf	invited
Ceaser Goldsby	Manager	Eskaton Village	500,000+ sf	invited
Dave Hanes	Tenant	Country Club Lanes	77,000 sf	invited
Jenn Jacques	Tenant	FedEX Ground	100,000+ sf	invited
Julie Karle	Owner	KCRA TV	75,000+ sf	invited
John King	Owner	Red Lion Inn	230,000 sf	attended
Colleen Maloney	Tenant	St. Patrick's School	100,000+ sf	invited
Shaun Meyer	Manager	Sheraton Grand Sacramento	425,000 sf	attended
Crystal Perras	Tenant	Pacific Pallet Exchange	50,000+ sf	invited
Miguel Sanchez	Tenant	Univision TV	57,000 sf	invited
Karl Shroeder	Owner	Capitol Christian Center	211,000 sf	attended

***Energy, Lighting and Governmental Professionals Roundtable***

<b>Name</b>	<b>Company</b>	<b>Type of Business</b>
Karl Johnson	KFJ Energy Strategies	Energy Consultant
Francis Rubinstein	Lawrence Berkeley National Labs	Lighting Research
Judie Porter	Architectural Energy Corporation	Energy Consultant
Jim Parks	Sacramento Municipal Utility District	Electric Utility
Greg Ander	Southern California Edison	Electric Utility
Jack Melnyck	Southern California Edison	Electric Utility
George Loisos	Loisos + Ubbelohde	Energy Consultant
Bob Knight	Bevilaqua-Knight, Inc.	Marketing Consultant
Bret Logue	Bevilaqua-Knight, Inc.	Marketing Consultant
Terry Clark	Finelite	Lighting Manufacturer
John Kesselring		Energy Consultant
Jon Null	Watt Stopper	Controls Manufacturer
Peter Turnbull	Pacific Gas & Electric	Electric Utility
Karen Hertner	Lawrence Berkeley National Labs	Representing the CA Utility Commission
Peter Pettler	Vistron	System Developer