SOUTHERN CALIFORNIA EDISON
1993-1994
COMMERCIAL/INDUSTRIAL
/AGRICULTURAL
ENERGY EFFICIENCY
INCENTIVES PROGRAM
FOURTH YEAR
RETENTION STUDY

CEC Study ID #529A,B,C

Final Report

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EXECUTIVE SUMMARY

This report provides the results of a study of the fourth-year retention of measures installed by customers of Southern California Edison (SCE) in 1993 and 1994 under SCE's Commercial/Industrial/Agricultural (C/I/A) Energy Efficiency Incentives Program. The following types of measures covered in the C/I/A EE Incentives Program have been studied:

- Commercial sector measures
  - Electronic ballasts
  - CFBs (modular)
  - T8 lamps
  - Delamping/Reflectors
  - HVAC EMS systems
  - High-Efficiency Chiller Systems
  - Adjustable Speed Drives
- Industrial and Agricultural sector measures
  - Adjustable Speed Drives
  - Pumps
  - Pump System (hardware) improvements
  - Ballasts
  - T8 Lamps
  - Lighting EMS (1994 only)
  - Injection molding (1994 only)
  - Process cooling (1994 only)
  - Insulation on process equipment (1994 only)
  - Air compressors (1994 only)
  - High efficiency chillers for process (1994 only)

Data for the study were collected through a longitudinal survey effort over four years. The data that were collected through on-site visits and telephone surveys over the four-year period were used to determine the percent retention for each measure. Based on the data collected, the retention rates for the various measures are as shown in Table ES-1.

Table ES-1. Four-Year Retention Rates for C/I/A EE Incentives Program Measures

Type of Measure	*Percentage of Measures Removed, Failed or Replaced within Four Years*	*Percentage of Measures Retained after Four Years*
Commercial Measures		
T8 lighting fixtures	9.3%	90.7%
T8 lamps	33.1%	66.9%
Electronic ballasts	5.9%	94.1%
CF fixtures (modular)	5.7%	94.3%
CF lamps	25.4%	74.6%
Delamping/reflectors	7.8%	92.2%
HVAC EMS	1.1%	98.9%
Chillers	0.0%	100.0%
Adjustable speed drives	2.7%	97.3%
Industrial Measures		
T8 lighting fixtures	6.6%	93.4%
T8 lamps	19.1%	80.9%
Electronic ballasts	2.8%	97.2%
Adjustable speed drives*	10.1%	89.9%
Lighting EMS	9.1%	91.9%
Injection molding machines	18.5%	81.5%
Plastic extrusion equipment	37.5%	63.5%
Process cooling	0.00%	100.0%
Process equipment insulation	20.0%	80.0%
High efficiency chillers	0.00%	100.0%
Air compressors	16.7%	83.3%
Agricultural Measures		
Pumps/pump system improvements	10.3%	89.7%
Adjustable speed drives*	10.1%	89.9%

*Numbers are for all ASDs in both industrial and agricultural sectors.

Another objective of the study was to estimate effective useful life (EUL) for each measure and to determine if the estimated EULs were different from expected EULs. Because the early retention rates for the different measures were relatively high, direct estimation of survival functions from the collected data was not informative. However, hazard functions could be estimated for many of the measures, and corresponding survival functions could be developed using the estimated hazard functions. For measures where there was a relatively small number of failures, the hazard analysis could not be performed.

The estimates of effective useful lives determined through this study are reported in Table ES-2, which also reports SCE's *ex ante* estimates of effective useful lives. For most measures, the hypothesis of no difference between *ex ante* and *ex post* estimates of useful life could not be rejected. The hypothesis of no difference could be rejected only for electronic ballasts and CF lamps in the commercial sector.

Table ES-2. Estimated Median Lives Compared to SCE's Ex Ante Estimates for Effective Useful Lives (Lives in years)

Type of Measure	*SCE Ex Ante Estimate of EUL*	*Estimated Median Life*	*Ex Ante Different from Ex Post?*
Commercial Measures			
T8 lighting fixtures	11.0	9.11	No
T8 lamps	5.0	5.37	No
Electronic ballasts	10.0	7.80	Yes
CF fixtures (modular)	12.2	10.51	No
CF lamps	2.2	5.73	Yes
Delamping/reflectors	10.0	18.85	No
Adjustable speed drives	10.0	11.13	No
HVAC EMS	15.0	*	*
Chillers	20.0	*	*
Industrial Measures			
T8 lighting fixtures	11.0	9.18	No
T8 lamps	5.0	4.32	No
Electronic ballasts	10.0	7.94	No
Adjustable speed drives	10.0	12.31	No
Lighting EMS	15.0	*	*
Injection molding machines	15.0	*	*
Plastic extrusion equipment	15.0	*	*
Process cooling	15.0	*	*
Process equipment insulation	15.0	*	*
High efficiency chillers	20.0	*	*
Air compressors	15.0	*	*
Agricultural Measures			
Pumps/pump system improvements	15.0	6.72	No
Adjustable speed drives	10.0	12.31	No

*Data on numbers of removals/failures were not sufficient to estimate median useful life.

1. INTRODUCTION AND BACKGROUND

This report provides the results of a study of the fourth-year retention of measures installed by customers of Southern California Edison (SCE) in 1993 and 1994 under SCE's Commercial/Industrial/Agricultural (C/I/A) Energy Efficiency Incentives Program. The 1995 program is not included in this study because it involved only eight customers, and SCE's request to waiver the requirement to measure the impacts of that year was approved by the California DSM Measurement Advisory Committee (CADMAC). The waiver is provided in Appendix J.

1.1 PROJECT OBJECTIVES

The objectives of this non-residential measure retention study were as follows:

- Locate energy conservation measures installed by 1993 or 1994 participants in SCE's Energy Management Hardware Rebate Program
- Determine the fraction of measures that were installed and operational to establish a baseline condition
- Determine the rates of early removal and disconnects, including survival functions
- Determine reasons for early removal and disconnects
- Determine what has replaced removed measures
- Identify changes in usage patterns over time
- Identify changes in circumstances of use (e.g., location of measure, end-use service provided, use of space in the area surrounding the measure, etc.) over time
- Establish measures' effective useful lives

Under the DSM Measurement Protocols[1] adopted by the California Public Utilities Commission, measures are to be studied in retention studies that either make up 50% of the savings for their respective sectors or that account for the top 10 measures in a sector. Accordingly, the measures studied include the following:

[1] See *Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings for Demand-Side Management Programs*, as adopted by California Public Utilities Commission Decision 93-05-063, with subsequent revisions.

- Commercial sector measures
  - Electronic ballasts
  - CFBs (modular)
  - T8 lamps
  - Delamping/Reflectors
  - HVAC EMS systems
  - High-Efficiency Chiller Systems
  - Adjustable Speed Drives
- Industrial and Agricultural sector measures
  - Adjustable Speed Drives
  - Pumps
  - Pump System (hardware) improvements
  - Ballasts
  - T8 Lamps

For 1994 only, additional measures were added for the industrial sector to provide coverage as required by the Protocols. These measures included the following:

- Lighting EMS
- Injection molding
- Process cooling
- Insulation on process equipment
- Air compressors
- High efficiency chillers (for processes)

The data for accomplishing the study objectives were collected for a sample of facilities chosen from among customers who participated in SCE's Energy Management Hardware Rebate Program (EMHRP) in 1993 and 1994.

1.2 ORGANIZATION OF REPORT

This interim report on the non-residential measure retention study is organized into the following sections.

- Chapter 2 discusses the methods used for the study.
- Chapter 3 presents and discusses the results of the analysis.

- Chapter 4 reports the results of examining whether changes in technology have affected the useful lives of the types of measures installed by customers in 1993 or 1994.
- Appendix A contains a copy of the on-site data collection form for the commercial sector.
- Appendix B contains a copy of the on-site data collection form for the industrial sector.
- Appendix C contains a procedures manual to guide field personnel in completing the on-site data collection forms.
- Appendix D contains a copy of the survey instrument for the telephone follow-ups.
- Appendix E contains spreadsheets showing the sample size calculations.
- Appendix F is a copy of the customer notification letter.
- Appendix G provides the data used to estimate hazard functions for commercial measures and plots of the estimated hazard and survival functions.
- Appendix H provides the data used to estimate hazard functions for industrial/agricultural measures and plots of the estimated hazard and survival functions.
- Appendix I contains Tables 6 and 7 as required by the Protocols.
- Appendix J provides the retroactive waiver that excluded the 1995 C/I/A EEI program from this study.

2. DATA COLLECTION METHODS AND PROCEDURES

This chapter discusses the methods and procedures used to collect data for the nonresidential measure retention study. Section 2.1 discusses the survey design underlying the data collection effort. Section 2.2 discusses the data collection instruments. Section 2.3 discusses the data collection procedures.

2.1 SURVEY DESIGN

The data on measure retention were to be collected for a sample of facilities chosen from among SCE customers who participated in SCE's Energy Management Hardware Rebate Program (EMHRP) in 1993 and 1994. The sample of facilities was to be chosen through measure-based sampling. The measures for which data needed to be collected included the following:

- Commercial sector measures
  - Electronic ballasts
  - CFBs (modular), fixtures and lamps
  - T8 fixtures and lamps
  - Delamping/Reflectors
  - HVAC EMS systems
  - High-Efficiency Chiller Systems
  - Adjustable Speed Drives
- Industrial and Agricultural sector measures
  - Adjustable Speed Drives
  - Pumps
  - Pump System (hardware) improvements
  - Ballasts
  - T8 fixtures and lamps

For 1994, additional measures were added for the industrial sector to provide coverage as required by the Protocols. These measures included the following energy efficiency measures:

- Lighting EMS
- Injection molding

- Process cooling
- Insulation on process equipment
- Air compressors
- High efficiency chillers (for processes)

The goal in preparing the sample design was to permit results for a measure to be reported with a relative precision of ±20 percentage points at the 80 percent confidence level. It was permissible to use a sample that combined sample points from the EMHRP for 1993 and 1994 to satisfy these precision/confidence requirements. At the same time, it was desirable to incorporate features into the sample design that lowered the data collection costs.

2.1.1 Analytical Framework For Sample Design

The analytical framework for the development of the sample design for the study was provided by survival analysis techniques. Survival analysis pertains to the analysis of data that correspond to the time from a well-defined time origin until the occurrence of some particular event or end-point. For this study, the time origin is defined by the installation of a measure under the EMHR program, while the end-point is defined by the removal or failure of the measure or the discontinuance of its use.

The measure survival data were expected to have several features that warranted special treatment in preparing the sample design.

- The measure survival data would probably not be symmetrically distributed and cannot be reasonably represented by a normal distribution.
- The survival data would be *right-censored* in that the removal/failure/discontinuance end-points will not be observable for some of the installed measures.
- The survival data for some types of measures (e.g., lighting measures) would likely be affected by clustering. That is, a single customer may have multiple occurrences of a particular type of measure (e.g., T8 lamps). For a single customer, there can be expected to be some homogeneity in the lifetimes for the particular type of measure, since they were all installed at the same time and were subject to similar operational conditions. Because of this homogeneity, a sample of clustered measure occurrences provides less information than a similar sample that does not show such homogeneity.

A sample design for addressing these and other features of the data was developed through the following steps.

- First, the number of removals/failures required to meet the precision/confidence specifications for each type of measure was determined.
- Second, the probability of removal/failure for each type of measure over the period of the study was determined and applied to the required number of removals/failures to determine the number of points required in the sample.
- Third, the required sample size was adjusted to account for the effects of clustering.
- Fourth, sample points for a measure were allocated among facilities.

The first step in preparing the sample design was to arrive at quantitative estimates of the required sample sizes for the various types of measures. To do this, it was necessary to use a parametric representation for the measure survival data. For the sample design, it was assumed that the survivor function for a measure's life data could be represented with the exponential distribution:

$$S(t) = e^{-\lambda t}$$

The mean survival time for this function is given by $\mu = 1/\lambda$ and the standard error given by $\frac{\mu}{\sqrt{r}}$, where r is the number of measure occurrences within a sample that have been removed or failed. Thus, with an exponential survivor function, the standard error for the estimated mean from a sample depends on the number of removals/failures that are observed.

The precision/confidence requirements for the sample were that the estimate of mean effective useful life for a measure must have relative precision of ±20 percent at the 80 percent confidence level. This implies the following:

$$.0.2\mu = \frac{z\mu}{\sqrt{r}}$$

where μ and r are defined as above and z is the upper point of the standard normal distribution defining the desired level of confidence. For the 80 percent confidence level, z = 1.28. Thus, the number of removals/failures required to estimate mean measure life for a particular measure at the specified precision/confidence is r = 41.

As noted above, it was expected that there would likely be right-censoring of the occurrences of a measure in the sample; not all of the occurrences would be observed until their life end-point. Accordingly, the number of measure occurrences brought into the sample had to be greater to accommodate this right censoring phenomenon. The sample size needed to provide the required number of removals was determined as follows:

$$\text{Sample Size} = \frac{\text{Number of required removals / failures}}{\text{Probability of removal / failure}}$$

As shown by Collett[1], the probability of removal/failure with an assumed survivor function can be calculated as a function of (1) specified values for the survivor function, (2) the study accrual time (i.e., the period when measure occurrences take place) and (3) the study follow-up time (i.e., the period when occurrences are tracked to see whether they are removed or fail). For this study, the accrual period was 24 months (the years 1993 and 1994 for the EMHR Program), and the follow-up period is 48 months (the four years 1995-1998 when on-site and telephone data collection occur). Mean values of measure life for calculating the parameters of the assumed exponential survivor functions for the various types of measures were taken from *DSM Measure Life Project: Master Tables of Measure Life Estimates and Final Report*, prepared by Energy Management Services.

Given that the length of the study was fixed, the probability of removal/failure was determined primarily by the expected mean life of a measure. The shorter the mean life of a measure, the higher the probability of removal or failure. For example, the probability of removal/failure is 0.593 for a measure with a mean life of 5 years and 0.368 for a measure with a mean life of 10 years. With the required number of removals/failures for either type of measure being 41, the respective sample sizes are 69 and 112.

For measures where there were expected to be multiple occurrences at a site (e.g., for lighting measures), an additional step in the sample design was to adjust for the intra-site correlation among useful lives for the different occurrences at a site. As noted above a sample drawn from clusters with some degree of homogeneity carries less information than a random sample of the same size which is heterogeneous.[2] On the other hand, using a cluster sampling approach would lower the number of sites that needed to be visited, thereby reducing costs.

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[1]Collett, D. *Modelling Survival Data in Medical Research*, Chapman & Hall, 1994, pp. 260-264.

[2] Formally, this can be seen by comparing the variance of the estimated mean between a random sample and a cluster sample.

For a random sample, $\mathrm{var}(\bar{y}) = \frac{S^2}{n}$

For a cluster sample: $\mathrm{var}(\bar{y}) = \frac{S^2}{l m_o}\left[1 + \delta\,(m_o - 1)\right]$

where S^2 is the variance of the variable in the population, n is the size of the random sample, l is the number of sites in the cluster sample, m_o is the number of measure occurrences from a site, and δ is the intraclass correlation coefficient measuring the degree of homogeneity in the

To determine the necessary sample size of sites to visit and measure occurrences to collect data on at each site, a two-stage sampling procedure was used. For this sampling, sites were designated as primary sampling units (PSUs) and measure occurrences as secondary sampling units. A sample of sites was chosen first and then a sample of measure occurrences was chosen within each selected site.

As the formulas in footnote 2 show, a cluster sample will be equivalent in variance to a random sample if $lm_o = n \times [1 + \delta(m_o - 1)] = n \times$ Design Effect. Once lm_o is determined, the number of sites to be sampled for a measure depends on m_o. The spreadsheets in Appendix E include the results of calculations for different values of m_o for lighting measures: 1, 10, 50, 100. (For those calculations, δ was assumed to be 0.5.) Figure 2-1 plots the data for electronic ballasts for the total required number of measure occurrences for the different values of m_o, while Figure 2-2 shows the plot for the required number of sites. Inspection of Figures 2-1 and 2-2 and the results in the spreadsheets indicated that the optimal m_o for lighting measures appeared to be 10.

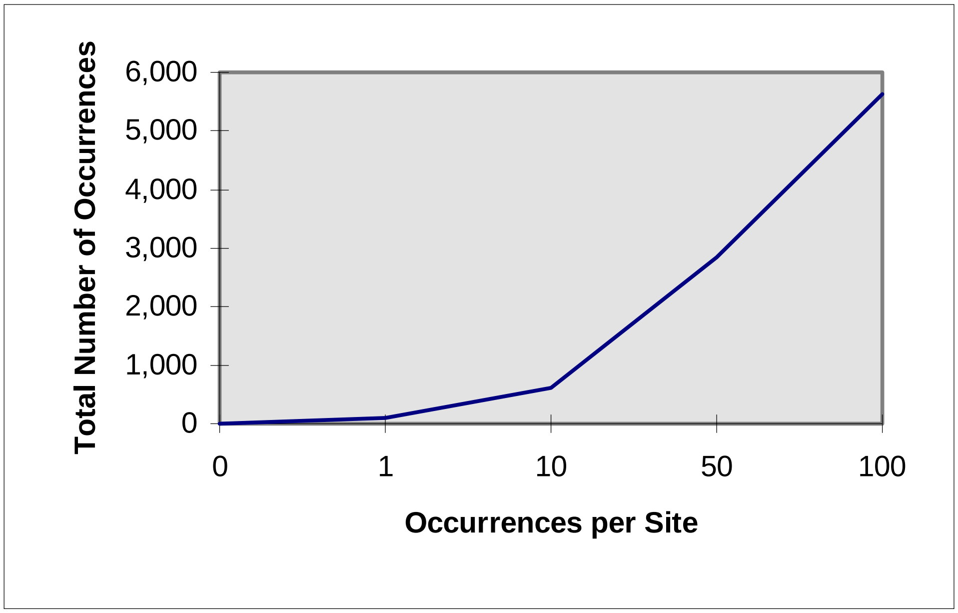

Figure 2-1. Total Number of Occurrences for Sample for Various Occurrences per Site

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clusters. (δ shows the degree to which effective useful life for measure occurrences within a site are correlated; if $\delta = 1$, then all measure occurrences at a site have the same useful lives.) Taking $n = lm_o$, then it can be seen that the variance of the cluster sample is larger to the extent that $\delta > 0$ and $m_o > 1$.

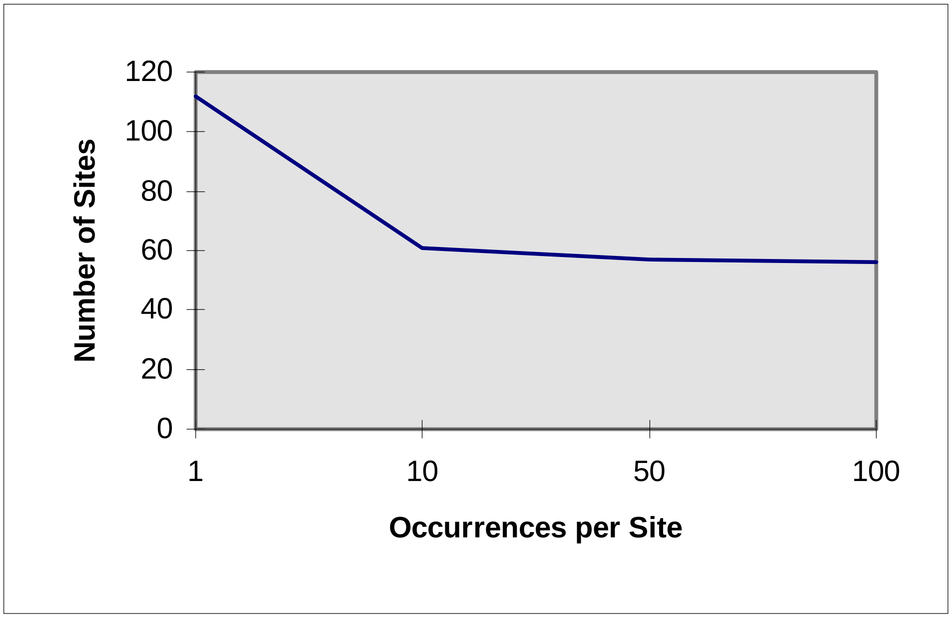

Figure 2-2. Number of Sample Sites for Various Occurrences per Site

Table 2-1 reports the results of applying the preceding analysis. Reported there are the total number of sites and total number of occurrences for which data need to be collected for each measure to satisfy the precision/confidence requirements. As can be seen, whether information is collected for all or for a sample of measure occurrences depends on the type of measure.

- Sampling of occurrences was used for lighting measures. For each type of lighting measure, 10 occurrences of the measure were inspected at a sample site. Fixture groups were defined that have equivalent physical design and approximately similar operating hours (based on lighting system operating controls). Detailed information was recorded on ballast, reflector, lens, bulb, controls, task use, and other features as installed under the program and as noted on program records.
- A census approach was used for HVAC measures (e.g., EMS, high-efficiency chillers) and for the process measures for the 1994 program year. The field staff verified the presence and operation of all program-installed measures. Because of the long lives of most HVAC and process equipment, removal/failures might not occur often. However, changes in utilization for such equipment was of interest, so that data were collected that pertain to how conditions that affect equipment operation may have changed.

Table 2-1. Numbers of Sites and Numbers of Measure Occurrences Required for Measure Retention Study: By Type of Measure

Measure	*Number of Sites*	*Number of Measure Occurrences*
Commercial:		
Electronic ballasts	61	614
CFBs (modular)	72	719
T8 lamps	38	381
Delamping/reflectors	61	614
HVAC EMS systems	112	112
High-efficiency chillers	199	199
ASDs (commercial)	84	167
Industrial and Agricultural:		
ASDs (industrial)	84	167
Pumps	77	155
Pump system (hardware) improvements	77	155
Ballasts	61	614
Lamps	61	614
Lighting EMS systems (1994 only)	112	112
Injection molding machines (1994 only)	112	112
Process cooling (1994 only)	112	112
Insulation on process equipment (1994 only)	112	112
Air compressors (1994 only)	112	112
High efficiency chillers for process (1994 only)	199	199
Totals:	1,746	5,270

2.1.2 Sample Allocation and Selection

Table 2-1 showed the number of sites and occurrences that needed to be sampled for each type of measure to meet the specified precision/confidence requirements. The final step in the sample design was to allocate the sample points for each type of measure among sites and to select the sites from which data would be collected.

The number of sample points required for any particular measure was divided equally between 1993 and 1994 participants. The sample allocation and selection work for each year's EMHRP participants made use of files that SCE staff prepared that contained information on the participants in the two years. Sampling frames for selecting the sample sites for the different types of measures were created by extracting various items of data from three sets of files.

- The first set of files included the "Coupon Files" for 1993 and 1994 EMHRP participants that had been created by the Pine Company. The file for 1993 contained information for (approximately) the 1,000 largest coupons for program participants in that year. The 1994 Coupon file contained information for about 1,250 coupons. In creating these files, the Pine Company disaggregated some of the measures on the original coupons, thus providing a higher degree of measure resolution. For example, Lighting System Replacement was broken down into its component parts (i.e., fixture, lamp, ballast, reflector, etc.) to facilitate the identification of measures for this study.

- The second set of files included measure-based files (FRAME3B for 1993 and Frame3AB for 1994) that contained information on *all* measures installed by EMHRP participants in the two program years.
- The third set of files included a customer-based file (CUSTINC) that contained information on the *customers* who were EMHRP participants.

For each type of measure, EMHRP participants in each year were stratified according to business sector and size.

- With the business sector stratification, participants were separated into a commercial customer class and an industrial/agricultural customer class.
- Within each measure/sector grouping, customers were further stratified according to size using a program category variable developed by SCE program staff. Agricultural customers were assigned to an “A” category. Commercial and industrial customers were assigned to categories according to their kW demand.[3]
  - Small (S) included C&I customers with demand between 0 and 49 kW.
  - Medium (M) included C&I customers with demand between 50 and 499 kW.
  - Large (L) included C&I customers with demand of 500 kW or more.

  If the program category assignment for a customer was not available on the SCE files, the customer was assigned to an Unknown (U) category.

Data were available on the SCE files regarding the kWh savings associated with a measure. For most measures, sample points for a measure were allocated to program categories in proportion to the distribution of savings. However, for some types of measures, the required sample size exceeded the number of customer facilities available on the sampling frame. For example, the sample size calculations design called for 199 sample points allocated to commercial locations that installed high efficiency chillers, of which 100 would be allocated to 1993 participants and 99 to 1994 participants. However, in actuality there were only 30 sites where high efficiency chillers were installed under the 1993 program.

3 The program category assignments were generally available on the CUSTINC file.

Accordingly, this left 70 sample points to be reallocated among measures for the commercial sector. Since the original sample sizes satisfied the confidence/precision requirements that SCE desired, the increases in sample sizes for the various measures in effect improved the precision with which the measure lives are estimated.

The sample design allocations are shown in Tables 2-2, 2-3, 2-4, and 2-5. The sample sizes for the industrial measures were those developed through the sample size calculations discussed above. The sample designs for ASDs, ballasts, and T8 lamps for the industrial sector were similar to those for these measures in the commercial sector. That is, sample points for each measure were allocated across program categories in proportion to the kWh savings accounted for by each category. For pump replacements, locations had not been assigned to program categories in the SCE files, so that no stratification by program category was used for that measures.

Primary preference for selection into the sample was given to the customers represented in the Coupon Files. For some types of measures, it was possible to select sample sites from among only those EMHRP participants represented in the Coupon File. However, for other measures, EMHRP participants not represented in the Coupon Files needed to be included in the sample pool to ensure that a sample of the required size could be recruited.

Within each sector/measure/program category combination, participants that were candidates for the sample were sorted first according to their Coupon File status; participants represented in a Coupon File were sorted to the beginning of a list, followed by any participants not in the Coupon File who needed to be added to meet the sample size requirement. Within each of these two groupings, customers were randomly sorted. In the sample recruiting, customers were contacted according to their ordering on these sorted lists until the required number of sites was recruited for the sample.

In practice, customers who had been surveyed within the past year for another SCE study were not contacted again. Where possible, the data collected on such customers for the other studies were used. For example, data for sites with chillers that had been visited as part of an impact evaluation of the EMHR Program were included in the sample for this retention study.

Table 2-2. Sample Allocation for Commercial Sector Measures: 1993 EMHRP Participants

Measure	*Program Category*	*1993 EMHRP Population*	*Sampling Population (from Coupon File)*	*Sample Size*		*Sample Allocation*
				Original	*Adjusted*	
Electronic Ballasts	U	12	6			1
Electronic Ballasts	S	198	39			3
Electronic Ballasts	M	393	159			22
Electronic Ballasts	L	74	53			14
		677	257	31	40	40
CFBs (Modular)	U	14	6			1
CFBs (Modular)	S	311	110			13
CFBs (Modular)	M	256	109			17
CFBs (Modular)	L	49	21			9
		630	246	36	40	40
T8 Lamps	U	24	24			3
T8 Lamps	S	56	56			3
T8 Lamps	M	258	257			12
T8 Lamps	L	143	142			22
		481	479	19	40	40
Delamping/Reflectors	U	2	1			1
Delamping/Reflectors	S	119	17			3
Delamping/Reflectors	M	190	84			17
Delamping/Reflectors	L	45	35			19
		356	137	31	40	40
HVAC EMS	U	10	8			4
HVAC EMS	S	14	5			1
HVAC EMS	M	122	77			28
HVAC EMS	L	48	38			29
		194	128	56	62	62
High-Efficiency Chillers	U	1	1		1	1
High-Efficiency Chillers	S	1	1		1	1
High-Efficiency Chillers	M	6	6		6	6
High-Efficiency Chillers	L	22	17		22	22
		30	25	100	30	30
ASDs	U	27	5			15
ASDs	S	0	0			0
ASDs	M	33	14			8
ASDs	L	65	40			41
		125	59	42	63	63
Totals				315	315	315

Table 2-3. Sample Allocation for Industrial and Agricultural Sector Measures: 1993 EMHRP Participants

Measure	*Program Category*	*1993 EMHRP Population*	*Sampling Population (from Coupon File)*	*Sample Size Original*	*Sample Allocation*
ASDs	U	21	13		3
ASDs	S	0	0		0
ASDs	M	14	1		2
ASDs	L	77	27		38
		112	41	42	42
Pump Replacement	U				
Pump Replacement	S				
Pump Replacement	M				
Pump Replacement	L				
		125	67	39	39
Pump Improvements	U				
Pump Improvements	S				
Pump Improvements	M				
Pump Improvements	L				
		58	13	39	39
Ballasts	U	1	1		1
Ballasts	S	13	1		0
Ballasts	M	48	18		5
Ballasts	L	48	31		25
		110	51	31	31
T8 Lamps	U	5	5		1
T8 Lamps	S	2	2		0
T8 Lamps	M	28	28		3
T8 Lamps	L	53	52		27
		88	87	31	31
Totals				182	182

Table 2-4. Sample Allocation for Commercial Sector Measures: 1994 EMHRP Participants

Measure	Program Category	1994 EMHRP Population	Sampling Population (from Coupon File)	Sample Size		Sample Allocation
				Original	Adjusted	
Electronic Ballasts	S	66	66			1
Electronic Ballasts	M	211	211			14
Electronic Ballasts	L	152	152			22
		429	429	31	37	37
CFBs (Modular)	S	13	13			2
CFBs (Modular)	M	46	46			21
CFBs (Modular)	L	26	26			17
		85	85	36	40	40
T8 Lamps	S	60	60			1
T8 Lamps	M	203	203			14
T8 Lamps	L	145	145			22
		408	408	19	37	37
Delamping/Reflectors	S	5	5			1
Delamping/Reflectors	M	25	25			26
Delamping/Reflectors	L	17	17			10
		47	47	31	37	37
HVAC EMS	S	79	19			20
HVAC EMS	M	127	58			31
HVAC EMS	L	45	27			11
		251	104	56	62	62
High-Efficiency Chillers	A	1	1			1
High-Efficiency Chillers	S	0	0			0
High-Efficiency Chillers	M	4	3			4
High-Efficiency Chillers	L	34	23			34
		39	27	100	39	39
ASDs	S	3	1			1
ASDs	M	67	32			29
ASDs	L	74	31			32
		144	64	42	63	63
Totals				315	315	315

Table 2-5. Sample Allocation for Industrial and Agricultural Sector Measures: 1994 EMHRP Participants

Measure	*Program Category*	*1994 EMHRP Population*	*Sampling Population from Coupon File*	*Sample Size Original*	*Sample Allocation*
ASDs	A	21	1		12
ASDs	S	1	0		1
ASDs	M	6	0		4
ASDs	L	43	15		25
		71	16	42	42
Pump Replacement	A	160	0	38	38
Pump Improvements	A	28	0		28
Pump Improvements	S	1	0		1
Pump Improvements	M	2	1		2
Pump Improvements	L	8	2		8
		39	3	39	39
Ballasts	S	6	6		1
Ballasts	M	27	27		5
Ballasts	L	43	43		24
		76	76	30	30
T8 Lamps	S	6	6		1
T8 Lamps	M	27	27		6
T8 Lamps	L	45	45		24
		78	78	30	30
Totals				179	179

For 1994, inspection of the coverage of savings in each sector provided by the initial set of measures indicated that additional measures should be added to the study in the industrial sector. These measures included:

- EMS on lighting
- Injection molding machines
- Plastic extrusion equipment
- Process cooling
- Insulation on process equipment
- Air compressors

With these measures added, the menu of 1994 measures included in this retention study provided the coverage required by the Protocols. This coverage is shown in Table 2-6.

Table 2-6. Coverage of Sector kWh Savings Provided by 1994 Measures Included in Retention Study

Type of Measure	*Commercial Sector*	*Industrial Sector*	*Agricultural Sector*
Indoor lighting	40.36%	15.61%	2.80%
HVAC-EMS	9.64%	2.54%	0.00%
Chillers	2.62%	1.23%	0.00%
ASDs	9.90%	11.59%	33.10%
Pump replacement		0.16%	28.78%
Pump improvement		3.04%	14.59%
Injection molding machine		5.26%	
EMS on lighting		4.59%	
Process cooling		2.59%	
Insulation on process equipment		1.27%	
Air compressors		1.14%	
Percent of Sector Savings	62.52%	49.02%	79.27%
Tracking system kWh savings	313,290,256	289,287,201	32,706,638

2.1.3 Final Sample of Sites

The final sample of sites that resulted after the recruitment effort is shown in Table 2-7. There was a total of 937 sites included in the final sample, distributed across sectors and program years as shown in Table 2-7. Also shown in Table 2-7 are the numbers of sites having the measures of interest for the study. Note, moreover, that the number of occurrences for some of the measures was higher than the number of sites because of multiple occurrences of a measure at a site. For example, there generally were multiple occurrences of lighting measures at a site.

2.2 DATA COLLECTION INSTRUMENTS

The types of instruments required for the non-residential measure retention study were as follows:

- Baseline and follow-up on-site data collection forms
- Follow-up telephone survey form

Preparation of these instruments is discussed in this section.

Table 2-7. Final Sample of Sites for Retention Study

	1993 Commercial	*1993 Industrial/ Agricultural*	*1994 Commercial*	*1994 Industrial/ Agricultural*	*All Sites*
Total Number of Sites	356	179	253	149	937
Numbers of Sites with Specified Measures					
ASDs	78	49	64	42	233
T8 Lamps	145	59	114	41	359
Electronic Ballasts	98	52	114	41	305
Compact Fluorescent Bulbs	79		50		129
Delamping/Reflectors	72		28		100
Chillers	17		21		38
HVAC Energy Management Systems	94		84		178
Pump Improvements		26		31	57
Pump Replacements		48		50	98
Lighting EMS				11	11
Injection molding machines				24	24
Plastic extrusion equipment				6	6
Process cooling				7	7
Process equipment insulation				9	9
High efficiency chillers				7	7
Air compressors				18	18

2.2.1 Baseline and Follow-Up On-Site Data Collection Forms

Baseline and follow-up data on the measures studied were collected through on-site data collection visits. Adequate information needed to be collected during these surveys to ensure that the specific research goals of the study were met. That is, data needed to be collected during the visits that could be used to estimate effective measure lives and to analyze the effects on service lives of such factors as operational hours, maintenance practices, etc. The marginal cost of including additional data items was (up to a limit) practically zero, and the additional information that was collected could be used to refine the analysis.

Examples of the type of information that needed to be collected with the on-site data collection forms included the following:

- Was the program-installed measure still in place and properly installed as specified by program requirements?
- If the measure was not in place and/or properly installed:
  - Was it removed, disconnected, broken, or damaged?
  - Why?

  - When was it removed/disconnected?
  - Was its removal part of a larger change? What?
  - What, if anything, replaced the measure?
- Was the measure in a good state of repair?
- Was there a specific maintenance schedule for each measure?
- Has the use of space surrounding the measure changed since installation? How?
- Was the equipment used differently than it was originally? Less? More? Had it been modified?
- Had there been business turnover and/or occupant changes?
- What were the customer and building characteristics?

The data collection form for the baseline on-site data collection for commercial sector measures is provided in Appendix A, while the form for the industrial sector measures is provided in Appendix B. A procedures manual to guide field personnel in completing the forms is included in Appendix C.

2.2.2 Follow-up Telephone Survey Instrument

To keep track of events that were relevant to measure retention but which occurred between on-site surveys, telephone follow-up interviews were conducted. The survey instrument for the follow-up telephone calls is provided in Appendix D.

Substantively, the survey instrument for the telephone interviews was designed to allow collection of information to determine the following:

- Whether the facility identified in the baseline survey was still occupied
- Whether the owner/tenant had changed
- Whether the business conducted on the site had changed
- Whether remodels or renovations had occurred or were planned
- Whether the building occupant was satisfied with the measure

Besides the considerations of what substantive information needed to be collected with the telephone survey instrument, there were also considerations in designing the instrument to facilitate the collection of the data. The telephone survey instrument was therefore designed to include the following features:

- An introductory statement was included that addressed possible problems that arise from contacting a customer at inconvenient times. The interviewer must be careful not to alienate those contacted during possibly inopportune times.

The introductory statement includes an acknowledgment of the possible untimeliness of the phone call and allows for rescheduling the contact.

- The format of the instrument was kept simple, in order both to make administering it easier and to make those surveyed more responsive. It must be possible to administer the instrument without undue disruption of the business's normal activities.
- Interview questions were structured to increase their readability and understanding when spoken over the phone. Questions were phrased so as not to be suggestive of particular answers.
- The instrument was designed so that it could be administered in 20 minutes or less.

2.3 DATA COLLECTION PROCEDURES

Data for the measure retention study were collected both through on-site visits and telephone interviews according to the schedule shown in Table 2-8. The procedures used for each type of data collection are described in the following discussion.

Table 2-8. Data Collection Schedule

Study Cohort	*1995 (Baseline)*	*1996*	*1997*	*1998*
1993 Commercial	On-site	Telephone	On-site	Telephone
1993 Industrial/Agricultural	On-site	On-site	Telephone	Telephone
1994 Commercial	On-site	Telephone	Telephone	On-site
1994 Industrial/Agricultural	On-site	Telephone	On-site	Telephone

2.3.1 Customer Recruitment and Tracking

Contacts with customers to schedule the data collection visits were coordinated with SCE staff and/or customer service representatives. The list of customers in the sample was provided to SCE staff to identify any (1) customers who had been already surveyed in other data collection projects that SCE had recently performed; (2) customers who should not be contacted at all; and (3) customers who should be contacted by SCE before they were called for scheduling an on-site data collection visit.

During the scheduling effort, a callback procedure was used to ensure that data collection visits were scheduled and completed with a large percentage of the "primary" customers in the sample. Three attempts were made by phone to contact a customer and schedule a data collection visit. To help increase the probability for scheduling a data collection visit, telephone contacts were attempted on different days at different times. Attempts to recruit a customer were stopped after three calls. Unlike households, it is generally possible to reach businesses during the day, and their agreement or refusal to participate can be attained over the telephone.

When a customer agreed to participate in the data collection effort, the scheduler arranged a mutually acceptable date and time for data collection, based on the convenience of the customer and on the travel schedule of the field staff. After each data collection visit was scheduled, the date, time, and any other particulars pertaining to the visit were entered onto the customer's record in a Customer Status File on the computerized tracking and reporting system that was used to administer and manage the data collection effort.

The Customer Status File contained a record of specified characteristics for each customer in the sample, along with information pertaining to all attempts to contact a customer and to the final disposition of the attempts to schedule a data collection visit. Accordingly, if all attempts to recruit a candidate were unsuccessful, a report was generated from the Customer Status File that documents the attempts that had been made. This report is used to determine whether to release an alternate sample point to replace a customer that could not be recruited. The procedures that we use in recruiting primary candidates were also used in recruiting any alternate candidates.

2.3.2 Data Collection and Quality Control

Data for the measure retention study were collected through on-site visits to customers' facilities. The discussion in this section addresses the various aspects of the work effort involved in conducting the on-site data collection for the customers selected for the sample. These aspects included selecting and supervising the field staff; contacting customers and scheduling data collection visits; and collecting data.

Trained engineers were used as the field staff for the on-site data collection A training session was held before the beginning of the data collection effort to instruct the field staff on the specific requirements of the data collection effort. The training session included a discussion of project objectives and provided for review of the data collection form and of the procedures to be used to collect data effectively with minimum disruption to the customer.

Once the arrangement for a data collection visit had been made, a member of the field staff visited the customer's facility on the scheduled date to collect the data. Before the field staff went to a facility, they reviewed information on the measures installed at that facility. This review ensured that the field engineer was familiar with the facility and measures for which data were to be collected when he went on-site and that he appropriately allocated his time to collect data on those measures that were the primary subjects for the analysis.

Program data that SCE had collected were used to facilitate the on-site data collection. These program data were used to establish the baseline information on equipment and measures that were installed in the buildings under the EMHR Program. Changes from these data were indicative of building changes and component changeouts. These and other items of information were extracted from the program records and provided to the field staff to facilitate the site visits. This was needed so that the field staff could know what "was" to compare with what "is" at the site and thereby note or query any apparent changes.

During the on-site data collection visit, the field personnel used the data collection form described in Section 2.2 to collect the required data. They paid particular attention to getting sufficient information with which to analyze the life of the measures. They located the measures and verified the ratings and operational characteristics of the affected equipment. They also collected information on other building operations that affect the operation of the installed measures.

Some of the required data were collected through interviews with the staff of the facility. For most sizable facilities, there was generally a building or plant engineer who was familiar with the operation of the facility and its equipment. This interview provided the facility staff with a brief introduction to the purpose and conduct of the study. Facility staff were asked a limited set of questions that were directed at investigating inconsistencies in previous data as well as toward forming a basis for visual inspection of measures. Following the interview, the field engineer visually inspected and verified measure installation. Data were recorded on whether the measure was installed and operating; equipment maintenance was assessed qualitatively; and (where relevant) make and model number of equipment was verified.

Quality control procedures were used throughout the data collection effort to ensure that the data collected were of high quality. Discrepancies between baseline, interview, and visual inspection results were resolved prior to leaving a facility. The field staff prepared facility layouts that showed the locations of the measures inspected. They also placed stickers on the measure devices to identify them as being included in this study; the stickers included a telephone number to be called if the devices were removed.

For the follow-up on-site data collection, the baseline data collection form was carried back to the site, and changes in any of the original conditions at the site were noted on the form.

The baseline and follow-up data collected on-site for each customer were entered into a computerized file using a *Paradox for Windows* full-screen data entry/modification form. The data entered into the Paradox data base were later converted into a PC-SAS database for validation and analysis.

2.3.3 Follow-Up Telephone Procedures

Telephone follow-up interviews of 1993/1994 commercial program participants were conducted in the first quarter of each year in which an on-site follow-up survey was not required.

The interviewers for the telephone survey have considerable experience, having conducted numerous telephone interviews. Because of this experience, the amount of training that they require is relatively limited and pertains primarily to the specific requirements of this project. This training session is held before the telephone survey is begun. The following topics were covered in the training session:

- When to interview and make callbacks
- How to record reasons for a non-completion and the need for a callback
- Suggestions for achieving completed interviews and gaining respondent cooperation
- Question by question explanation of the interview
- General interviewing principles

In the training, the interviewers were reminded of the techniques of conducting telephone interviews and were briefed on the objectives and critical issues involved in the study. The telephone interviewers were thoroughly trained on the questionnaire. Each interviewer does a minimum of three practice interviews to make sure they were completely familiar with and can efficiently administer the questionnaire. The telephone interviewers were also trained on appropriate responses to questions that customers might ask.

During the actual execution of the telephone survey, telephone call times were varied between 8:00 A.M. and 5:00 P.M. For those customers not contacted with an initial call, call backs were attempted at varying times of the day and week. At least five attempts were made to complete an interview with a customer before it is classified as a non-respondent. The telephone interviewers maintain a status log for each customer in the telephone survey sample. This log is used to record the disposition of each call made to a customer.

The telephone interviewing was continuously monitored to make sure that the interviewers were administering the questionnaire correctly and that the respondents were not having a problem with any aspect of the interviewing. Completed interviews were reviewed and checked for procedural errors and omitted questions.

3. ANALYSIS AND RESULTS

This chapter presents and discusses the results of the analysis of the data collected regarding the retention of measures installed by customers under SCE's 1993 and 1994 Energy Management Hardware Rebate Program. Section 3.1 discusses the methods used for the analysis. The results from the analysis were presented and discussed in Section 3.2 for commercial sector measures and in Section 3.3 for industrial sector measures.

3.1 ANALYSIS METHODS

The data collected were used in analysis to accomplish the following:

- Establish baseline conditions by determining the fraction of measures that had been installed and were operational
- Determine the rates of early removal and disconnects and the reasons for early removal and disconnects
- Establish measures' effective useful lives

The first two of these were accomplished directly through tabulation of the data collected through the on-site and telephone surveying. However, additional analysis was required to establish the effective useful lives of the measures.

Under the DSM Measurement Protocols, a utility recovers 25% of the earnings in the third and fourth earnings claims based on the following equation:

Net resource benefits = first year impacts x EUL x TDF

where EUL is the effective useful life of a measure and TDF is a technical degradation factor used to account for time-and-use related change in the energy savings of a high efficiency measure or practice relative to a standard efficiency measure or practice. The first year impacts are developed in the first year impact evaluation studies, while the technical degradation factors have been developed from a statewide study sponsored by the California DSM Measurement Advisory Committee (CADMAC). Estimates of EUL are to be developed through retention studies, such as this one.

Under the Protocols, effective useful life of a measure is defined as the median number of years that the measure installed under the program is still in place and operable. In effect, the median age is the number of years that pass until 50% of the installed measures are no longer in place and operable. Determining the effective useful life according to this definition requires deriving a survival function for a measure, where a survival function shows the fraction of installed measures still in place and operable as time passes.

The analytical difficulty that arises in trying to derive a survival function for a program measure is that the amount of data available are relatively limited. There are 100% of the measures in place and operable under the baseline conditions that are established. Moreover, estimates of the percentage of measures still in place after three or four years are shown by the retention rates determined from the data collected in a retention study. However, no actual data on which to base the survival function are available for the particular measures beyond the third or fourth year.

As the data presented below will show, the retention rates for the first four years after installation are high for the measures considered in this study. Because of this, non-parametric methods of estimating survival functions are not appropriate. Non-parametric methods can give an accurate estimate of median survival time only if more than 50% of the measures are no longer in place and operable.

Parametric methods were therefore used for estimating a median survival time for each measure. A possible difficulty with the parametric approach is that if a measure has a high early retention rate, then there is little information with which to distinguish between different functional forms for the survival function if estimated directly. Because of the limited time span that the collected data cover, a variety of functions that imply significantly different survival patterns and median lives can be fitted through the data.[1]

However, an alternative to trying to estimate the survival function directly is to estimate a hazard function using the available data, and then using the estimated hazard function to develop an associated survival function. The steps in the parametric procedure for estimating the survival functions were as follows:

- Prepare data for calculation of hazard rate function
- Calculate hazard rate function
- Use hazard rate function to determine survival function
- Estimate effective useful life of measures from survival function

An essential component in this analytical procedure is the estimation of the hazard rate function. A hazard function defines the probability that an item will fail in the

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[1] For discussion of this problem, see Hahn, G.J. and Meeker, W.Q, Jr., "Pitfalls and Practical Considerations in Product Life Analysis—Part I: Basic Concepts and Dangers of Extrapolation", *Journal of Quality Technology*, Vol. 14, July 1982, pp. 144-152.

next unit of time, given that it has survived to the present. The hazard rate at time t is the ratio of the number of units failing in that interval to the number surviving to that time:

$$h(t) = \frac{f(t)}{1-F(t)}$$

where h(t) is the hazard rate at time t; f(t) is the probability of failure during an increment of time at time t; and F(t) is the cumulative probability of failure up to time t. For the analysis in this study, the hazard rate for any given time period (e.g., a year) represents the proportion of items that were removed or failed during the time period, given that they had survived to the beginning of the time period. Once a hazard function is estimated, a corresponding survival function S(t) can be determined, where S(t) represents the percent surviving at time t.[2]

Two of the distributions commonly used for survival analysis are the exponential distribution and the Weibull distribution[3]. The probability density functions and associated hazard functions and survival functions for these distributions are shown in Table 3-1.

Table 3-1. Hazard and Survival Functions for Exponential and Weibull Distributions

Exponential Distribution	
Probability Density Function	$f(t) = \gamma \exp(-\gamma t)$
Hazard Function	$h(t) = \gamma$
Survival Function	$S(t) = \exp(-\gamma t)$
Weibull Distribution	
Probability Density Function	$f(t) = \alpha\beta t^{\beta-1} \exp(-\alpha t^{\beta})$
Hazard Function	$h(t) = \alpha\beta t^{\beta-1}$
Survival Function	$S(t) = \exp(-\alpha t^{\beta})$

As Table 3-1 shows, the exponential distribution can be used to represent a hazard rate that is constant. The associated survival function is also exponential. However, the exponential distribution does not represent hazards that increase or decrease over time. If the hazard rate does increase or decrease monotonically with age, the Weibull distribution can be used to represent the hazard function and

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[2] Collett, *op. cit.*, pp. 10-13.

[3] Collett, *ibid.* Also see Kiefer, Nicholas "Economic Duration Data and Hazard Functions" *Journal of Economic Literature*, Vol. XXVI, pp. 646-679, June 1988.

the survival function. (Note that with the Weibull distribution, α is termed as the scale parameter, while β is termed as the shape parameter.)

The results from applying this parametric analytical approach to analyze the effective useful lives for the different types of measures are presented and discussed in the following subsections.

3.2 RESULTS FOR COMMERCIAL MEASURES

This section presents and discusses the results from analyzing retention rates and estimating effective useful lives for commercial measures. Retention rates are presented in Section 3.2.1, while estimates of effective useful lives are presented in Section 3.2.2.

3.2.1 Retention Rates for Commercial Measures

Fourth-year retention rates for the various types of commercial measures for each program year were calculated using the information collected through the on-site and telephone surveying. Table 3-2 shows the percentage of measures installed in each year that were no longer in place after four years. The implied retention rates are also shown. The rates of retention for some of the measures are relatively high (e.g., energy management systems, chillers).

3.2.2 Estimates of Effective Useful Lives for Commercial Measures

Estimates of effective useful lives for the various commercial measures were developed using the procedure described in Section 3.1. Those estimates are presented and discussed in this subsection. We illustrate the estimation procedures and results using T8 lamps as an example. We then provide a summary of the results for all of the measures. Detailed charts and information for the estimated hazard functions and survival functions are provided for all of the commercial measures in Appendix G.

As described in Section 3.1, the first step in the analysis to determine the effective useful life for a measure was to estimate a hazard function. The data for this were taken from the on-site data collection, since the on-site inspections had allowed for identifying removals of individual lamps. Data for both 1993 and 1994 program years were combined for the analysis. These data and the calculated hazard rates are reported in Table 3-3. For example, there were 6,667 T8 lamps in the sample at the start of year 1. During year 1, 35 of the lamps were observed to have been removed or to have failed, implying a hazard rate of 0.52%. With 35 lamps of the sample removed/failed during year 1, there were 6,632 lamps “at risk” at the start of year 2. During year 2, 166 lamps were observed to have been removed or to have failed, implying a hazard rate for the second year of 2.50%. Similar calculations provided the hazard rate estimates for years 3 and 4. These calculated hazard rates for T8 lamps are plotted in Figure 3-1.

Table 3-2. Retention Rates for Commercial Measures by Program Year

Type of Measure	*Number of Measures Installed*	*Number of Measures Removed, Failed or Replaced in Four Years after Installation*	*Percentage of All Measures Removed, Failed or Replaced in Four Years after Installation*	*Percentage of Measures Retained after Four Years*
		1993 Program Year		
T8 lighting fixtures	1,237	146	11.8%	88.2%
T8 lamps	3,136	1,118	35.7%	64.3%
Electronic ballasts	1,316	101	7.7%	92.3%
CF fixtures (modular)	816	54	6.6%	93.4%
CF lamps	1,008	236	23.4%	76.6%
Delamping/reflectors	852	71	8.3%	91.7%
HVAC EMS	96	1	1.0%	99.0%
Chillers	25	-	0.0%	100.0%
Adjustable speed drives	129	3	2.3%	97.7%
		1994 Program Year		
T8 lighting fixtures	1,376	98	7.1%	92.9%
T8 lamps	3,531	1,091	30.9%	69.1%
Electronic ballasts	1,433	60	4.2%	95.8%
CF fixtures (modular)	485	20	4.1%	95.9%
CF lamps	578	167	28.9%	71.1%
Delamping/reflectors	502	34	6.8%	93.2%
HVAC EMS	82	1	1.2%	98.8%
Chillers	13	-	0.0%	100.0%
Adjustable speed drives	96	3	3.1%	96.9%
		1993 and 1994 Program Years Combined		
T8 lighting fixtures	2,613	244	9.3%	90.7%
T8 lamps	6,667	2,209	33.1%	66.9%
Electronic ballasts	2,749	161	5.9%	94.1%
CF fixtures (modular)	1,301	74	5.7%	94.3%
CF lamps	1,586	403	25.4%	74.6%
Delamping/reflectors	1,354	105	7.8%	92.2%
HVAC EMS	178	2	1.1%	98.9%
Chillers	38	-	0.0%	100.0%
Adjustable speed drives	225	6	2.7%	97.3%

Table 3-3. Data for Calculating Hazard Rates for Commercial T8 Lamps

Year	*Lamps at Start of Year*	*Lamps Removed/Failed during Year*	*Hazard Rate (Rate of Removal/Failure)*
1	6,667	35	0.52%
2	6,632	166	2.50%
3	6,466	714	11.04%
4	5,752	1,294	22.50%

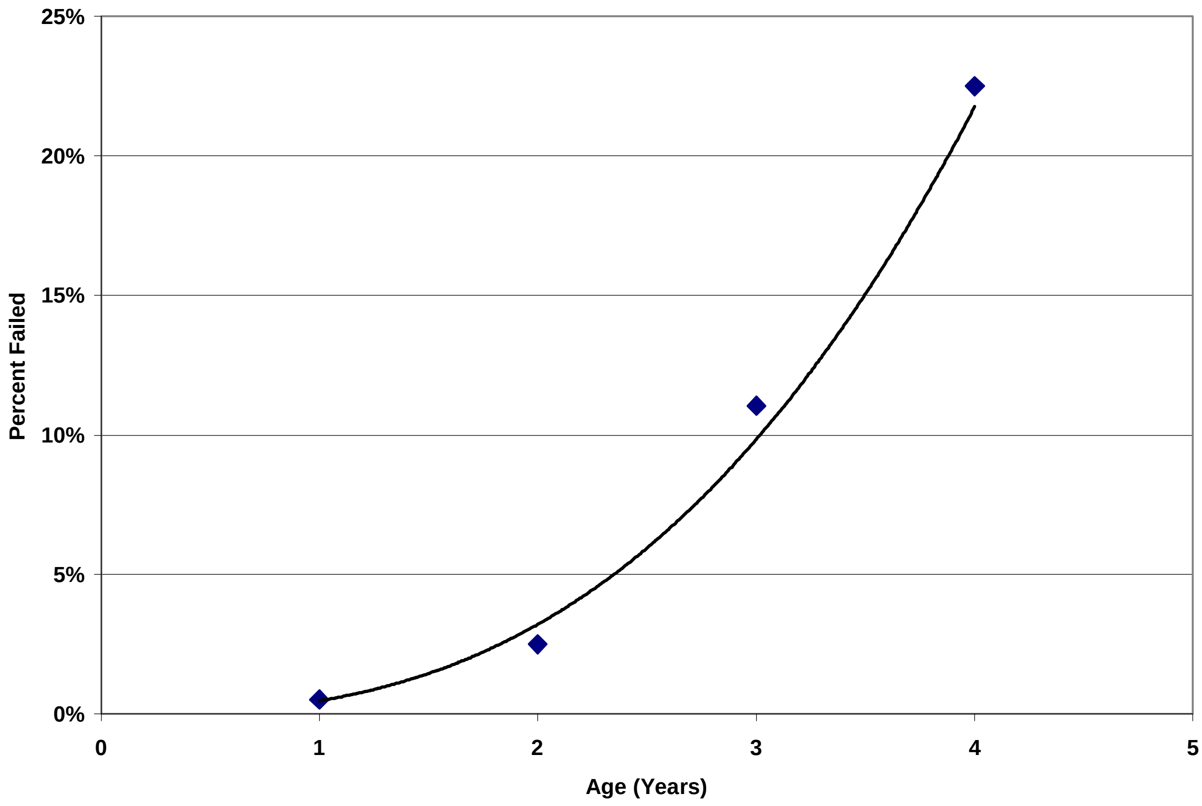

Figure 3-1. Plot of Hazard Rates for T8 Lamps in Commercial Sector

Inspection of the calculated hazard (removal/failure) rates for each year since installation showed clearly that the hazard rate increased over time. This indicated that it was not warranted to assume that the survival function for T8 lamps could be represented using the exponential distribution, since the hazard rate for an exponential survival function is constant. However, the Weibull distribution does allow for hazard rates that increase over time, and the Weibull-based hazard function was therefore used as the functional form for estimating the hazard function for T8 lamps.

A power curve fit to the hazard rate data in Table 3-3 provided the estimates of the parameters for the Weibull distribution representation of the hazard rate function. The fitted power curve was:

Hazard rate at time t = h(t) = $0.0047\text{Age}^{2.7594}$

The R^2 for this fit was 0.9896.

The parameters from the power curve fit to the hazard rate data imply the following parametrization of the Weibull function for the hazard function:

Weibull hazard rate function = $0.00125 \times 3.7594 \times \text{Age}^{2.7594}$

where 0.00125 represents the α (scale) parameter for the Weibull distribution and 3.7594 represents the β (shape) parameter.

Given that the Weibull distribution provides a representation of the hazard function for T8 lamps, the associated survival function is given by

Percent surviving at age t = S(t) = $\exp(-0.00125 \times \text{Age}^{3.7594})$

The implied survival function for T8 lamps is shown in Figure 3-2.

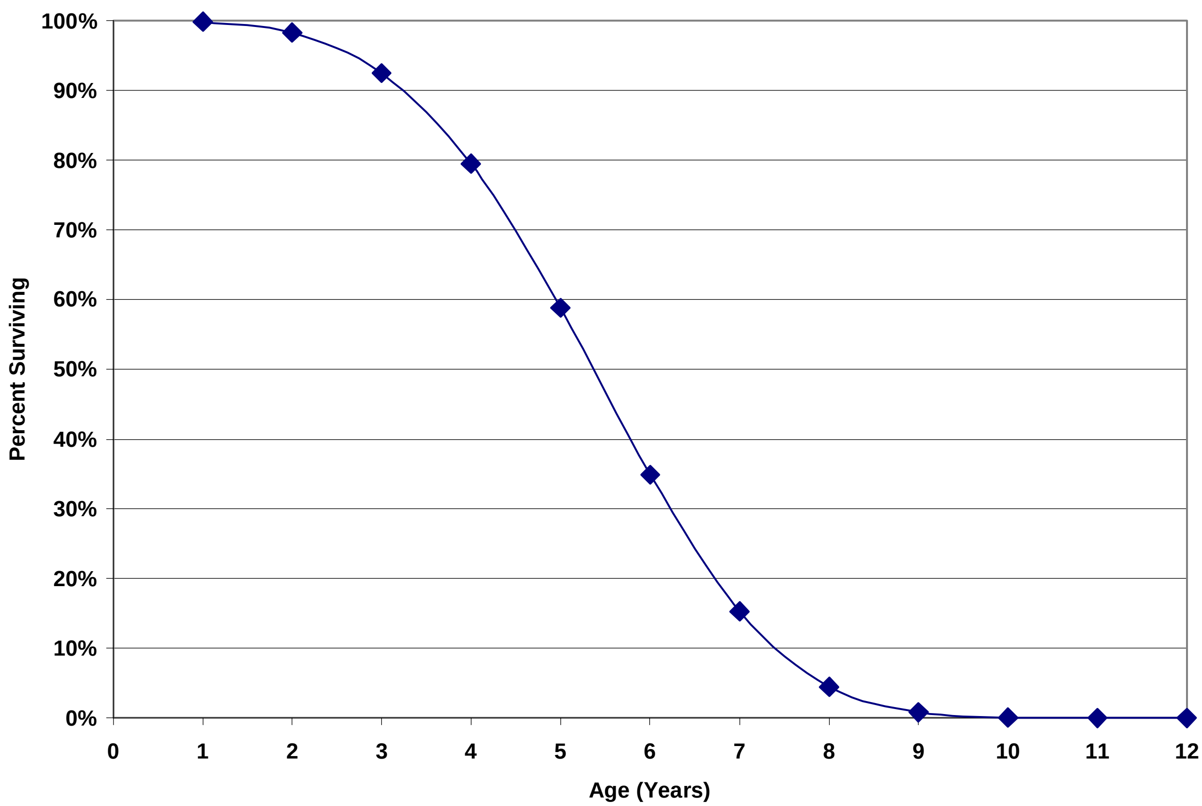

Figure 3-2. Survival Function Plot for T8 Lamps in Commercial Sector

With the survival function estimated, the effective useful life of T8 lamps can be estimated as the median survival time, defined as that age where 50% of the lamps have been removed or failed. For the survival function calculated for commercial T8 lamps, the median survival time is 5.37 years. This can be compared to SCE's *ex ante* estimate that the effective useful life of a T8 lamp is 5 years.

As provided for in the M&E Protocols, a statistical test of whether the *ex post* estimate of useful life is significantly different from the *ex ante* estimate can be made by constructing an 80% confidence interval around the *ex post* estimate and determining whether the *ex ante* estimate falls within this confidence interval. That is, if the *ex ante* estimate falls inside the constructed confidence interval, then the hypothesis of no difference between the *ex ante* and *ex post* estimates cannot be rejected. If the *ex ante* estimate falls outside the constructed confidence interval, then the hypothesis of no difference between the *ex ante* and *ex post* estimates can be rejected.[4]

For the analytical approach used in this study to estimate useful lives of the measures, an 80% confidence interval for the estimated median life of a measure was calculated as follows. The regression fit of the power curve coefficients was used to report the values of the estimated coefficients associated with the 80% confidence levels. Thus, the power curve regression analysis for each measure provided three sets of parameters for the Weibull hazard rate function: the "best" fit parameters and parameters for the upper and lower bounds of the 80% confidence interval for the estimated coefficients. In effect, the analysis provided an estimate of the "best" hazard function and survival function for a measure, plus estimates of the functions for the upper and lower bounds of the 80% confidence interval.

Figure 3-3 illustrates this analysis for the case of T8 lamps. Shown there are the "best" fit survival function (as in Figure 3-2) and the upper and lower bound survival functions associated with the 80% confidence level. The upper and lower bounds on the "best" fit survival function provide the confidence interval bounds for the estimated median useful life. For T8 lamps, the estimated median useful life is 5.37 years. The 80% confidence interval for this estimate (*cf*. Figure 3-3) is 4.31 years to 6.96 years. Because SCE's *ex ante* estimate of 5 years for the useful life of T8 lamps falls within this confidence interval, the hypothesis of no difference between the *ex ante* and *ex post* estimates cannot be rejected.

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[4] See, for example, Snedecor, G.W. and Cochran, W.G., *Statistical Methods, 7th Edition*, Iowa State University Press, 1980, p. 66.

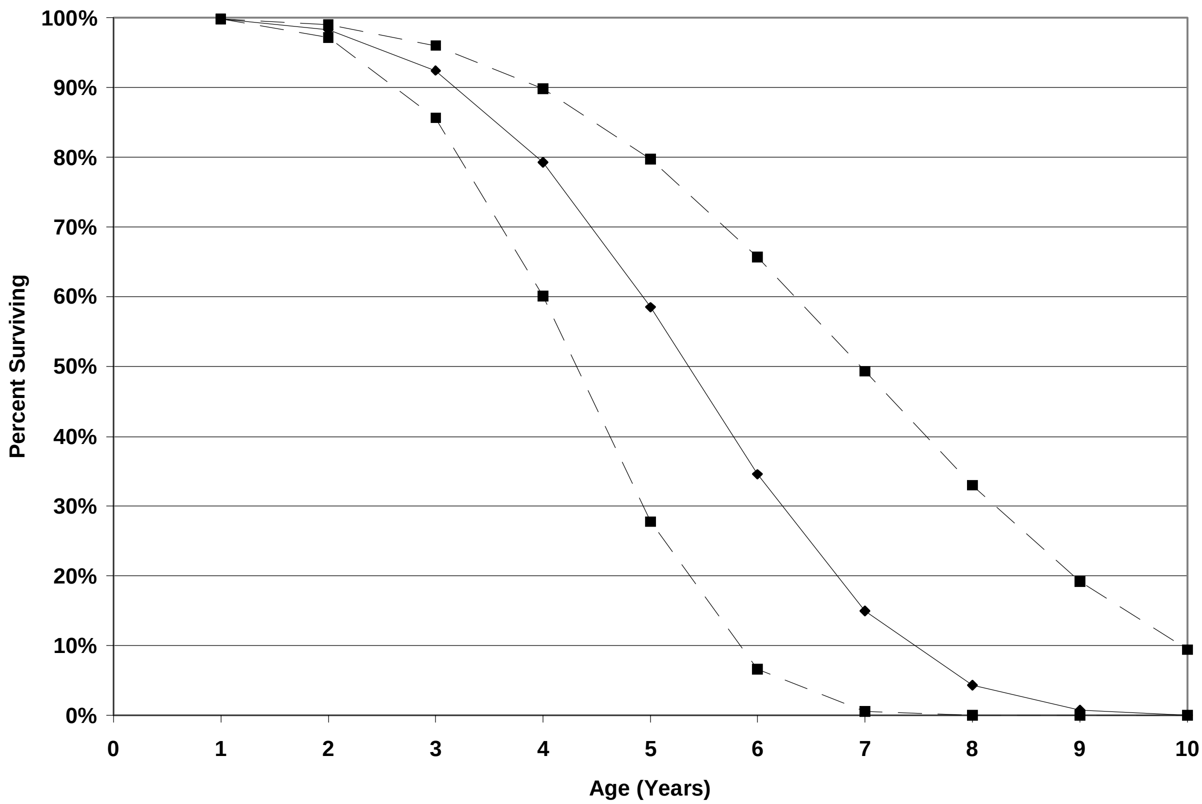

Figure 3-3. Survival Function Plot for T8 Lamps in Commercial Sector with Upper and Lower Bounds

Similar analyses were performed for the other commercial measures. Plots of the hazard functions and survival functions for all of the commercial measures are provided in Appendix G. The results from the analysis are summarized in Table 3-4 and Table 3-5. Results are not reported for HVAC EMS and for high efficiency chillers, since there were not sufficient numbers of removals/failures for these measures to support the hazard function estimation.

- For HVAC EMS, the system had been removed or had failed at 2 out of 178 sites. Both removals/failures occurred during the fourth year after installation.
- For high efficiency chillers, none of the chillers had been replaced or had failed at the 38 sites in the sample.

All of the measures for which the data allowed analysis of effective useful lives showed hazard rates that increased with time, so that a Weibull distribution was used to represent the hazard function for each. The parameters estimated through power curve fits and the estimated scale and shape parameters of the Weibull function are reported in Table 3-4. The resulting estimates of median survival lives are reported in Table 3-5 and compared to SCE's *ex ante* estimates of effective useful lives.

Table 3-4. Summary of Hazard Rate Estimation for Commercial Measures

Type of Measure	Power Curve Fit			Weibull Distribution Parameters	
	a	b	R-squared	α (Scale)	β (Shape)
T8 lighting fixtures	0.0041	1.7860	0.8419	0.001472	2.7860
T8 lamps	0.0047	2.7594	0.9896	0.001250	3.7594
Electronic ballasts	0.0004	3.4369	0.9997	0.000092	4.4369
CF fixtures (modular)	0.0021	1.9205	0.8196	0.000719	2.9205
CF lamps	0.0038	2.7392	0.9997	0.001016	3.7392
Delamping/reflectors	0.0110	0.5630	0.2721	0.007038	1.5630
Adjustable speed drives	0.0006	2.4405	1.0000	0.000174	3.4405

Table 3-5. Estimated Median Lives Compared to Ex Ante Estimates for Commercial Measures (Lives in years)

Measure	SCE Ex Ante Useful Life Estimate		Estimated Median Life			Ratio of Estimated to Ex Ante
	Value	Source	80% Lower bound	Estimate	80% Upper Bound	
T8 lighting fixtures	11	1997 AEAP, Table C	2.24	9.11	> 100	0.83
T8 lamps	5	Protocol, App. F, Table 1	4.31	5.37	6.96	1.07
Electronic ballasts	10	Protocol, App. F, Table 1	6.82	7.80	8.78	0.78
CF fixtures (modular)	12	Protocol, App. F, Table 1	4.38	10.51	78.43	0.86
CF lamps	2	Protocol, App. F, Table 1	5.48	5.73	5.99	2.60
Delamping/reflectors	10	Protocol, App. F, Table 1	4.20	18.85	> 100	1.89
Adjustable speed drives	10	Protocol, App. F, Table 1	**	11.13	**	1.11
HVAC EMS	15	Protocol, App. F, Table 1	**	*	**	
Chillers	20	Protocol, App. F, Table 1	**	*	**	

*Data were not sufficient to estimate median life.

**Data were not sufficient to estimate confidence interval.

Inspection of the estimates reported in Table 3-5 shows that there is relatively good agreement between SCE's *ex ante* estimates of effective useful lives and the median survival lives estimated through this study. Except for two measures, the hypothesis of no difference between *ex ante* and *ex post* estimates cannot be rejected. The hypothesis can be rejected for two measures: electronic ballasts and compact fluorescent lamps.

- For electronic ballasts, the median useful life estimated through this study is somewhat lower than SCE's *ex ante* estimate. As discussed in Chapter 4, some electronic ballasts manufactured in 1993 and 1994 failed prematurely. To the extent that the problems with such ballasts carried over, the survival function estimated in this study would show higher percentages of failures in early years, which would lower the estimate of median useful life.

- For CF lamps, the median useful life estimated through this study is higher than SCE's *ex ante* estimate.

Based on this analysis, SCE's *ex ante* estimates of useful life are also used as the *ex post* useful life for third and fourth earnings claims for all measures except electronic ballasts and CF lamps. For these two measures, the *ex post* useful lives for the earnings claims are 7.80 years for ballasts and 5.37 years for CF lamps.

3.3 RESULTS FOR INDUSTRIAL MEASURES

This section presents and discusses the results from analyzing retention rates and estimating effective useful lives for industrial measures. Retention rates are presented in Section 3.3.1, while estimates of effective useful lives are presented in Section 3.3.2.

3.3.1 Retention Data for Each Type of Industrial Measure

Fourth-year retention rates for the various types of industrial measures for each program year were calculated using the information collected through the on-site and telephone surveying. Table 3-6 shows the percentage of measures installed in each year that were no longer in place after four years. The implied retention rates are also shown.

3.3.2 Estimates of Effective Useful Lives for Industrial Measures

Analyses similar to those for commercial measures were used to develop estimates of effective useful lives for four of the industrial measures for which there were sufficient data. As Table 3-6 showed, there were seven industrial measures for which the number of installations and number of removals/failures were relatively small and not sufficient to support analysis of median useful life.

The results from the analysis are summarized in Table 3-7 and Table 3-8. Plots of the hazard functions and survival functions for the industrial measures analyzed are provided in Appendix H. All of the industrial measures analyzed showed hazard rates that increased with time, so that a Weibull distribution was used to represent the hazard function for each. The parameters estimated through power curve fits and the estimated scale and shape parameters of the Weibull function are reported in Table 3-7. The resulting estimates of median survival lives are reported in Table 3-8 and compared to SCE's *ex ante* estimates of effective useful lives.

Inspection of the estimates reported in Table 3-8 shows that there is relatively good agreement between SCE's *ex ante* estimates of effective useful lives for industrial measures and the median survival lives estimated through this study. For measures for which median useful lives could be estimated, the hypothesis of no difference between *ex ante* and *ex post* estimates cannot be rejected.

Based on this analysis, SCE's *ex ante* estimates of useful lives for industrial measures are used as the *ex post* useful lives for the third and fourth earnings claims.

Table 3-6. Retention Rates for Industrial Measures by Program Year

Type of Measure	*Number of Measures Installed*	*Number of Measures Removed, Failed or Replaced by Four Years from Installation*	*Percentage of All Measures Removed, Failed or Replaced by Four Years Since Installation*	*Percentage of Measures Retained after Four Years*
		1993 Program Year		
T8 lighting fixtures	659	54	8.2%	91.8%
T8 lamps	1,836	278	15.1%	84.9%
Electronic ballasts	697	20	2.9%	97.1%
Adjustable speed drives	73	5	6.8%	93.2%
		1994 Program Year		
T8 lighting fixtures	346	12	3.5%	96.5%
T8 lamps	917	247	26.9%	73.1%
Electronic ballasts	376	10	2.7%	97.3%
Adjustable speed drives	66	9	13.6%	86.4%
Lighting EMS	11	1	9.1%	91.9%
Injection molding machines	27	5	18.5%	81.5%
Plastic extrusion equipment	8	3	37.5%	63.5%
Process cooling	6	0	0.0%	100.0%
Process equipment insulation	5	1	20.0%	80.0%
High efficiency chillers	5	0	0.0%	100.0%
Air compressors	18	3	16.7%	83.3%
		1993 and 1994 Program Years Combined		
T8 lighting fixtures	1,005	66	6.6%	93.4%
T8 lamps	2,753	525	19.1%	80.9%
Electronic ballasts	1,073	30	2.8%	97.2%
Adjustable speed drives	139	14	10.1%	89.9%
Lighting EMS	11	1	9.1%	91.9%
Injection molding machines	27	5	18.5%	81.5%
Plastic extrusion equipment	8	3	37.5%	63.5%
Process cooling	6	0	0.0%	100.0%
Process equipment insulation	5	1	20.0%	80.0%
High efficiency chillers	5	0	0.0%	100.0%
Air compressors	18	3	16.7%	83.3%

Table 3-7. Summary of Hazard Rate Estimation for Industrial Measures

Type of Measure	Power Curve Fit			Weibull Distribution Parameters	
	a	b	R-squared	α (Scale)	β (Shape)
T8 lighting fixtures	0.0009	3.7391	1.0000	0.000019	4.7391
T8 lamps	0.0007	4.9292	0.9969	0.000118	5.9292
Electronic ballasts	0.0010	2.8029	0.9968	0.000263	3.8029
Adjustable speed drives	0.0461	0.1274	1.0000	0.040891	1.1274

Table 3-8. Estimated Median Lives Compared to Ex Ante Estimates for Industrial Measures (Lives in years)

Measure	SCE Ex Ante Useful Life Estimate		Estimated Median Life			Realization Rate
	Value	Source	80% Lower bound	Estimate	80% Upper Bound	
T8 lighting fixtures	11	1997 AEAP, Table C	**	9.18	**	0.83
T8 lamps	5	Protocol, App. F, Table 1	3.36	4.32	6.08	0.86
Electronic ballasts	10	Protocol, App. F, Table 1	5.97	7.94	11.65	0.79
Adjustable speed drives	10	Protocol, App. F, Table 1	**	12.31	**	1.23
Lighting EMS	15	Tracking System	**	*	**	*
Injection molding machines	15	Tracking System	**	*	**	*
Plastic extrusion equipment	15	Tracking System	**	*	**	*
Process cooling	15	Tracking System	**	*	**	*
Process equipment insulation	15	Tracking System	**	*	**	*
High efficiency chillers	20	Protocol, App. F, Table 1	**	*	**	*
Air compressors	15	Tracking System	**	*	**	*

*Data were not sufficient to estimate median life and realization rates.

**Data were not sufficient to estimate confidence interval.

3.4 RESULTS FOR AGRICULTURAL MEASURES

This section presents and discusses the results from analyzing retention rates and estimating effective useful lives for agricultural measures. Retention rates are presented in Section 3.4.1, while estimates of effective useful lives are presented in Section 3.4.2.

3.4.1 Retention Data for Each Type of Agricultural Measure

Fourth-year retention rates for the agricultural measures for each program year were calculated using the information collected through the on-site and telephone surveying. Table 3-9 shows the percentage of measures installed in each year that were no longer in place after four years. The implied retention rates are also shown.

Table 3-9. Retention Rates for Agricultural Measures by Program Year

Type of Measure	*Number of Measures Installed*	*Number of Measures Removed, Failed or Replaced by Four Years from Installation*	*Percentage of All Measures Removed, Failed or Replaced by Four Years Since Installation*	*Percentage of Measures Retained after Four Years*
1993 Program Year				
Pumps/pump system improvements	93	5	5.4%	94.6%
Adjustable speed drives	73	5	6.8%	93.2%
1994 Program Year				
Pumps/pump system improvements	82	13	15.9%	84.1%
Adjustable speed drives	66	9	13.6%	86.4%
1993 and 1994 Program Years Combined				
Pumps/pump system improvements	175	18	10.3%	89.7%
Adjustable speed drives	139	14	10.1%	89.9%

3.4.2 Estimates of Effective Useful Lives for Agricultural Measures

Analyses similar to those for commercial and industrial measures were used to develop estimates of effective useful lives for pumps and pump improvements. Adjustable speed drives were also an agricultural measure, but agricultural ASDs were combined with industrial ASDs for analysis purposes to provide a sample of sufficient size. The estimates reported for industrial ASDs also apply to agricultural ASDs and are repeated here.

The results from the analysis are summarized in Table 3-10 and Table 3-11. Plots of the hazard functions and survival functions for these agricultural measures are provided in Appendix H. The agricultural measures showed hazard rates that increased with time, so that a Weibull distribution was used to represent the hazard function for each. The parameters estimated through power curve fits and the estimated scale and shape parameters of the Weibull function are reported in Table 3-8. The resulting estimates of median survival lives are reported in Table 3-9 and compared to SCE's *ex ante* estimates of effective useful lives.

Inspection of the estimates reported in Table 3-11 shows that the estimated median life for pumps/pump system improvements estimated through this study is less than half of SCE's *ex ante* estimate of effective useful life. However, the confidence interval is wide, so that the hypothesis of no difference between the *ex ante* and *ex post* estimates of useful life for pumps/pump system improvements cannot be rejected. The same is true for adjustable speed drives.

Based on this analysis, SCE's *ex ante* estimates of useful lives for the agricultural measures are used as the *ex post* useful lives for the third and fourth earnings claims.

Table 3-10. Summary of Hazard Rate Estimation for Agricultural Measures

Type of Measure	*Power Curve Fit*			*Weibull Distribution Parameters*	
	a	*b*	*R-squared*	*α (Scale)*	*β (Shape)*
Pumps/pump system improvements	0.0045	2.2660	0.8359	0.001378	3.2660
Adjustable speed drives	0.0461	0.1274	1.0000	0.040891	1.1274

Table 3-11. Estimated Median Lives Compared to Ex Ante Estimates for Agricultural Measures (Lives in years)

Measure	*SCE Ex Ante Useful Life Estimate*		*Estimated Median Life*			*Realization Rate*
	Value	*Source*	*80% Lower bound*	*Estimate*	*80% Upper Bound*	
Pumps/pump system improvements	11	1997 AEAP, Table C	2.05	6.72	> 100	0.45
Adjustable speed drives	10	Protocol, App. F, Table 1	**	12.31	**	1.23

**Data were not sufficient to estimate confidence interval.

4. TECHNOLOGY CHANGES AND EFFECTS ON USEFUL LIVES

As part of the retention study, an examination was made of whether there had been changes in technology for the types of measures installed in 1993 and 1994 that would have affected the expected lives of these measures. Data for this examination were gathered from three main sources:

- From interviews with manufacturers
- From interviews with research organizations (e.g., EPRI, Lighting Research Center, etc.)
- From review of equipment catalogs (e.g., Graingers, manufacturers)

The results of examining changes in technology for the 1993 and 1994 measures are summarized in Table 4-1. There were no changes in basic technology for any of the measures. Short synopses are provided here of the information gathered during the examination.

For adjustable speed drives (ASDs), information on changes technology was obtained from one manufacturer, from the EPRI Adjustable Speed Drive Demonstration Office, from the Advanced Energy Industrial Energy Lab, and from a consulting engineer specializing in ASDs.

- One respondent pointed out that vendors are reporting much higher levels of reliability for ASDs and that a MTF (mean time to failure) of 80,000 hours is now common. There has been a substantial change in the technology and reliability with the increase of digitization of the designs. The advertised MTF has drifted up since 1989–1990. In the 1993-1995 period, he estimated the MTF quoted by manufacturers would be in the 35-40,000 hour range.
- Others interviewed reported that the drives themselves have not significantly changed. They did not feel that the drives had substantially longer full lives. All respondents stressed that actual MTF was highly dependent on actual operating conditions (e.g., temperature, load).

Table 4-1. Summary of Changes in Technology for 1993/1994 Measures

Technology	*Change in basic technology?*	*New Features?*	*Decrease in premature failure?*	*Change in rated life expectancy?*	*New longer life models available?*
ASDs	No	Minor	No	Yes—manufacturers report longer MTF, but no consensus that this is true from respondents	No
Electronic Ballasts	No	No	Yes—problems with premature failures solved	No	No
Chillers	No	Yes—electronic controls and safeties	No	No	No
Compact Fluorescents	No	Yes—changes in shape and configuration	No	No	No
Energy Management Systems	No	Yes--More user friendly	No	No	No
Pumps	No	No	No	No	No
Reflectors	No	No	No	No	Yes—models with harder finishes
T-8 lamps	No	No	No	No	Yes—higher priced for special applications

For electronic ballasts, information was obtained from four major manufacturers, from Lawrence Berkeley Laboratories, Energy Efficiency and Renewable Energy Clearinghouse and from the Lighting Research Center at Renesselaer Polytechnic Institute. In addition sales literature from 1994 and 1999 was examined.

- Lighting ballasts are described with a rated life. This is defined as the median life for the equipment or the age by which 50% of the equipment is estimated to fail.
- During the 1993-1994 period there were relatively high percentages of premature failures of electronic ballasts manufactured by some manufacturers. However, the consensus of those interviewed was that changes in the design, components and manufacturing have led to much lower "out-of-box" and premature failures of electronic ballasts. This has led too much higher overall reliability.
- The maximum life determined by end-of-life failure has not increased much or at all. Manufacturers report rated lives in the 60,000 to 80,000 hour range. Catalogs confirm that manufacturers have not increased the rated life of electronic ballasts. Rated life is estimated to decrease 50% with a 10-degree Celsius increase in operating temperature (which allows accelerated testing of the equipment). This needs to be kept in mind when comparing rated life among manufacturers, since they may report the rated life under different operating temperatures. The initial failure rate for the major manufacturers is now estimated in the range of 0.1% to 1%.

For compact fluorescent lamps and ballasts, information was obtained from two major manufacturers, from Lawrence Berkeley Laboratories' Energy Efficiency and Renewable Energy Clearinghouse, and from the Lighting Research Center. In addition sales literature from 1994 and 1999 was examined.

- One manufacturer's representative reported changes in size configuration and design. NEMA now requires CFL's to have end of life circuitry to prevent overheating and meltdown. Other changes in design have increased compatibility between manufacturers and created de facto standards. This may decrease some premature failures. The miss-match of bulbs and ballasts can shorten the life of the equipment.
- Other respondents reported that there have been no changes in the technology. All of the respondents reported that the rated life of the equipment has not changed.

For T-8 lamps, information was obtained from two major manufacturers, from Lawrence Berkeley Laboratories's Energy Efficiency and Renewable Energy Clearinghouse and from the Lighting Research Center. In addition sales literature from 1994 and 1999 was examined.

- Both manufacturers reported new models of T-8 lamps with rated lives of 24,000 hours. (Corresponding models are also available from other manufacturers.) These long life models have a rated life 20% longer than the longest rated life T-8 models available in 1994. The long life models sell for approximately double the price of older models, about $10 compared to $5 per bulb. In terms of lumen output, color, and other characteristics they are comparable to the older models. Because of the higher cost, these lamps appear to be of use in areas where the labor cost or other costs of replacement are quite high.

For chillers, information was obtained from two manufacturers and from the Energy Efficiency and Renewable Energy Clearinghouse. The consensus was that there have been no fundamental changes in technologies that would increase the life of the equipment. There has been an increase in the use of helical screw compressors, which have fewer moving parts than reciprocating compressors and are more reliable and more efficient. However, helical screw compressors were available in 1993-1994. Electronic controls and safeties have been added to some chillers. This may improve maintenance and may prevent some premature failure of equipment but does not change the 20- to 30-year design life of the equipment.

For pumps, information was obtained from three pump manufacturers. The consensus was there have been very minor changes to some pump designs since 1993 –1994. This has allowed minor increases in efficiency.

- One respondent felt this increase in efficiency would increase pump life on the order of 5 to 10%.
- The other respondents reported that the small changes to pump design would not increase in reliability noticeably, if at all. There is an increased use of energy efficient motors due to their greater availability and lower prices.

For reflectors, information was obtained from two vendors and from the Energy Efficiency and Renewable Energy Clearinghouse. One respondent reported that there are luminaires available with harder finishes. These finishes result in the reflectors staying cleaner longer and being somewhat more resistant to corrosion.

For energy management systems, information was obtained from three manufacturers of energy management systems and from Lawrence Berkeley Laboratories. The life span of the equipment is determined by the ability to repair the equipment, with the availability of components from the manufacturer being the limiting factor. Two of the manufacturers reported having equipment in place and operating since the beginning of their businesses 10 to 12 years ago. The electronics of the systems have not changed, and there have been relatively minor changes in the hardware. Changes in the technology have been in the areas of "user friendliness" and increased functionality.

Appendix A

BASELINE ON-SITE DATA COLLECTION FORM: COMMERCIAL SECTOR MEASURES

Data Entry	Date	Checked	Date	Received	Surveyed	Date	ID Number

Southern California Edison

EMHR Program Measure Retention Survey

1993 Commercial Final

7/14/95

Table of Contents

Introductory Information

Survey Date: (month/day/year) __ __ /__ __ /__ __

Surveyor: __

Business Name: __

Street Address: __

City, State: __ , __ __

Zip Code: __ __ __ __ __ - __ __ __ __

Business Contact

Name: __

Title: __

Phone # ( ): (__ __ __) __ __ __ __ __ __ __ ext. __ __ __ __

FAX # ( ): (__ __ __) __ __ __ __ __ __ __

Establishment Site Activity

Office:	Administration and management	011	Restaurant:	Fast Food or Self Service	021
	Financial / Legal	012		Table Service	022
	Insurance/Real Estate	013		Bar/Tavern/Nightclub/Other	023
	Other Office	014			
Food Store:	Supermarket	031	Retail Store:	Department / Variety Store	041
	Convenience Store	032		Shop in Enclosed Mall	042
	Other Food Store	033		Other Retail Store	043
Warehouse:	Refrigerated Warehouse	051	Health Care:	Hospital	061
	Nonrefrigerated Warehouse	052		Nursing Home	062
				Medical Office	063
				Clinic/Outpatient Care	064
Education:	Daycare or Preschool	071	Lodging:	Hotel	081
	Elementary / Secondary School	072		Motel	082
	College or University	073			
	Vocational or Trade School	074			
Public Assembly:	Church	091	Services:	Gas Station / Auto Repair	101
	Recreational or Other	092		Repair (Non-Auto)	102
				Other Service Shop	103
Manufacturing:	Assembly / Light Mfg.	111			
	Med/Heavy Equip. Mfg.	112	Other:	Describe	120
	Food/Beverage Processor	113		Construction	121
	Mining	114		Agriculture	122

Establishment site activity: ___________

Activity/Product Description ______________________________

____

____

SIC Code: (In-house) ___________

General Information

How many buildings at this location?	
Year main building built?	
Year business established in the building?	
Percent of building occupied by this establishment?	

Floor Space

Total square feet ___________________________ Percent Heated _____________ Percent Cooled _____________

Fuel Use

		1 = No 2 = Yes
Fuel type utilized by the establishment:	Electricity	__
	Gas	__
	Oil	__
	LPG	__
	Wood	__
	Solar	__
	Coal/Coke	__
	Purchased Steam	__
	Purchased Chilled Water	__
	Other (describe) _______ ____________________	__

Electric Accounts

Do electric account numbers match those indicated by the sample selection for this building ?	1 = No 2 = Yes 3 = Not Verified	__

Number	Account Number	Meter Numbers	End Uses Served
1	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
2	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
3	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
4	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
5	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
6	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
7	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
8	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
9	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
10	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
11	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________
12	__ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __	__ __ __ __ __ __ __ __ __ __ __ __ __	___________________

End Use Codes				
H = heating	IL = internal lighting	W = water heating	P = process	A = all
C = cooling	EL = external lighting	CK = cooking	M = miscellaneous	U = unknown
V = ventilation	R = refrigeration		(including plug loads)	

List meter numbers affected by EMHRP lighting retrofits: ____

Business Operating Hours & Employees

	% Occup.	Start Time	End Time	% Occup.	Start Time	End Time	% Occup.	Start Time	End Time
Weekday									
Saturday									
Sunday & Holiday									

Number of employees in establishment? __ __ __ __ __

Do the operating hours change with season? 1 = No 2 = Yes __

If yes, check high medium or low operating levels by month:

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
High												
Medium												
Low												

Changes in Building Occupancy and Renovations

Have there been any significant changes in occupancy since 1992? 1=No 2=Yes	
Date of Occupancy Change (MM/YY)	
Percent of Floorspace Affected by Occupancy Change	%

Rebated Equipment Use Affected by Occupancy Change (check all that apply):

- ☐ Electronic Ballasts (commercial / industrial)
- ☐ CFBs - modular (commercial)
- ☐ T8 Lamps (commercial / industrial)
- ☐ Delamping/Reflectors (commercial)
- ☐ HVAC EMS (commercial)
- ☐ High Eff. Chillers (commercial)
- ☐ ASDs (commercial / industrial)
- ☐ High Efficiency Pumps (industrial)
- ☐ Pump System Hardware Improvements ((industrial)

List Meter Numbers affected by occupancy change: ____

Did the facility tenant change during this occupancy change? 1=No 2=Yes __
If yes, establishment site activity prior to the occupancy change: ________
Activity/Product Description prior to the occupancy change: ____________________
____
____

Did the number of employees change during this occupancy change? 1=No 2=Yes __
If yes, number of employees prior to the occupancy change: __ __ __ __ __

Did the operating schedule change during this occupancy change? 1=No 2=Yes __

If yes, enter the schedule prior to the occupancy change:

	% Occup.	Start Time	End Time	% Occup.	Start Time	End Time	% Occup.	Start Time	End Time
Weekday									
Saturday									
Sunday & Holiday									

Did the seasonal schedule change during this occupancy change? 1=No 2=Yes __

If yes, check high medium or low operating levels by month prior to change

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
High												
Medium												
Low												

Describe the change in building occupancy and use: ______________________________
____
____
____
____

Have there been any significant renovations since 1992? 1=No 2=Yes	
If yes, type of renovation A=Space addition R=Space reduction C=conversion to new use	
Date of Renovation (MM/YY)	
Percent of Floorspace Affected by Renovation	%

Rebated Equipment Use Affected by Renovation (check all that apply):

- ☐ Electronic Ballasts (commercial / industrial)
- ☐ CFBs - modular (commercial)
- ☐ T8 Lamps (commercial / industrial)
- ☐ Delamping/Reflectors (commercial)
- ☐ HVAC EMS (commercial)
- ☐ High Eff. Chillers (commercial)
- ☐ ASDs (commercial / industrial)
- ☐ High Efficiency Pumps (industrial)
- ☐ Pump System Hardware Improvements ((industrial)

List Meter Numbers affected by the renovation: ____________________

Describe this building renovation: ____________________

____

____

____

____

Energy Management Hardware Rebate Program Measures

Measure	Installed Under 1993 EMHRP		Installed Under 1994 EMHRP	
	new	**replacmt.**	**new**	**replacmt.**
<u>**Commercial Sector**</u>				
Electronic Ballasts	☐	☐	☐	☐
CFBs (modular)	☐	☐	☐	☐
T8 Lamps	☐	☐	☐	☐
Delamping/reflectors	☐	☐	☐	☐
HVAC EMS Systems	☐	☐	☐	☐
High Efficiency Chillers	☐	☐	☐	☐
ASDs (commercial)	☐	☐	☐	☐
<u>**Industrial & Agricultural**</u>				
ASDs (industrial)	☐	☐	☐	☐
High Efficiency Pumps	☐	☐	☐	☐
Pump System (hardware) Improvements	☐	☐	☐	☐
Electronic Ballasts	☐	☐	☐	☐
T8 Lamps	☐	☐	☐	☐

Other Equipment Changes Since 1992

Equipment Type	**Date** (MM/YY)	**Energy Efficient?** (1=N 2=Y)	**Change Type** (1=new 2=replacmt. 3=retrofit 4=removed)	**Meter Numbers Affected**

Electronic Ballasts (commercial / industrial) Floorspace affected ___________ sq.ft.

Sampled Fixture Number	1	2	3	4	5	6	7	8	9	10
Fixture Type										
Space Utilization Code										
Lamp Type										
Watts/Lamp										
Number of Ballasts/Fixture										
1st Ballast in Fixture										
Number of Lamps/Ballast										
Hours per Week										
EMHRP Ballast Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Ballast for EMHRP										
2nd Ballast in Fixture (if applicable)										
Number of Lamps/Ballast										
Hours per Week										
EMHRP Ballast Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Ballast for EMHRP										

Satisfaction with Ballast Installation _______________ Reasons for Satisfaction/Dissatisfaction ___________________

Space Utilization Code

Code	Name	Code	Name	Code	Name	Code	Name
OFF	Office	LOD	Lodging	FDS	Food Service Preparation	INC	Industrial/Mechanical (conditioned)
HAL	Hall	CLS	Classroom	GRC	Grocery	INU	Industrial/Mechanical (unconditioned)
ATR	Lobby/Atrium	ASY	Assembly	RET	Retail	LAB	Laboratory
BTH	Bathroom	GYM	Gymnasium	WAR	Warehouse/Storage	OT1	Other #1______________________
CMP	Computer Room	LIB	Library	VAC	Vacant	OT2	Other #2______________________
PRK	Parking	DIN	Dining Area				

Lamp Type Code

Code	Name	Code	Name	Code	Name
4F	4 Foot fluorescent	UT	U-tubes	CF	Compact fluorescent
6F	6 foot fluorescent	OF	Other fluorescent	EF	Exit sign, Fluorescent
8F	8 foot fluorescent				

Ballast Type Code

Code	Name
S	Standard Magnetic
H	High-Efficiency Magnetic
E	Electronic

EMHRP Ballast Use Codes

Code	Name
S	Still in Use - Same
A	Still in Use - Altered
N	Not in Use

Altered Use Codes

Code	Name
PR	Poor Repair/Maintenance
I	Improper Application
HI	Increased Hours Use
HD	Decreased Hours Use
LF	Lamp Failed/Not Replaced
LI	Lamp Replaced - Increased Wattage
LD	Lamp Replaced - Decreased Wattage

Not-in-Use Codes

Code	Name
B	Burned Out / Replaced
D	Damaged or Broken / Replaced
P	Pre-Failure Replacement
I	Improper Application
R	Removed or Disconnected/Not Replaced
N	Lighting/ Space Not in Use

Satisfaction Level Codes

Code	Name
4	Very Satisfied
3	Somewhat Satisfied
2	Somewhat Dissatisfied
1	Very Dissatisfied

Satisfaction/Dissatisfaction Reason Codes

Code	Name	Code	Name
S	Savings	P	Impact on Building Operations / Processes / Productivity
Q	Quality of Service Provided		
O	Ease of Operation	O1	Other #1 ______________________
M	Frequency/Ease of Maintenance	O2	Other #2 ______________________
R	Reliability/Failures	O3	Other #3 ______________________

Explain Any Rebated Ballasts Not in Use or Change in Use: ______________________________

CFBs (commercial) / T8 Lamps (commercial / industrial) Floorspace affected ___________ sq.ft.

Sampled Fixture Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Fixture Type										
Space Utilization Code										
Ballast Type										
Number of Lamps/Fixture										
1st Lamp in Fixture										
Lamp Type										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Lamp for EMHRP										
2nd Lamp in Fixture (if applicable)										
Lamp Type										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Lamp for EMHRP										
3rd Lamp in Fixture (if applicable)										
Lamp Type										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Lamp for EMHRP										
4th Lamp in Fixture (if applicable)										
Lamp Type										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Lamp for EMHRP										

Satisfaction with Lamp Installation _______________ Reasons for Satisfaction/Dissatisfaction ___________________

Lamp Type Code

Code	Name	Code	Name	Code	Name
4F	4 Foot fluorescent	OF	Other fluorescent	L	Low Pressure Sodium
6F	6 foot fluorescent	I	Incandescent	H	High Pressure Sodium
8F	8 foot fluorescent	IR	Incandescent Elliptical Reflector	MV	Mercury Vapor
UT	U-tubes	IS	Incandescent Spotlight	MH	Metal Halide
CF	Compact fluorescent	EI	Exit sign, Incandescent	EL	Exit sign, LED
EF	Exit sign, Fluorescent	Q	Quartz		

Ballast Type Code

Code	Name
S	Standard Magnetic
H	High-Efficiency Magnetic
E	Electronic

EMHRP Lamp Use Codes

Code	Name
S	Still in Use - Same
A	Still in Use - Altered
N	Not in Use

Altered Use Codes

Code	Name
PR	Poor Repair/Maintenance
I	Improper Application
HI	Increased Hours Use
HD	Decreased Hours Use
BI	Ballast Changed - Increased Wattage
BD	Ballast Changed - Decreased Wattage

Not-in-Use Codes

Code	Name
B	Burned Out / Replaced
D	Damaged or Broken / Replaced
P	Pre-Failure Replacement
I	Improper Application
R	Removed or Disconnected/Not Replaced
N	Lighting/ Space Not in Use

Explain Any EMHRP High Efficiency Lamps Not in Use or Change in Use:

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Delamping/Reflectors (commercial) Floorspace affected ___________ sq.ft.

Sampled Fixture Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Fixture Type										
Space Utilization Code										
Ballast Type										
Lamp Type										
Watts per Lamp										
Number of Lamps per Fixture										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										

Satisfaction with Delamping/Reflectors _______________ Reasons for Satisfaction/Dissatisfaction ___________________

EMHRP Use Codes

Code	Name
S	Still in Use - Same Use
A	Still in Use- Altered Use
N	Not in Use

Altered Use Codes

Code	Name
PR	Poor Repair/Maintenance
I	Improper Application
HI	Increased Hours Use
HD	Decreased Hours Use
LR	Some Lamps Reinstalled
LI	Lamp or Ballast Changed - Increased Wattage
LD	Lamp or Ballast Changed - Decreased Wattage

Not-in-Use Codes

Code	Name
B	Reflectors Broken or Damaged/Replaced w/ Same
R	Reflectors Removed/Not Replaced
LR	All Lamps Reinstalled
I	Improper Application
N	Lighting/ Space Not in Use

Explain Any EMHRP Delamping/Reflectors Not in Place or Change in Use:

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Adjustable Speed Drives (commercial/industrial)

Sampled ASD Number	**1**	**2**
ASD Type		
Motor Service		
Motor Type (AC/DC)		
Size (hp)		
Hours per Week		
EMHRP ASD Use Codes		
Altered Use Codes		
Not-in-Use Codes		
Date Not in Use (MM/YY)		
Replacement Type for EMHRP ASD		
Subsystem Failure Codes		

Satisfaction with ASD Installation _______________ Reasons for Satisfaction/Dissatisfaction ___________________

Motor Service			**ASD Type**
HP: Hot Water Pump	SF: Supply Fan	C: Compressor	PWM: Pulse Width Modulator
CP: Chilled Water Pump	RF: Return Fan	M : Material Handling	CSI: Current Source Inverter
CH: Chilled/Hot Water Pump	EF : Exhaust Fan	T : Machine Tool	VSI: Voltage Source Inverter
CW: Condenser Water Pump	CF: Cooling Tower Fan	G : Grinding/milling	
IP: Irrigation Pump	OF: Other Fan	S : Separation	
PP: Process Pump		E : Environmental	
OP: Other Pump		V: Vertical Transport	
		O : Other	

EMHRP ASD Use Codes		**Altered Use Codes**		**Not-in-Use Codes**	
Code	**Name**	**Code**	**Name**	**Code**	**Name**
S	Still in Use - Same Use	PR	Poor Repair/Maintenance	B	Burned Out/ Replaced
A	Still in Use - Altered Use	I	Improper Application	DS	Damaged or Broken /Replaced
N	Not in Use	HI	Increased Hours Motor Use	P	Pre-Failure Replacement
		HD	Decreased Hours Motor Use	I	Improper Application
		R	ASD Reprogrammed	R	Removed or Disconnected/Not Replaced
		O	Manual Override to Constant Speed	N	Motor Not in Use
		IT	Isolation Transformer for Harmonics		
		MI	Motor Changed - Increased Load		
		MD	Motor Changed - Decreased Load		

Subsystem Failure Codes	
Code	**Name**
VB	Variable Ratio Belt Failure
MC	Magnetic (eddy current) Clutch Failure
HS	Heat Sink Fan Failure
MB	Motor Bearing/Oil Seal Failure
IR	Inverter/Rectifier Failure

Explain Any EMHRP ASDs Not in Use or Change in Use: ________________________________

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High Efficiency Pumps / Pump System Improvements (industrial)

Sampled Pump Number	**1**	**2**
Pump Service		
Control Type		
Size (hp)		
Hours per Week		
EMHRP Pump Use Code		
Altered Use Codes		
Not-in-Use Codes		
Date Not-in-Use (MM/YY)		
Replacement Pump Size		

Satisfaction with Pumps _______________ Reasons for Satisfaction/Dissatisfaction ___________________

EMHRP Pump Use Codes		**Altered Use Codes**		**Not-in-Use Codes**	
Code	**Name**	**Code**	**Name**	**Code**	**Name**
S	Still in Place - Same Use	PR	Poor Repair/Maintenance	B	Burned Out/ Replaced
A	Still in Place - Altered Use	I	Improper Application	D	Damaged or Broken / Replaced
N	Not in Place	HI	Increased Hours Pump Use	P	Pre-Failure Replacement
		HD	Decreased Hours Pump Use	I	Improper Application
		FS	Set to Fixed Speed	R	Removed or Disconnected/Not Replaced
		VS	Variable Speed Drive Added	N	Pump Not in Use

Pump Service	**Control Type**
H: Hot Water	1=Fixed Speed
C: Chilled Water	2=Variable Speed
CH: Chilled/Hot Water	
CW: Condenser Water	
I: Irrigation	
P: Process	
O: Other	

Explain Any EMHRP Pumps Not in Use or Change in Use: ____________________

High Efficiency Chillers (commercial)

Cooling Equipment Type	
Output Capacity (Tons)	
Backup 1 = No 2 = Yes	
Operating Hours per Week	
EMHRP Chiller Use Code	
Altered Use Codes	
Not-in-Use Codes	
Date Not-in-Use (MM/YY)	
Subsystem Failure Codes	

*** Cooling equipment type :**
C = Centrifugal
R = Reciprocating
S = Screw Compressor

Satisfaction with High Efficiency Chillers ______________ Reasons for Satisfaction/Dissatisfaction ___________________

EMHRP Chiller Use Codes		**Altered Use Codes**		**Not-in-Use Codes**	
Code	**Name**	**Code**	**Name**	**Code**	**Name**
S	Still in Place - Same Use	PR	Poor Repair/Maintenance	F	Failed
A	Still in Place - Altered Use	I	Improper Application	D	Damaged or Broken
N	Not in Place	HI	Increased Hours Chiller Use	I	Improper Application
		HD	Decreased Hours Chiller Use	R	Removed or Disconnected
		HT	Higher Chilled Water Temperature	N	Chiller / Area Not in Use
		LT	Lower Chilled Water Temperature		
		R	Different Refrigerant		

Subsystem Failure Codes	
Code	**Name**
CM	Compressor Motor Failure
RL	Refrigerant / Oil Leak
EC	Chiller Electric Control Failure
T	Thermostat Failure
TS	Temperature Sensor Failure
RV	High Pressure Relief Valve Failure
DV	Discharge Valve Failure
SL	Suction Line Strainer Failure
CF	Built-up System Component Failure

Explain Any EMHRP High Efficiency Chillers Not in Use or Change in Use:

HVAC Energy Management System (commercial)

Systems Controlled	Current	When Installed
Number of Chillers		
Number of Boilers		
Number of Furnaces		
Number of Supply Fans		
Number of Return Fans		
Number of Hot Water Pumps		
Number of Chilled Water Pumps		
Number of Hot/Chilled Water Pumps		
Thermal Energy Storage? 1=No 2=Yes		
Heat Recovery System? 1=No 2=Yes		

Control Strategies 1=No 2=Yes	Current	When Installed
Night Temperature Setback		
Optimum Start/Stop		
Staggered Start		
Chilled Water Temperature Reset		
Hot Water Temperature Reset		
Economizer Dampers		
Peak Demand Limiting		
Duty Cycling		
Monitoring Equipment		

Conditioned Hours per Week	
Employee Access 1=No 2=Yes	
EMHRP EMS Use Code	
Altered Use Codes	
Not-in-Use Codes	
Date Not in Use (MM/YY)	
Subsystem Failure Codes	

Satisfaction with EMS _______________ Reasons for Satisfaction/Dissatisfaction _______________________

EMHRP EMS Use Codes

Code	Name
S	Still in Place - Same Use
A	Still in Place - Altered Use
N	Not in Place

Altered Use Codes

Code	Name
PR	Poor Repair/Maintenance
I	Improper Application
HI	Increased Hours HVAC Use
HD	Decreased Hours HVAC Use
S	Change in Systems Controlled
SE	Change in Efficiency of Systems Controlled
SO	Change in Operations of Systems Controlled

Not-in-Use Codes

Code	Name
FR	Failed
DS	Damaged or Broken
I	Improper Application
R	Removed or Disconnected
N	System/ Area Not in Use

Subsystem Failure Codes

Code	Name
SF	Temperature/Pressure Humidity Sensor Failure
DF	Data Communication Failure
AF	Actuator Failure

Explain Any EMHRP EMS Not in Use or Change in Use:

Notes

Appendix B

BASELINE ON-SITE DATA COLLECTION FORM: INDUSTRIAL SECTOR MEASURES

Data Entry	Date	Checked	Date	Received	Surveyed	Date	ID Number

Southern California Edison

EMHR Program Measure Retention Survey

1993 Industrial Final

7/26/95

Table of Contents

Introductory Information

Survey Date: (month/day/year) __ __ /__ __ /__ __

Surveyor: __

Business Name: __

Street Address: __

City, State: __ , __ __

Zip Code: __ __ __ __ __ - __ __ __ __

Business Contact

Name: __

Title: __

Phone # ( ): (__ __ __) __ __ __ __ __ __ __ ext. __ __ __ __

FAX # ( ): (__ __ __) __ __ __ __ __ __ __

Establishment Site Activity

Office:	Administration and management	011	Restaurant:	Fast Food or Self Service	021
	Financial / Legal	012		Table Service	022
	Insurance/Real Estate	013		Bar/Tavern/Nightclub/Other	023
	Other Office	014			
Food Store:	Supermarket	031	Retail Store:	Department / Variety Store	041
	Convenience Store	032		Shop in Enclosed Mall	042
	Other Food Store	033		Other Retail Store	043
Warehouse:	Refrigerated Warehouse	051	Health Care:	Hospital	061
	Nonrefrigerated Warehouse	052		Nursing Home	062
				Medical Office	063
				Clinic/Outpatient Care	064
Education:	Daycare or Preschool	071	Lodging:	Hotel	081
	Elementary / Secondary School	072		Motel	082
	College or University	073			
	Vocational or Trade School	074			
Public Assembly:	Church	091	Services:	Gas Station / Auto Repair	101
	Recreational or Other	092		Repair (Non-Auto)	102
				Other Service Shop	103
Manufacturing:	Assembly / Light Mfg.	111			
	Med/Heavy Equip. Mfg.	112	Other:	Describe	120
	Food/Beverage Processor	113		Construction	121
	Mining	114		Agriculture	122

Establishment site activity: ___________

Activity/Product Description ____

____

____

SIC Code: (In-house) ___________

General Information

How many buildings at this location?	
Year main building built?	
Year business established in the building?	
Percent of building occupied by this establishment?	

Floor Space

Total square feet ___________________________ Percent Heated _____________ Percent Cooled _____________

Fuel Use

		1 = No 2 = Yes
Fuel type utilized by the establishment:	Electricity Gas Oil LPG Wood Solar Coal/Coke Purchased Steam Purchased Chilled Water Other (describe) ________ ____________________	__ __ __ __ __ __ __ __ __ __

Electric Accounts

Business Operating Hours & Employees

	Opening Time	Closing Time
Weekday	__ __ __ __	__ __ __ __
Weekend & Holiday	__ __ __ __	__ __ __ __

Number of employees in establishment? __ __ __ __ __

Changes in Building Occupancy and Renovations

Have there been any significant changes in occupancy since 1992? 1=No 2=Yes	
Date of Occupancy Change (MM/YY)	
Percent of Floorspace Affected by Occupancy Change	%

Rebated Equipment Use Affected by Occupancy Change (check all that apply):

- ☐ Electronic Ballasts (commercial / industrial)
- ☐ CFBs - modular (commercial)
- ☐ T8 Lamps (commercial / industrial)
- ☐ Delamping/Reflectors (commercial)
- ☐ HVAC EMS (commercial)
- ☐ High Eff. Chillers (commercial)
- ☐ ASDs (commercial / industrial)
- ☐ High Efficiency Pumps (industrial)
- ☐ Pump System Hardware Improvements ((industrial)

Did the facility tenant change during this occupancy change? 1=No 2=Yes __
If yes, establishment site activity at time of EMHRP installation: ___________
Activity/Product Description at time of EMHRP installation: ____________________________

____

____

Did the number of employees change during this occupancy change? 1=No 2=Yes __
If yes, number of employees at time of EMHRP installation: __ __ __ __ __

Did the operating schedule change during this occupancy change? 1=No 2=Yes __
If yes, enter the previous schedule

	Opening Time	Closing Time
Weekday	__ __ __ __	__ __ __ __
Weekend & Holiday	__ __ __ __	__ __ __ __

Describe the change in building occupancy and use:

____

____

____

____

____

____

Have there been any significant renovations since 1992? 1=No 2=Yes	
If yes, type of renovation A=Space addition R=Space reduction C=conversion to new use	
Date of Renovation (MM/YY)	
Percent of Floorspace Affected by Renovation	%

Rebated Equipment Use Affected by Renovation (check all that apply):

- ☐ Electronic Ballasts (commercial / industrial)
- ☐ CFBs - modular (commercial)
- ☐ T8 Lamps (commercial / industrial)
- ☐ Delamping/Reflectors (commercial)
- ☐ HVAC EMS (commercial)
- ☐ High Eff. Chillers (commercial)
- ☐ ASDs (commercial / industrial)
- ☐ High Efficiency Pumps (industrial)
- ☐ Pump System Hardware Improvements ((industrial)

Describe this building renovation:

____

____

____

____

Energy Management Hardware Rebate Program Measures

Measure	Installed Under 1993 EMHRP		Installed Under 1994 EMHRP	
	new	**replacmt.**	**new**	**replacmt.**
Commercial Sector				
Electronic Ballasts	☐	☐	☐	☐
CFBs (modular)	☐	☐	☐	☐
T8 Lamps	☐	☐	☐	☐
Delamping/reflectors	☐	☐	☐	☐
HVAC EMS Systems	☐	☐	☐	☐
High Efficiency Chillers	☐	☐	☐	☐
ASDs (commercial)	☐	☐	☐	☐
Industrial & Agricultural				
ASDs (industrial)	☐	☐	☐	☐
High Efficiency Pumps	☐	☐	☐	☐
Pump System (hardware) Improvements	☐	☐	☐	☐
Electronic Ballasts	☐	☐	☐	☐
T8 Lamps	☐	☐	☐	☐

Electronic Ballasts (commercial / industrial)

Sampled Fixture Number	1	2	3	4	5	6	7	8	9	10
Fixture Type										
Space Utilization Code										
Lamp Type										
Watts/Lamp										
Number of Ballasts/Fixture										
1st Ballast in Fixture										
Number of Lamps/Ballast										
Hours per Week										
EMHRP Ballast Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Ballast for EMHRP										
2nd Ballast in Fixture (if applicable)										
Number of Lamps/Ballast										
Hours per Week										
EMHRP Ballast Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Ballast for EMHRP										

Satisfaction with Ballast Installation ______________ Reasons for Satisfaction/Dissatisfaction ________________

Space Utilization Code

Code	Name	Code	Name	Code	Name	Code	Name
OFF	Office	LOD	Lodging	FDS	Food Service Preparation	INC	Industrial/Mechanical (conditioned)
HAL	Hall	CLS	Classroom	GRC	Grocery	INU	Industrial/Mechanical (unconditioned)
ATR	Lobby/Atrium	ASY	Assembly	RET	Retail	LAB	Laboratory
BTH	Bathroom	GYM	Gymnasium	WAR	Warehouse/Storage	OT1	Other #1____________________
CMP	Computer Room	LIB	Library	VAC	Vacant	OT2	Other #2____________________
PRK	Parking	DIN	Dining Area				

Lamp Type Code

Code	Name	Code	Name	Code	Name
4F	4 Foot fluorescent	UT	U-tubes	CF	Compact fluorescent
6F	6 foot fluorescent	OF	Other fluorescent	EF	Exit sign, Fluorescent
8F	8 foot fluorescent				

Ballast Type Code

Code	Name
S	Standard Magnetic
H	High-Efficiency Magnetic
E	Electronic

EMHRP Ballast Use Codes

Code	Name
S	Still in Use - Same
A	Still in Use - Altered
N	Not in Use

Altered Use Codes

Code	Name
PR	Poor Repair/Maintenance
I	Improper Application
HI	Increased Hours Use
HD	Decreased Hours Use
LF	Lamp Failed/Not Replaced
LI	Lamp Replaced - Increased Wattage
LD	Lamp Replaced - Decreased Wattage

Not-in-Use Codes

Code	Name
B	Burned Out / Replaced
D	Damaged or Broken / Replaced
P	Pre-Failure Replacement
I	Improper Application
R	Removed or Disconnected/Not Replaced
N	Lighting/ Space Not in Use

Satisfaction Level Codes

Code	Name
4	Very Satisfied
3	Somewhat Satisfied
2	Somewhat Dissatisfied
1	Very Dissatisfied

Satisfaction/Dissatisfaction Reason Codes

Code	Name	Code	Name
S	Savings	P	Impact on Building Operations / Processes / Productivity
Q	Quality of Service Provided		
O	Ease of Operation	O1	Other #1 ____________________
M	Frequency/Ease of Maintenance	O2	Other #2 ____________________
R	Reliability/Failures	O3	Other #3 ____________________

Explain Any Rebated Ballasts Not in Use or Change in Use: ____

____

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____

CFBs (commercial) / T8 Lamps (commercial / industrial)

Sampled Fixture Number	1	2	3	4	5	6	7	8	9	10
Fixture Type										
Space Utilization Code										
Ballast Type										
Number of Lamps/Fixture										
1st Lamp in Fixture										
Lamp Type										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Lamp for EMHRP										
2nd Lamp in Fixture (if applicable)										
Lamp Type										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Lamp for EMHRP										
3rd Lamp in Fixture (if applicable)										
Lamp Type										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Lamp for EMHRP										
4th Lamp in Fixture (if applicable)										
Lamp Type										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										
Replacement Lamp for EMHRP										

Satisfaction with Lamp Installation _______________ Reasons for Satisfaction/Dissatisfaction ___________________

Lamp Type Code

Code	Name	Code	Name	Code	Name
4F	4 Foot fluorescent	OF	Other fluorescent	L	Low Pressure Sodium
6F	6 foot fluorescent	I	Incandescent	H	High Pressure Sodium
8F	8 foot fluorescent	IR	Incandescent Elliptical Reflector	MV	Mercury Vapor
UT	U-tubes	IS	Incandescent Spotlight	MH	Metal Halide
CF	Compact fluorescent	EI	Exit sign, Incandescent	EL	Exit sign, LED
EF	Exit sign, Fluorescent	Q	Quartz		

Ballast Type Code

Code	Name
S	Standard Magnetic
H	High-Efficiency Magnetic
E	Electronic

EMHRP Lamp Use Codes		**Altered Use Codes**		**Not-in-Use Codes**	
Code	Name	Code	Name	Code	Name
S	Still in Use - Same	PR	Poor Repair/Maintenance	B	Burned Out / Replaced
A	Still in Use - Altered	I	Improper Application	D	Damaged or Broken / Replaced
N	Not in Use	HI	Increased Hours Use	P	Pre-Failure Replacement
		HD	Decreased Hours Use	I	Improper Application
		BI	Ballast Changed - Increased Wattage	R	Removed or Disconnected/Not Replaced
		BD	Ballast Changed - Decreased Wattage	N	Lighting/ Space Not in Use

Explain Any EMHRP High Efficiency Lamps Not in Use or Change in Use:

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Delamping/Reflectors (commercial)

Sampled Fixture Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Fixture Type										
Space Utilization Code										
Ballast Type										
Lamp Type										
Watts per Lamp										
Number of Lamps per Fixture										
Hours per Week										
EMHRP Lamp Use Code										
Altered Use Code										
Not-in-Use Code										
Date Not in Use (MM/YY)										

Satisfaction with Delamping/Reflectors _______________ Reasons for Satisfaction/Dissatisfaction ___________________

EMHRP Use Codes		**Altered Use Codes**		**Not-in-Use Codes**	
Code	**Name**	**Code**	**Name**	**Code**	**Name**
S	Still in Use - Same Use	PR	Poor Repair/Maintenance	B	Reflectors Broken or Damaged/Replaced w/ Same
A	Still in Use- Altered Use	I	Improper Application	R	Reflectors Removed/Not Replaced
N	Not in Use	HI	Increased Hours Use	LR	All Lamps Reinstalled
		HD	Decreased Hours Use	I	Improper Application
		LR	Some Lamps Reinstalled	N	Lighting/ Space Not in Use
		LI	Lamp or Ballast Changed - Increased Wattage		
		LD	Lamp or Ballast Changed - Decreased Wattage		

Explain Any EMHRP Delamping/Reflectors Not in Place or Change in Use:

Adjustable Speed Drives (commercial/industrial)

Sampled ASD Number	**1**	**2**
ASD Type		
Motor Service		
Motor Type (AC/DC)		
Size (hp)		
Hours per Week		
EMHRP ASD Use Codes		
Altered Use Codes		
Not-in-Use Codes		
Date Not in Use (MM/YY)		
Replacement Type for EMHRP ASD		
Subsystem Failure Codes		

Satisfaction with ASD Installation _______________ Reasons for Satisfaction/Dissatisfaction ___________________

Motor Service			**ASD Type**
HP: Hot Water Pump	SF: Supply Fan	C: Compressor	PWM: Pulse Width Modulator
CP: Chilled Water Pump	RF: Return Fan	M : Material Handling	CSI: Current Source Inverter
CH: Chilled/Hot Water Pump	EF : Exhaust Fan	T : Machine Tool	VSI: Voltage Source Inverter
CW: Condenser Water Pump	CF: Cooling Tower Fan	G : Grinding/milling	
IP: Irrigation Pump	OF: Other Fan	S : Separation	
PP: Process Pump		E : Environmental	
OP: Other Pump		V: Vertical Transport	
		O : Other	

EMHRP ASD Use Codes		**Altered Use Codes**		**Not-in-Use Codes**	
Code	**Name**	**Code**	**Name**	**Code**	**Name**
S	Still in Use - Same Use	PR	Poor Repair/Maintenance	B	Burned Out/ Replaced
A	Still in Use - Altered Use	I	Improper Application	DS	Damaged or Broken /Replaced
N	Not in Use	HI	Increased Hours Motor Use	P	Pre-Failure Replacement
		HD	Decreased Hours Motor Use	I	Improper Application
		R	ASD Reprogrammed	R	Removed or Disconnected/Not Replaced
		O	Manual Override to Constant Speed	N	Motor Not in Use
		IT	Isolation Transformer for Harmonics		
		MI	Motor Changed - Increased Load		
		MD	Motor Changed - Decreased Load		

Subsystem Failure Codes	
Code	**Name**
VB	Variable Ratio Belt Failure
MC	Magnetic (eddy current) Clutch Failure
HS	Heat Sink Fan Failure
MB	Motor Bearing/Oil Seal Failure
IR	Inverter/Rectifier Failure

Explain Any EMHRP ASDs Not in Use or Change in Use: ______________________________

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High Efficiency Pumps / Pump System Improvements (industrial)

Sampled Pump Number	**1**	**2**
Pump Service		
Control Type		
Size (hp)		
Hours per Week		
EMHRP Pump Use Code		
Altered Use Codes		
Not-in-Use Codes		
Date Not-in-Use (MM/YY)		
Replacement Pump Size		

Satisfaction with Pumps _______________ Reasons for Satisfaction/Dissatisfaction __________________

EMHRP Pump Use Codes		**Altered Use Codes**		**Not-in-Use Codes**	
Code	**Name**	**Code**	**Name**	**Code**	**Name**
S	Still in Place - Same Use	PR	Poor Repair/Maintenance	B	Burned Out/ Replaced
A	Still in Place - Altered Use	I	Improper Application	D	Damaged or Broken / Replaced
N	Not in Place	HI	Increased Hours Pump Use	P	Pre-Failure Replacement
		HD	Decreased Hours Pump Use	I	Improper Application
		FS	Set to Fixed Speed	R	Removed or Disconnected/Not Replaced
		VS	Variable Speed Drive Added	N	Pump Not in Use

Pump Service	**Control Type**
H: Hot Water	1=Fixed Speed
C: Chilled Water	2=Variable Speed
CH: Chilled/Hot Water	
CW: Condenser Water	
I: Irrigation	
P: Process	
O: Other	

Explain Any EMHRP Pumps Not in Use or Change in Use:

High Efficiency Chillers (commercial)

Cooling Equipment Type	
Output Capacity (Tons)	
Backup 1 = No 2 = Yes	
Operating Hours per Week	
EMHRP Chiller Use Code	
Altered Use Codes	
Not-in-Use Codes	
Date Not-in-Use (MM/YY)	
Subsystem Failure Codes	

*** Cooling equipment type :**
C = Centrifugal
R = Reciprocating
S = Screw Compressor

Satisfaction with High Efficiency Chillers _______________ Reasons for Satisfaction/Dissatisfaction ____________________

EMHRP Chiller Use Codes		**Altered Use Codes**		**Not-in-Use Codes**	
Code	**Name**	**Code**	**Name**	**Code**	**Name**
S	Still in Place - Same Use	PR	Poor Repair/Maintenance	F	Failed
A	Still in Place - Altered Use	I	Improper Application	D	Damaged or Broken
N	Not in Place	HI	Increased Hours Chiller Use	I	Improper Application
		HD	Decreased Hours Chiller Use	R	Removed or Disconnected
		HT	Higher Chilled Water Temperature	N	Chiller / Area Not in Use
		LT	Lower Chilled Water Temperature		
		R	Different Refrigerant		

Subsystem Failure Codes	
Code	**Name**
CM	Compressor Motor Failure
RL	Refrigerant / Oil Leak
EC	Chiller Electric Control Failure
T	Thermostat Failure
TS	Temperature Sensor Failure
RV	High Pressure Relief Valve Failure
DV	Discharge Valve Failure
SL	Suction Line Strainer Failure
CF	Built-up System Component Failure

Explain Any EMHRP High Efficiency Chillers Not in Use or Change in Use: ____________________

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HVAC Energy Management System (commercial)

Systems Controlled	Current	When Installed
Number of Chillers		
Number of Boilers		
Number of Furnaces		
Number of Supply Fans		
Number of Return Fans		
Number of Hot Water Pumps		
Number of Chilled Water Pumps		
Number of Hot/Chilled Water Pumps		
Thermal Energy Storage? 1=No 2=Yes		
Heat Recovery System? 1=No 2=Yes		

Control Strategies 1=No 2=Yes	Current	When Installed
Night Temperature Setback		
Optimum Start/Stop		
Staggered Start		
Chilled Water Temperature Reset		
Hot Water Temperature Reset		
Economizer Dampers		
Peak Demand Limiting		
Duty Cycling		
Monitoring Equipment		

Conditioned Hours per Week	
Employee Access 1=No 2=Yes	
EMHRP EMS Use Code	
Altered Use Codes	
Not-in-Use Codes	
Date Not in Use (MM/YY)	
Subsystem Failure Codes	

Satisfaction with EMS _______________ Reasons for Satisfaction/Dissatisfaction _______________________

EMHRP EMS Use Codes

Code	Name
S	Still in Place - Same Use
A	Still in Place - Altered Use
N	Not in Place

Altered Use Codes

Code	Name
PR	Poor Repair/Maintenance
I	Improper Application
HI	Increased Hours HVAC Use
HD	Decreased Hours HVAC Use
S	Change in Systems Controlled
SE	Change in Efficiency of Systems Controlled
SO	Change in Operations of Systems Controlled

Not-in-Use Codes

Code	Name
FR	Failed
DS	Damaged or Broken
I	Improper Application
R	Removed or Disconnected
N	System/ Area Not in Use

Subsystem Failure Codes

Code	Name
SF	Temperature/Pressure Humidity Sensor Failure
DF	Data Communication Failure
AF	Actuator Failure

Explain Any EMHRP EMS Not in Use or Change in Use: ______________________________

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Notes

Appendix C

PROCEDURES MANUAL FOR ON-SITE DATA COLLECTION FORM

Procedure Manual
for On-Site Surveys of Southern California Edison Customers
for the 1993-1994 Energy Management Hardware Rebate Program
Measure Retention Study

July 31, 1995

Prepared by:

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Table of Contents

Introduction

The purpose of this survey is to provide detailed information on the current status of conservation retrofit measures which were adopted under Southern California Edison's Hardware Rebate Program. Analysts and decision makers will use this information to evaluate the persistence of savings due to the Hardware Rebate Program over time. To accomplish this you will be collecting detailed data on the building characteristics, changes in building operations, and changes in the use of the Hardware Rebate Program equipment for each site you visit. Your visit to Edison's customers will be followed over the next three years by additional visits and telephone surveys to identify changes in the equipment use over time. The data you collect is important because it forms the first and most detailed description of the sites. Future data collection will depend on the accuracy of these surveys and on the correct marking of the equipment examined for future identification. The survey sites have been selected via statistical sampling to represent the industrial and commercial populations in Edison service area. Accuracy in the data collection, therefore, is crucial, as it will represent a large number of sites.

The tool that will be used to gather this data is the Survey Instrument or 'form' as it is usually referred. Instructions for completing the form are presented in this manual on a question by question basis. The materials in this Manual should answer most of your questions. Any questions that cannot be answered by this Manual should be addressed to Jay Parkarinen or Bruce Rittenhouse at the ADM Sacramento office.

1. Conducting the Survey

Before leaving for the field you will have a schedule (Figure 1) showing the facilities to be surveyed and the time allotted to conduct the survey . The name and phone number of the contact person at the site are provided on the customer contact sheet (Figure 2). The appointments will be setup by our main office in Sacramento and confirmed with a follow-up letter. If you are going to be late for an appointment, call the contact to ensure that he/she will be able to meet with you at a later time. Keep in mind that this person is doing you a favor by agreeing to meet with you and that your conduct is critical in making this a smooth and successful survey .

Be aware of the types of information you will be gathering. This will enable you to identify potential difficulties in obtaining accurate information as you approach the site, conduct the interview, and are given a tour of the site. You will probably have questions about some of the things you observe. You will usually have two opportunities for obtaining the answers. The first opportunity is to ask a worker in the immediate area. This should be done with a minimal amount of interference. The second opportunity is to ask the contact person. If you are surveying without the benefit of an escort, save your questions and review them with the contact person before leaving the site.

The survey form has been organized to guide you in the data collection. It contains tables that you will use to document all the information obtained during the survey of the building. You must complete all questions and entries which relate to the building and business, and all questions relating to the types equipment for which the Edison customer received a rebate. A list of rebated equipment for the site can be found on the customer contact sheet. The following section will describe in detail each page and question of the survey form.

Survey or Schedule for the Week of: ________________________ **Project:** ___________________

Location: ____________________ **Engineer:** ____

DATE	First Appointment	Second Appointment	Third Appointment
Monday __ / __			
Tuesday __ / __			
Wednesday __ / __			
Thursday __ / __			
Friday __ / __			
Saturday __ /__			
Sunday __ /__			

Figure 1. Survey Schedule Form

Southern California Edison 1993-94 Hardware Rebate Program Retention Study
Customer Information Call Sheet

Customer Information

Premise	________		
Account Number(s)	________	________	________
Customer Name	________________		
Service Address	________________		
	________________		
Contact Person	________________		
Phone Number	________		
SIC Code	________	Climate Zone	________
Annual kWh	________	kW Demand	________

Appointment Information

Date	________	Day of Week	________
Time	________	Engineer	________

Site Information

Rebated Equipment Type	Program Year	Estimated kWh Savings
T-8 Lamps	____	________
electronic ballasts	____	________
reflectors	____	________
delamped fixtures	____	________
ASDs	____	________
high efficiency pumps	____	________
pump hardware improvements	____	________
chillers	____	________
EMS	____	________

Figure 2. Customer Contact Sheet

2. Survey Instrument Questions

This chapter will describe the form in detail by expanding on each question and entry as necessary. You should consult this section first if you have any questions regarding the form or how to properly record the information you have collected.

General

The survey form consists of two major sections: the interview portion and the data collection portion. There will be some overlap in that you will need to ask questions during the interview to properly complete portions of the data collection.

Recording Methods:

- All of what you collect will be entered into a database, therefore many of your entries will have to be 'coded.' Appropriate codes are included in the form at the bottom of each page as necessary. There is space for comments if you are unsure of the correct code or need to describe why it doesn't fit a particular code.

- All zeroes are written with an overstrike (Ø) to differentiate them from the letter 'O'.

- Many questions require a yes or no answer. For this survey we will use the convention that 1 = No and 2 = Yes.

- Do not use fractions when recording values, use decimals. Write 1.25 **not** 1¼

- For some questions an answer may not be given; use the following codes to indicate the reason:

  ' -7 ' if the question **does not apply** to them
  ' -8 ' **if it applies** but the answer can't be determined (e.g. the nameplate is missing from a motor, they don't know the horsepower, and you can't make a good estimate.)
  ' -9 ' if customer declines to answer the question.

- Use a pencil with number 2 lead when filling out the forms. Do **<u>not</u>** use ink.

- The information you will record is to be input into a computer data base. <u>Please</u> print legibly so that the data entry personnel do not have to struggle to read the data.

- Because this information is to be entered into a computer database many of the entries (fields) are limited in length. In these situations the maximum length is indicated by a series of lines (__ __ __.) Write only one character per line. Characters include numbers, letters, commas, periods, spaces, brackets, etc. Because of this you may need to abbreviate some of your entries. Make the abbreviations as clear as possible.

- Before you start the interview ask your contact if he has building plans and energy bills available. These items were asked for when your appointment was made, but they may not be ready when you arrive.

- After completing the interview portion inform your contact that you would like to conduct an inspection of the facility to gather an inventory of equipment. If he/she will not be accompanying you inform him/her that you will check with him/her before you leave. If you have questions about what you see during your walk through you can obtain the answers when you check out with your contact.

Page 1. Cover Page

ID Number Enter building Premise number from the contact sheet. The contact sheet (Figure 2) will be provided to you prior to the on-site visit. Re-enter this number on every subsequent page.

Data Entry / Date Leave blank, for office use only.

Checked / Date Leave blank, for office use only.

Received Leave blank, for office use only.

Surveyed Enter your initials.

Date Enter the date of your visit to the site

ID Number Re-enter building Premise number from the top of the page.

Page 2. Table of Contents

No entries required.

Page 3. Introductory Information

Survey Date: Record the date you complete the on-site work: (mm/dd/yy)

Surveyor: Record your name. Use the same form of your name for each survey ; we do not want J. Smith on some and John Smith on others.

Business Name: Record the business name of the survey site. Make sure that this is the same business as identified on the contact sheet.

Street: Record the street address of the survey site.

City, State: Record the name of the city and state of the survey site.

Zip Code: Record the 5-digit zip code (or 9-digit if available) for the survey site.

Business Contact:

Name: Record the name of primary contact of the survey site. (The name of the individual who gives you permission to survey the building. This could be the building owner, property manager, or a major tenant in a multi-tenant building.)

Title: Record the contact person's official title.

Phone #: Write in the telephone number of the primary contact. Include the extension if appropriate.

FAX #: Write in the FAX number of the primary contact if there is one.

Establishment site activity: The Establishment Site Activity types are listed in the table on page 4. The entry for this item should most closely describe the major use of the site. If the site is a multi-tenant building, enter the code that best describes the major tenant or the primary business type of the site.

Activity/Product Description:
Give more detailed description of the site that the codes provide. Example: “Regional headquarters of lighting manufacturer, all office activity”

SIC Code: (In house) Leave this entry blank.

Page 4. General Information

How many buildings? Record the number of buildings used by the establishment at the survey site. A building is defined as a structure that has no permanent openings to the outdoors. See Figure 3.

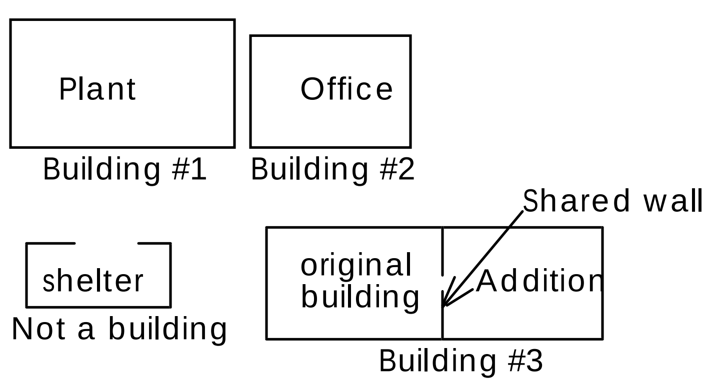


Figure 3. Example of Building Counts

Year main building built? Record the year the survey building, or main building of a multi building site, was originally constructed. Possible sources of this information include the building plans, the cornerstone, or interviews with site contacts. If the information is not available from one of these sources, you should estimate the year of construction by examining the condition of the building.

Year business established in the building?
The year the business was established at the survey site.

Percent of building occupied by this establishment? Indicate the percentage of the space occupied by the establishment in this building.

Fuel Use The purpose of this section is to map energy consumption to specific end uses through utility billing records. The person providing the account number should have a good idea of the areas and loads served by the account. Meters can present more of a problem. They may be in a remote location and may not have any identifying information as to what areas and loads they serve or what accounts they correspond to. However, the documentation of meter numbers is important, as they will help to obtain the correct utility billing histories for specific end uses. Care should be taken to record the meter number and not the meter serial number.

Fuel type utilized by the establishment:
Indicate all types of energy used by this establishment. Answer with 1 = No 2 = Yes for each of the following fuel types.

Electricity	**LPG**
Gas	**Solar**
Oil	**Purchased Steam**

Do electric account numbers match those indicated by the sample selection for this building ?
Answer with 1 = No 2 = Yes 3 = Not Verified (no utility data present on contact sheet). You should be able to verify the account by comparing the customers bills to the account number printed on the contact sheet.

Record all electric utility accounts and corresponding meters in the table provided. There may be more than one meter per account, in which case you would repeat the account number for each meter on the account.

Account Number: Record the utility account number. This should be obtained from the site contact and checked against the number listed on your customer contact sheet.

Meter Number: Record meter number for the account. This can be obtained from the utility bill or from the meter. Care must be taken to record the meter number and not the meter serial number.

Code: This column is to identify the end-use(s) of each individual meter. Enter the code for each end use served. The codes are provided in the table at the bottom of the page.

List meter numbers affected by EMHRP lighting retrofits.
Enter the meter identification numbers from the first column of the previous table, which serve the area in which T8 lamps, compact fluorescent lamps, electronic ballasts, reflectors were installed, or where fixtures were delamped, under the Hardware Rebate Program. It may be necessary to first an employee with knowledge of the program to identify areas where the retrofit took place, and then to find a second employee to identify which meter(s) serve that area.

Page 5. Business Hours, Employees, and Changes in Occupancy

Business Operating Hours and Employees
This information should be obtained in the interview. For each day type (Weekday, Saturday, and Sunday/Holiday), enter the start time and end time of each period in which occupancy changes, and add the percentage of total occupants who would be present during that period. Do not enter for any period in which occupancy is zero. Any period for which no entry is made will be assumed to have zero occupancy.

Number of Employees in Establishment Enter the highest number of employees which are present at the site at any one time.

Operating Hours Change with Season Enter 1 if occupancy schedules do not change over the course of the year. Enter 2 if they do change over the course of the year.

If you checked 2, that operating hours change with season, then fill in the following table. Ask the contact person which months have higher than average operating levels, which are lower than average, and which are about average.

Changes in Building Occupancy and Renovations

Significant Changes in Occupancy Since 1992. This information will be obtained in the interview. Enter 2 if the building's tenant has changed, the number of employees has changed significantly, the operating schedule has changed, or the seasonal differences in building operations have changed since January 1992. Otherwise enter 1. If no significant changes in occupancy occurred, you may skip the rest of this page. If more than one change has occurred make copies of this page and fill out the remaining questions on the page one time for each significant change in occupancy.

Date of Occupancy Change. Enter the month and year in which the occupancy change occurred (e.g., 6/93).

Percent of Floorspace Affected by Occupancy Change. Enter the percent of the building's space which was affected by the occupancy change.

Rebated Equipment Affected by Occupancy Change. Check the box for each type of equipment rebated under the 1993 or 1994 Hardware Rebate Program which was affected by the occupancy change. If the change occurred prior to the Hardware Rebate Program retrofit, do not check any of these boxes.

Meter Numbers Affected by the Occupancy Change. List the meter identification numbers from the first column of the meter table at the bottom of page 4 which serve the area affected by the occupancy change.

Tenant Change During Occupancy Change. Enter 1 if the building's tenant(s) remained the same, 2 if they changed.

If the tenant changed, enter the site activity of the building prior to the change, using the codes in the establishment site activity table on page 3, and enter a more detailed activity or product description of the building's use prior to the change.

Number of Employees Change During Occupancy Change. Enter 1 if the number of employees at the site did not change significantly, 2 if the number did change significantly. Use plus or minus 25 percent as the threshold for what constitutes a significant change.

If the number of employees did change significantly, enter the maximum number of employees present at the site prior to the change.

Operating Schedule Change During Occupancy Change. Enter 1 if there was no significant change in the operating schedule, 2 if there was a significant change in the operating schedule.

If the operating schedule did change, enter the operating schedule prior to the change, if known. Use the same format as in the schedule at the top of page 5.

Seasonal Schedule Change During Occupancy Change. Enter 1 if there was no significant change in the seasonal schedule, 2 if there was a significant change in the seasonal schedule.

If the seasonal schedule did change, enter the seasonal schedule prior to the change, if know. Use the same format of high, medium and low months as in the seasonal schedule at the top of page 5.

Describe the change in building occupancy and use. Write a brief description of the nature of the occupancy change, along with any clarifying comments to the previous items in this section.

Page 6. Renovation, Hardware Rebate Program Equipment, and Other Equipment Changes

Significant Renovations Since 1992. This information will be obtained in the interview. Enter 2 if a significant renovation has occurred since January 1992. Otherwise enter 1. A significant renovation is defined as a space addition or space reduction which affects at least 10 percent of the floorspace, or a conversion of the space to a new use which affects at least 25 percent of the floorspace. If no significant renovations occurred, you may skip the rest of this section. If more than one renovation has occurred make copies of this page and fill out the remaining questions in this section one time for each significant renovation.

Type of Renovation. Enter A if the renovation was a space addition, R if the renovation was a reduction in space and C if the renovation was a conversion of the space to a different use.

Date of Renovation. Enter the month and the year in which the renovation was completed (e.g., 10/95).

Percent of Floorspace Affected by Renovation. Enter the percent of the building's space which was affected by the renovation.

Rebated Equipment Affected by Renovation. Check the box for each type of equipment rebated under the 1993 or 1994 Hardware Rebate Program which was affected by the renovation. If the renovation occurred prior to the Hardware Rebate Program retrofit, do not check any of these boxes.

Meter Numbers Affected by the Renovation. List the meter identification numbers from the first column of the meter table at the bottom of page 4 which serve the area affected by the renovation.

Describe the building renovation. Write a brief description of the nature of the renovation, along with any clarifying comments to the previous items in this section.

Energy Management Hardware Rebate Program. For each type of equipment for which this Edison customer received a rebate under the Hardware Rebate Program retrofit program, check the box corresponding to the program year in which the retrofit was received and whether the equipment served a new function or replaced existing equipment. The program year should be obtained from the site contact, and should match the information on the customer information call sheet. If the program years do not match, prompt the site contact for clarification. A new application is defined as equipment which serves newly built floorspace or provides a service (e.g., air conditioning) to a space which did not previously receive that service. A replacement application is defined here as either equipment which replaced failed equipment or equipment which was retrofitted in the place of functioning equipment.

Other Equipment Changes Since 1992. For each addition, replacement, retrofit or removal of major equipment (e.g., chillers, boilers, cooling towers, furnaces, packaged AC, process equipment, commercial refrigeration units), which has occurred since January 1992, enter the following information:

Equipment Type. Enter the generic type of equipment for which the change occurred (e.g., chiller, boiler, etc.).

Date. Enter the month and year in which the equipment change occurred.

Energy Efficient. For each major piece of new equipment (in new service, postfailure replacement or prefailure retrofit application), enter 1 if the equipment efficiency conforms to standard or worse efficiency. Enter 2 if the equipment efficiency is significantly better than standard practice.

Change Type. Enter 1 if the change was new equipment which serves new floorspace or provides new service where none was previously provided. Enter 2 if the change was the replacement of failed equipment. Enter 3 if the change was the retrofit of new equipment in place of functioning equipment. Enter 4 if the change was the removal of equipment which was not replaced.

Meter Numbers Affected. List the meter identification numbers from the first column of the meter table at the bottom of page 4 which serve the equipment changed.

Page 7. Electronic Ballasts

Complete this page only if the Edison customer received rebates for installing electronic ballasts under the 1993 or 1994 Hardware Rebate Program.

Before entering any information, sample ten fixtures where Hardware Rebate Program electronic ballasts were installed. If the Edison customer also received a rebate for T-8 lamps, sample the same fixtures for electronic ballasts, if possible. Try to select as many different types of fixtures as possible. (e.g., 4-foot 4 lamp 2 ballast, two 4 foot U-tubes with one lamp per ballast, 8-foot 4-lamp, 2 ballast, 4-foot 3 lamp 2 ballast, etc.). Also try to select fixtures in as many different types of areas as possible. For each fixture selected, place a numbered identifying sticker next to the outside of the fixture for future identification. Place the sticker on one side of the fixture and begin ballast numbers from that side of the fixture.

For each sampled fixture collect the following data:

Fixture Type. Enter a number (1-10) for each unique combination of lamp type, lamp number, and ballast number. If the same as a previous fixture, enter the fixture type of the previous fixture.

Space Utilization Code. Enter the 3-letter code from the Space Utilization Code table in the middle of page 7 which corresponds to the use of the space where the fixture is located.

Lamp Type. Enter the 2-character code from the Lamp Type Code table in the middle of page 7 which corresponds to the lamps in the fixture.

Watts/Lamp. Enter the standard wattage rating of the lamps in the fixture (e.g., for F32T8 lamps, enter 32).

Number of Ballasts/Fixture. Enter the number of ballasts present in the fixture.

For each ballast in the fixture, then collect the following data:

Number of Lamps/Ballast. Enter the number of lamps served by the ballast.

Hours per Week. Ask how many hours per week, on average, the ballast is operating.

EMHRP Ballast Use Code. Enter S if the operation and use of the ballast has not changed since the ballast was installed under the Hardware Rebate Program. Enter A if the ballast which was installed under the program is still in use, but the use has changed. Enter N if the ballast which was installed under the program has been replaced or is not being used.

Altered-Use Code. If you entered A under the EMHRP Ballast Use Code, select one or more codes from the Altered Use Code table at the bottom of page 7 which describe the change in use of the rebated ballast. The types of changes to be recorded are: lamp replacements with a different wattage lamp (code LI or LD), a change in the number of hours the ballast is in use (code HI or HD), a burned-out lamp which has not been replaced (code LF), poor repair or maintenance of the ballast (code PR), or that the configuration of the fixture was not appropriate to the normal operation of an electronic ballast (code I).

Not-in-Use Code. If you entered N under the EMHRP Ballast Use Code, select one or more codes from the Not-in-Use Code table at the bottom of page 7 which describe how and why the rebated ballast is no longer in use. These situations include: that the ballast burned out and was replaced (code B), was broken or damaged and then replaced (code D), that the ballast was replaced prior to failure (code P), that the ballast was removed or disconnected (code R), that the fixture or the space is in place but no longer in use (code N), or that the configuration of the fixture was not appropriate to the normal operation of an electronic ballast (code I).

Date Not in Use. If you entered N under the EMHRP Ballast Use Code, then enter the month and year in which the ballast was replaced or was no longer used. If the exact date is not known, try to get an estimate from the site contact.

Replacement Ballast for EMHRP. If the ballast was replaced (as indicated by a not-in-use code of B, D or P) then enter the ballast type code for the ballast which replaced the rebated electronic ballast. The ballast type codes are listed in a table in the middle of page 7.

<u>For all rebated electronic ballasts as a whole, ask the following:</u>

Satisfaction with Ballast Installation. Ask the site contact his or her satisfaction with the electronic ballasts installed under the Hardware Rebate Program. Use the four point scale in the Satisfaction Level Code table at the bottom of page 7.

Reasons for Satisfaction/Dissatisfaction. Ask the site contact his or her reasons for being satisfied or dissatisfied with the electronic ballasts installed under the Hardware Rebate Program. Enter at least one code from the Satisfaction/ Dissatisfaction Reason Code table at the bottom of page 7 corresponding to these reasons.

Explain any Rebated Ballasts Not in Use or Change in Use. Add any comments needed to clarify the information provided on this page. Describe the location of the sampled fixtures if there could be any uncertainty in locating them.

Page 8. Compact Fluorescent Lamps and T-8 Lamps

Complete this page only if the Edison customer received rebates for installing compact fluorescent lamps or T-8 lamps under the 1993 or 1994 Hardware Rebate Program. If the Edison customer received rebates for both types of lamps, copy this page and fill out once for each type of lamp.

Before entering any information, sample ten fixtures where Hardware Rebate Program lamps were installed. If the Edison customer also received a rebate for electronic ballasts, sample the same fixtures for T-8 lamps, if possible. Try to select as many different types of fixtures as possible. (e.g., 4 lamp 2 ballast, 3 lamp 2 ballast, 2 lamp 1 ballast, etc.). Also try to select fixtures in as many different types of areas as possible. For each fixture selected, place a numbered identifying sticker next to the outside of the fixture for future identification. Place the sticker on one side of the fixture and begin lamp numbers from that side of the fixture.

<u>For each sampled fixture collect the following data:</u>

Fixture Type. Enter a number (1-10) for each unique combination of lamp number and ballast type. If the same as a previous fixture, enter the fixture type of the previous fixture.

Space Utilization Code. Enter the 3-letter code from the Space Utilization Code table in the middle of page 7 which corresponds to the use of the space where the fixture is located.

Ballast Type. Enter the ballast type code from the Ballast Type Code table at the bottom of page 8.

Number of Lamps/Fixture. Enter the number of lamps present in the fixture

<u>For each lamp in the fixture, then collect the following data:</u>

Lamp Type. Enter the lamp type code from the Lamp Type Code table at the bottom of page 8.

Hours per Week. Ask how many hours per week, on average, the lamp is operating.

EMHRP Lamp Use Code. Enter S if the operation and use of the lamp has not changed since the lamp was installed under the Hardware Rebate Program. Enter A if the lamp which was installed under the program is still in use, but the use has changed. Enter N if the lamp which was installed under the program has been replaced or is not being used.

Altered-Use Code. If you entered A under the EMHRP Lamp Use Code, select one or more codes from the Altered Use Code table at the bottom of page 8 which describe the change in use of the rebated lamp. The types of changes to be recorded are: ballast replacements with a different wattage (code BI or BD), a change in the number of hours the lamp is in use (code HI or HD), poor repair or maintenance of the lamp (code PR), or that the configuration of the fixture was not appropriate to the normal operation of this type of lamp (code I).

Not-in-Use Code. If you entered N under the EMHRP Lamp Use Code, select one or more codes from the Not-in-Use Code table at the bottom of page 8 which describe how and why the rebated lamp is no longer in use. These situations include: that the lamp burned out and was replaced (code B), was broken or damaged and then replaced (code D), that the lamp was replaced prior to failure (code P), that the lamp was removed or disconnected (code R), that the fixture or the space is in place but no longer in use (code N), or that the configuration of the fixture was not appropriate to the normal operation of this type of lamp (code I).

Date Not in Use. If you entered N under the EMHRP Lamp Use Code, then enter the month and year in which the ballast was replaced or was no longer used. If the exact date is not known, try to get an estimate from the site contact.

Replacement Lamp for EMHRP. If the lamp was replaced (as indicated by a not-in-use code of B, D or P) then enter the lamp type code for the lamp which replaced the rebated lamp. The lamp type codes are listed in a table at the bottom of page 8.

<u>For all rebated T-8 lamps or compact fluorescent lamps as a whole, ask the following:</u>

Satisfaction with Lamp Installation. Ask the site contact his or her satisfaction with the T-8 lamps or compact fluorescent lamps installed under the Hardware Rebate Program. Use the four point scale in the Satisfaction Level Code table at the bottom of page 7.

Reasons for Satisfaction/Dissatisfaction. Ask the site contact his or her reasons for being satisfied or dissatisfied with the T-8 lamps or compact fluorescent lamps installed under the Hardware Rebate Program. Enter at least one code from the Satisfaction/Dissatisfaction Reason Code table at the bottom of page 7 corresponding to these reasons.

Explain any EMHRP High Efficiency Lamps Not in Use or Change in Use. Add any comments needed to clarify the information provided on this page. Describe the location of the sampled fixtures if there could be any uncertainty in locating them.

Page 9. Delamping and Reflectors

Complete this page only if the Edison customer received rebates for delamping and installing reflectors under the 1993 or 1994 Hardware Rebate Program.

Before entering any information, sample ten fixtures where Hardware Rebate Program lamps were installed. If the Edison customer also received a rebate for electronic ballasts or T-8 lamps, sample the same fixtures for the delamping/reflectors measure if possible. Try to select as many different types of fixtures as possible. (e.g., 4 lamp 2 ballast, 3 lamp 2 ballast, 2 lamp 1 ballast, etc.). Also try to select fixtures in as many different types of areas as possible. For each fixture selected, place a numbered identifying sticker next to the outside of the fixture for future identification.

<u>For each sampled fixture collect the following data:</u>

Fixture Type. Enter a number (1-10) for each unique combination of lamp number, lamp type and ballast type. If the same as a previous fixture, enter the fixture type of the previous fixture.

Space Utilization Code. Enter the 3-letter code from the Space Utilization Code table in the middle of page 7 which corresponds to the use of the space where the fixture is located.

Ballast Type. Enter the ballast type code from the Ballast Type Code table at the bottom of page 8.

Lamp Type. Enter the lamp type code from the Lamp Type Code table at the bottom of page 7.

Number of Lamps/Fixture. Enter the number of lamps present in the fixture

Hours per Week. Ask how many hours per week, on average, the lamp is operating.

EMHRP Use Code. Enter S if the operation and use of the fixture has not changed since the lamp was installed under the Hardware Rebate Program. Enter A if the delamping and reflector are still in use, but the use has changed. Enter N if the delamping has been reversed, or if the reflector installed under the program has been replaced or is not being used.

Altered-Use Code. If you entered A under the EMHRP Use Code, select one or more codes from the Altered Use Code table at the bottom of page 9 which describe the change in use of the rebated fixture. The types of changes to be recorded are: lamp or ballast replacements with a different wattage (code LI or LD), a change in the number of hours the fixture is in use (code HI or HD), reinstallation of some but not all of the lamps removed during delamping (code LR), poor repair or maintenance of the reflector or fixture (code PR), or that delamping and reflectors were not appropriate for the application of this fixture (code I).

Not-in-Use Code. If you entered N under the EMHRP Use Code, select one or more codes from the Not-in-Use Code table at the bottom of page 9 which describe how and why the delamping and/or reflector are no longer in place. These situations include: that the reflector was broken or damaged and then replaced (code B), that the reflector was removed and not replaced (code R), that the fixture or the space is in place but no longer in use (code N), or delamping and reflectors were not appropriate for the application of this fixture (code I).

Date Not in Use. If you entered N under the EMHRP Use Code, then enter the month and year in which the delamping was reversed, or the reflector was replaced or no longer used. If the exact date is not known, try to get an estimate from the site contact.

<u>For the delamping/reflectors retrofit as a whole, ask the following:</u>

Satisfaction with Delamping/Reflectors. Ask the site contact his or her satisfaction with the delamping and reflector installation under the Hardware Rebate Program. Use the four point scale in the Satisfaction Level Code table at the bottom of page 7.

Reasons for Satisfaction/Dissatisfaction. Ask the site contact his or her reasons for being satisfied or dissatisfied with the delamping and reflector installation under the Hardware Rebate Program. Enter at least one code from the Satisfaction/Dissatisfaction Reason Code table at the bottom of page 7 corresponding to these reasons.

Explain any EMHRP Delamping/Reflectors Not in Place or Change in Use. Add any comments needed to clarify the information provided on this page.

Describe the location of the sampled fixtures if there could be any uncertainty in locating them.

Page 10. Adjustable Speed Drives

Complete this page only if the Edison customer received rebates for adjustable speed drives (ASDs) installed under the 1993 or 1994 Hardware Rebate Program.

Before entering any information, sample two ASDs which were rebated by the Hardware Rebate Program. (If only one ASD was rebated, that ASD is the sample. Try to select different types of applications if possible. (e.g., supply fans, chilled water pumps, process equipment, etc.) For each ASD selected, place a numbered identifying tag next to the ASD for future identification.

<u>For each sampled ASD collect the following data:</u>

ASD Type. Enter the 3-letter code from the ASD Type code table in the middle of page 10 which corresponds to the ASD type.

Motor Service. Enter the code from the Motor Service code table in the middle of page 10 which corresponds to the application of the motor with the ASD.

Size. Enter the motor power rating, in horsepower, for the ASD driven motor.

Hours per Week. Ask how many hours per week, on average, the ASD is operating.

EMHRP ASD Use Code. Enter S if the operation and use of the ASD has not changed since it was installed under the Hardware Rebate Program. Enter A if the ASD is still in use, but the use has changed. Enter N if the ASD installed under the program has been replaced or is not being used.

Altered-Use Code. If you entered A under the EMHRP ASD Use Code, select one or more codes from the Altered Use Code table at the bottom of page 10 which describe the change in use of the ASD. The types of changes to be recorded are: motor replacement with a different horsepower (code MI or MD), a change in the number of hours the ASD is in use (code HI or HD), reprogramming the ASD (code R), manual override of the ASD to set to constant speed (code O), installation of an isolation transformer to correct harmonics problems (code IT), poor repair or maintenance of the ASD and or motor (code PR), or that ASD was not appropriate for the application of this motor (code I).

Not-in-Use Code. If you entered N under the EMHRP ASD Use Code, select one or more codes from the Not-in-Use Code table at the bottom of page 10 which describe how and why the ASD is no longer in use. These situations include: that the ASD burned out and was replaced (code B), was broken or damaged and then replaced (code DS), that the ASD was replaced prior to failure (code P), that the ASD was removed and not replaced (code R), that the motor driven by the ASD is in place but no longer in use (code N), or that the ASD was not appropriate for the application of this motor (code I).

Date Not in Use. If you entered N under the EMHRP ASD Use Code, then enter the month and year in which the ASD was replaced or no longer used. If the exact date is not known, try to get an estimate from the site contact.

Replacement Type for EMHRP ASD. If the ASD was replaced (as indicated by a not-in-use code of B, DS or P) then enter the ASD type code for the ASD which replaced the rebated lamp. The ASD type codes are listed in a table in the middle of page 10.

Subsystem Failure Codes. If the rebated ASD is still in place (as indicated by an EMHRP ASD Use Code of S or A) but certain subsystems of the ASD have been replaced during repairs or routine maintenance, then enter the Subsystem Failure Codes from the table at the bottom of page 10 here. The subsystem failures which should be listed here are the variable belt (code VB), magnetic clutch (code MC), heat sink fan (code HS), motor bearing/oil seal (code MB), and inverter/rectifier (IR).

<u>For the rebated ASDs as a whole, ask the following:</u>

Satisfaction with ASDs. Ask the site contact his or her satisfaction with the ASDs installed under the Hardware Rebate Program. Use the four point scale in the Satisfaction Level Code table at the bottom of page 7.

Reasons for Satisfaction/Dissatisfaction. Ask the site contact his or her reasons for being satisfied or dissatisfied with the ASDs installed under the Hardware Rebate Program. Enter at least one code from the Satisfaction/ Dissatisfaction Reason Code table at the bottom of page 7 corresponding to these reasons.

Explain any EMHRP ASDs Not in Use or Change in Use. Add any comments needed to clarify the information provided on this page. Describe the location of the sampled ASDs if there could be any uncertainty in locating them.

Page 11. High Efficiency Pumps / Pump System Improvements

Complete this page only if the Edison customer received rebates for high efficiency pumps or pump system hardware improvements under the 1993 or 1994 Hardware Rebate Program. If the Edison customer received rebates for both pump measures, copy this page and fill out once for each measure.

Before entering any information, sample two pumps which were rebated by the Hardware Rebate Program. (If only one pump was rebated, that pump is the sample. Try to select different types of applications if possible. (e.g., chilled water pumps, condenser water pumps, process pumps, etc.) For each pump selected, place a numbered identifying tag next to the pump for future identification.

For each sampled pump collect the following data:

Pump Service. Enter the code from the Pump Service code table in the middle of page 11 which corresponds to the pump application.

Control Type. Enter the code from the Control Type code table in the middle of page 11 for either fixed or variable speed control.

Size. Enter the pump's power rating, in horsepower.

Hours per Week. Ask how many hours per week, on average, the pump is operating.

EMHRP Pump Use Code. Enter S if the operation and use of the pump has not changed since it was installed under the Hardware Rebate Program. Enter A if the pump is still in use, but the use has changed. Enter N if the pump installed under the program has been replaced or is not being used.

Altered-Use Code. If you entered A under the EMHRP Pump Use Code, select one or more codes from the Altered Use Code table at the bottom of page 11 which describe the change in use of the pump. The types of changes to be recorded are: a change in the number of hours the pump is in use (code HI or HD), setting the pump to fixed speed or to variable speed (code FS or VS), poor repair or maintenance of the pump (code PR), or that the high efficiency pump or pump hardware improvement was not appropriate for the application of this pump (code I).

Not-in-Use Code. If you entered N under the EMHRP Pump Use Code, select one or more codes from the Not-in-Use Code table at the bottom of page 11 which describe how and why the pump is no longer in use. These situations include: that the pump burned out and was replaced (code B), was broken or damaged and then replaced (code DS), that the pump was replaced prior to failure (code P), that the pump was removed and not replaced (code R), that the pump is in place but no longer in use (code N), or that the high efficiency pump or pump hardware improvement was not appropriate for the application of this pump (code I).

Date Not in Use. If you entered N under the EMHRP Pump Use Code, then enter the month and year in which the pump was replaced or no longer used. If the exact date is not known, try to get an estimate from the site contact.

Replacement Pump Size. If the rebated pump was replaced (as indicated by a not-in-use code of B, D or P) then enter the new pump's power rating, in horsepower.

<u>For the rebated pumps as a whole, ask the following:</u>

Satisfaction with Pumps. Ask the site contact his or her satisfaction with the high efficiency pumps or pump hardware improvements installed under the Hardware Rebate Program. Use the four point scale in the Satisfaction Level Code table at the bottom of page 7.

Reasons for Satisfaction/Dissatisfaction. Ask the site contact his or her reasons for being satisfied or dissatisfied with the pumps installed under the Hardware Rebate Program. Enter at least one code from the Satisfaction/ Dissatisfaction Reason Code table at the bottom of page 7 corresponding to these reasons.

Explain any EMHRP Pumps Not in Use or Change in Use. Add any comments needed to clarify the information provided on this page. Describe the location of the sampled pumps if there could be any uncertainty in locating them.

Page 12. High Efficiency Chillers

Complete this page only if the Edison customer received a rebate for one or more high efficiency chillers under the 1993 or 1994 Hardware Rebate Program.

Before entering any information, one chiller must be sampled. If only one chiller was rebated, that chiller is the sample. If there was more than one chiller rebated, select one and place an identifying tag next to the chiller for future identification.

Cooling Equipment Type. Enter the code from the Cooling Equipment Type code table in the middle of page 12 which corresponds to the chiller type.

Output Capacity. Enter the chiller's rated capacity, in tons.

Backup. Enter 2 if the chiller is operated as a backup or standby equipment. Otherwise, enter 1.

Operating Hours per Week. Ask how many hours per week, on average, the chiller is operating.

EMHRP Chiller Use Code. Enter S if the operation and use of the chiller has not changed since it was installed under the Hardware Rebate Program. Enter A if the chiller is still in use, but the use has changed. Enter N if the chiller installed under the program has been replaced or is not being used.

Altered-Use Code. If you entered A under the EMHRP Chiller Use Code, select one or more codes from the Altered Use Code table in the middle of Page 12 which describe the change in use of the chiller. The types of changes to be recorded are: a change in the number of hours the chiller is in use (code HI or HD), a change in the chilled water temperature (code HT or LT), the use of a different refrigerant (code R), poor repair or maintenance of the chiller (code PR), or that the high efficiency chiller was not appropriate for this application (code I).

Not-in-Use Code. If you entered N under the EMHRP Chiller Use Code, select one or more codes from the Not-in-Use Code table at the bottom of page 12 which describe how and why the chiller is no longer in use. These situations include: that the chiller failed and was replaced (code F), was broken or damaged and then replaced (code D), that the chiller was removed or disconnected and not replaced (code R), that the chiller is in place but no longer in use (code N), or that the high efficiency chiller was not appropriate for this application (code I).

Date Not in Use. If you entered N under the EMHRP Chiller Use Code, then enter the month and year in which the chiller was replaced or no longer used. If the exact date is not known, try to get an estimate from the site contact.

Subsystem Failure Codes. If the rebated chiller is still in place (as indicated by an EMHRP Chiller Use Code of S or A) but certain subsystems of the chiller have been replaced during repairs or routine maintenance, then enter the Subsystem Failure Codes from the table in the middle of page 12 here. The subsystem failures which should be listed here are the compressor motor (code CM), a refrigerant or oil leak (code RL), the chiller electric control (code EC), a thermostat (code T), temperature sensor (code TS), high pressure relief valve (code RV), discharge valve (code DV), suction line strainer (code SL) or built-up system component (code CF).

For the rebated chillers as a whole, ask the following:

Satisfaction with High Efficiency Chillers. Ask the site contact his or her satisfaction with the high efficiency chillers installed under the Hardware Rebate Program. Use the four point scale in the Satisfaction Level Code table at the bottom of page 7.

Reasons for Satisfaction/Dissatisfaction. Ask the site contact his or her reasons for being satisfied or dissatisfied with the chillers installed under the Hardware Rebate Program. Enter at least one code from the Satisfaction/ Dissatisfaction Reason Code table at the bottom of page 7 corresponding to these reasons.

Explain any EMHRP High Efficiency Chillers Not in Use or Change in Use. Add any comments needed to clarify the information provided on this page. Describe the location of the sampled chiller if there could be any uncertainty in locating it.

Page 13. HVAC Energy Management System

Complete this page only if the Edison customer received a rebate for a HVAC Energy Management System (EMS) under the 1993 or 1994 Hardware Rebate Program.

Systems Controlled. Enter the numbers of the following types of equipment which are currently controlled by the EMS:

- chillers
- boilers
- furnaces
- supply fans
- return fans
- hot water pumps
- chilled water pumps
- hot and chilled water pumps

Repeat for the equipment present at the time of the EMS installation.

In addition for thermal energy storage systems and heat recovery systems, enter 2 if currently present and controlled by the EMS., otherwise enter 1. Repeat for the situation at the time of the EMS installation.

Control Strategies. Enter 2 for each of the following control strategies which are currently employed by the EMS. If the strategy is not used, enter 1.

- night temperature setback
- optimum start/stop
- staggered start
- chilled water temperature reset
- hot water temperature reset
- economizer dampers
- peak demand limiting
- duty cycling
- monitoring equipment

Repeat for the control strategies used at the time the EMS was installed.

Conditioned Hours per Week. Ask how many hours per week, on average, the system is set to provide space conditioning.

Employee Access. Enter 2 if employees have access to EMS controls, otherwise enter 1.

EMHRP EMS Use Code. Enter S if the operation and use of the EMS has not changed since it was installed under the Hardware Rebate Program. Enter A if the EMS is still in use, but the use has changed. Enter N if the EMS installed under the program has been replaced, or is not being used.

Altered-Use Code. If you entered A under the EMHRP EMS Use Code, select one or more codes from the Altered Use Code table at the bottom of Page 13 which describe the change in use of the chiller. The types of changes to be recorded are: a change in the number of hours of HVAC service provided by the system (code HI or HD), a change in the systems controlled (code S), a change in the efficiency of the primary systems controlled (code SE), a change in the operations of the systems controlled (code SO), poor repair or maintenance of the EMS (code PR), or that the EMS was not appropriate for this application (code I).

Not-in-Use Code. If you entered N under the EMHRP EMS Use Code, select one or more codes from the Not-in-Use Code table at the bottom of page 13 which describe how and why the EMS is no longer in use. These situations include: that the EMS failed and was replaced (code FR), was broken or damaged and then replaced (code DS), that the EMS was removed or disconnected and not replaced (code R), that the EMS is in place but no longer in use (code N), or that the EMS was not appropriate for this application (code I).

Date Not in Use. If you entered N under the EMHRP EMS Use Code, then enter the month and year in which the EMS was replaced or no longer used. If the exact date is not known, try to get an estimate from the site contact.

Subsystem Failure Codes. If the rebated EMS is still in place (as indicated by an EMHRP EMS Use Code of S or A) but certain subsystems of the EMS have been replaced during repairs or routine maintenance, then enter the Subsystem Failure Codes from the table at the bottom of page 13 here. The subsystem failures which should be listed here are the temperature and humidity sensors (code SF), data communications components (code DF), or the actuators (code AF).

For the rebated EMS as a whole, ask the following:

Satisfaction with EMS. Ask the site contact his or her satisfaction with the EMS installed under the Hardware Rebate Program. Use the four point scale in the Satisfaction Level Code table at the bottom of page 7.

Reasons for Satisfaction/Dissatisfaction. Ask the site contact his or her reasons for being satisfied or dissatisfied with the EMS installed under the Hardware Rebate Program. Enter at least one code from the Satisfaction/ Dissatisfaction Reason Code table at the bottom of page 7 corresponding to these reasons.

Explain any EMHRP EMS Not in Use or Change in Use. Add any comments needed to clarify the information provided on this page.

Page 14. Notes

Use this page for any additional description of the site or the Hardware Rebate Program equipment which would be useful in understanding and using the data on this form to estimate the persistence of energy savings associated with the Hardware Rebate Program retrofits.

Appendix D

TELEPHONE FOLLOW-UP SURVEY INSTRUMENT

Southern California Edison

EMHR Program Measure Retention Study

Telephone Follow-up Survey

Final Version: 10/08/96

Instructions to Interviewer:
Before calling a customer, review conservation measures for that customer's facility, their number, where they are located, and in which building.

When you understand the data for this facility, call the customer and say something close to:

Hello, my name is ________________________ from ADM Associates. I am calling on Behalf of Southern California Edison. May I speak to __________________ *(the contact person)*?

If the contact person is not available, schedule a callback.

If the contact person will not be available later, ask:
Could you tell me who is most familiar with your electric systems or equipment at this location?

If the person is not available, schedule a callback.

If the interview is successful confirm mailing address and the phone number:

Name: ____________________________________
Position: __________________________________
Company __________________________________
Phone ( ) ___________________

Once the contact has been made, start:

I am _____________________, calling on behalf of Southern California Edison. Last year we visited your facility to check on the new (*measures)* that you installed and for which you received rebates from SCE. We would like to update the information from our last visit. We are conducting this follow-up survey to see how long energy conservation measures are effective, and we are grateful for your cooperation. This update should take only a few minutes.

SECTION ONE - CHANGES IN OCCUPANCY & RENOVATIONS

I would like to start with some questions about changes in operations at your facility over the past year.

1. Has there been any change in tenants at this facility in the past year?
   - ❑ No *GO TO Question 2.*
   - ❑ Yes

   ↓

   When did the change in tenancy occur? ______________________________ (*Specify Date)*

2. Have there been any major renovations to the building structure in the past year?
   - ❑ No *GO TO Question 3.*
   - ❑ Yes

   ↓

   What was the nature of the renovations?
   - ❑ Space was added ____ Square Feet Added
   - ❑ Space was reduced ____________________________________ Square Feet Reduced
   - ❑ Space was converted to different use
   - ❑ Other (*Please Specify)* ____

   ↓

   When did the renovations occur? __________________________________ (*Specify Date)*

   ↓

   What percentage of the facility's floor space was affected by the renovations? _______%

3. Have there been any major changes to the facility's heating and cooling equipment in the past year?
   - ❑ No *GO TO Question 4.*
   - ❑ Yes

   ↓

   What was the nature of the change in heating and cooling equipment?
   - ❑ New equipment was installed
     Was the new equipment energy efficient? ❑ Yes ❑ No
   - ❑ Equipment that had failed was replaced
   - ❑ Equipment was retrofitted before it failed
   - ❑ Equipment was removed
   - ❑ Other (*Please Specify)* ____

   ↓

   When did the change in heating and cooling equipment occur? _________ (*Specify Date)*

4. Have there been any major changes to the facility's lighting equipment in the past year?
   - ❑ No *GO TO Question 5.*
   - ❑ Yes

   ➜

   What was the nature of the change in lighting equipment?
   - ❑ New equipment was installed
     - Was the new equipment energy efficient? ❑ Yes ❑ No
   - ❑ Equipment that had failed was replaced
   - ❑ Equipment was retrofitted before it failed
   - ❑ Equipment was removed
   - ❑ Other (*Please Specify)* ________________________________

   ➜

   When did the change in lighting equipment occur? ____________________(*Specify Date)*

5. Have there been any major changes to any other important equipment in the past year?
   - ❑ No *GO TO Question 6.*
   - ❑ Yes

   ➜

   What was this equipment? ________________________________

   ➜

   What was the nature of the change to this equipment?
   - ❑ New equipment was installed
     - Was the new equipment energy efficient? ❑ Yes ❑ No
   - ❑ Equipment that had failed was replaced
   - ❑ Equipment was retrofitted before it failed
   - ❑ Equipment was removed
   - ❑ Other (*Please Specify)* ________________________________

   ➜

   When did the change in this equipment occur? ______________________(*Specify Date)*

6 Has the number of employees for this facility changed in the past year?
   - ❑ No *GO TO Question 7.*
   - ❑ Yes

   ➜

   When did the change in number of employees occur? _________________(*Specify Date)*

   ➜

   How many employees does the facility currently have? ______________________

7. Have the operating hours for this facility changed in the past year?
   - ❑ No *GO TO Section 2.*
   - ❑ Yes

   ↓

   When did the change in operating hours occur? ______________________(*Specify Date)*

   ↓

   What are the hours of operation for the facility on week days?
   From ___________ To __________

   ↓

   What are the hours of operation for the facility on weekend days and holidays?

   From ________ To __________

SECTION TWO - CHANGES IN REBATED EQUIPMENT

T8 LAMPS

(*Complete a set of these questions for each area in which T8 lamps were installed. Use a page for each area in which T8 lamps were installed and inspected.)*

Edison's records show that you received a rebate to install T8 lamps in *(Specify Area)*.

T8S1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Were any of the T8 lamps in *(Specify Area)* affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply*.)

❏ No *Go to T8S2.*
❏ Yes
↓
What percentage of the rebated T8 lamps were affected? ________________________%
↓
What effect did the major changes have on the T8 lamps?
↓
❏ T8 lamps were removed and not replaced.
❏ T8 lamps were replaced with a different type of lighting.
↓
What were the T8 lamps replaced with?
(*Specify*) ____
❏ T8 lamps were relocated to another part of facility.
❏ Number of fixtures with T8 lamps was decreased.
❏ Number of fixtures with T8 lamps was increased.
❏ Other (*Specify*) ____

T8S2. Approximately what percentage of the rebated T8 lamps in (Specify *Area)* have been replaced in the past year as a result of general maintenance? _________________________%
↓
Why did the T8 lamps need replacing? (*Check all mentioned.)*

❏ T8 lamps had burned out.
❏ T8 lamps were damaged.
❏ Other (*Specify*) ____

T8S3. Besides the major renovations and maintenance changes that we asked about earlier, have any other actions occurred at this facility that resulted in the T8 lamps in (*Specify Area*) being removed or replaced? (*Check all mentioned. Prompt if necessary.)*

- ❑ No *Go to Next Page.*
- ❑ Yes

↓

What actions were these? ____

↓

What effect did the actions have on the T8 lamps?

↓

- ❑ T8 lamps were removed and not replaced.

  ↓

  Why were the T8 lamps removed and not replaced?
  (*Specify*) ____

  ↓

  When were the T8 lamps removed? ____________________________ *(Specify Date)*
- ❑ T8 lamps were replaced with different type of lighting equipment.

  ↓

  What were the T8 lamps replaced with?
  (*Specify*) ____

  ↓

  When were the T8 lamps replaced? ____________________________ *(Specify Date)*
- ❑ T8 lamps were relocated to another part of facility.
- ❑ Number of fixtures with T8 lamps was decreased.
- ❑ Number of fixtures with T8 lamps was increased.
- ❑ Other (*Specify*) ____

Electronic Ballasts

(*Complete a set of these questions for each area in which electronic ballasts were installed. Use a page for each area in which electronic ballasts were installed and inspected.)*

Edison's records show that you received a rebate to install electronic ballasts in *(Specify Area)*.

B1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Were any rebated electronic ballasts in (*Specify* Area) affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply.*)

❑ No *Go to B2.*
❑ Yes
↓
What percentage of the rebated electronic ballasts were affected? ___________________%
↓
What effect did the major changes have on the electronic ballasts?
↓
❑ Electronic ballasts were removed and not replaced.
❑ Electronic ballasts were replaced with a different type of ballast.
↓
What were the electronic ballasts replaced with?
(*Specify*) ____
❑ Electronic ballasts were relocated to another part of facility.
❑ Number of fixtures with electronic ballasts was decreased.
❑ Number of fixtures with electronic ballasts was increased.
❑ Other (*Specify*) ____

B2. Approximately what percentage of the rebated electronic ballasts in (*Specify Area)* have been replaced in the past year as a result of general maintenance? ___________________________%
↓
For what reasons were the electronic ballasts replaced? (*Check all mentioned.)*

❑ Electronic ballasts had burned out.
❑ Electronic ballasts were damaged.
❑ Other *(Specify)* ____

B3. Besides the major renovations and maintenance changes that we asked about earlier, have any other actions occurred at this facility that resulted in the electronic ballasts in (*Specify Area*) being removed or replaced? (*Check all mentioned. Prompt if necessary.)*

- ❑ No *Go to Next Page.*
- ❑ Yes

  ↓

  What actions were these? ______________________________

  ↓

  What effect did the actions have on the electronic ballasts?

  ↓

  - ❑ Electronic ballasts were removed and not replaced.

    ↓

    Why were the electronic ballasts removed and not replaced?
    (*Specify*) ______________________________

    ↓

    When were the electronic ballasts removed? ____________ *(Specify Date)*
  - ❑ Electronic ballasts were replaced with different type of lighting equipment.

    ↓

    What were the electronic ballasts replaced with?
    (*Specify*) ______________________________

    ↓

    When were the electronic ballasts replaced? ____________ *(Specify Date)*
  - ❑ Electronic ballasts were relocated to another part of facility.
  - ❑ Number of fixtures with electronic ballasts was decreased.
  - ❑ Number of fixtures with electronic ballasts was increased.
  - ❑ Other (*Specify*) ______________________________

Compact Fluorescents

(*Complete a set of these questions for each area in which compact fluorescents were installed. Use a page for each area in which compact fluorescents were installed and inspected.)*

Edison's records show that you received a rebate to install compact fluorescent lamps in *(Specify Area)*.

CFB1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Were any compact fluorescent lamps in (*Specify* Area) affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply.*)

- ❑ No *Go to CFB2.*
- ❑ Yes

↓

What percentage of the rebated compact fluorescent lamps were affected? __________%

↓

What effect did the major changes have on the compact fluorescents?

↓

- ❑ Compact fluorescents were removed and not replaced.
- ❑ Compact fluorescents were replaced with a different type of lighting.

  ↓

  What were the compact fluorescents replaced with?
  (*Specify*) ____
- ❑ Compact fluorescents were relocated to another part of facility.
- ❑ Number of fixtures with compact fluorescents was decreased.
- ❑ Number of fixtures with compact fluorescents was increased.
- ❑ Other (*Specify*) ____

T2. Approximately what percentage of the rebated compact fluorescent lamps in (*Specify Area)* have been replaced in the past year as a result of general maintenance? ________________%

↓

For what reasons were the compact fluorescent lamps replaced? (*Check all mentioned.)*

- ❑ Compact fluorescent lamps had burned out.
- ❑ Compact fluorescent lamps were damaged.
- ❑ Other *(Specify)* ____

CFB3. Besides the major renovations and maintenance changes that we asked about earlier, have any other actions occurred at this facility that resulted in the compact fluorescent lamps in (*Specify Area*) being removed or replaced? (*Check all mentioned.*)

❑ No *Go to Next Page.*
❑ Yes
↓
What actions were these? ______________________________
↓
What effect did the actions have on the compact fluorescents?
↓
- ❑ Compact fluorescents were removed and not replaced.
  ↓
  Why were the compact fluorescents removed and not replaced?
  (*Specify*) ______________________________
  ↓
  When were the compact fluorescents removed? ____________________ *(Specify Date)*
- ❑ Compact fluorescents were replaced with different type of lighting equipment.
  ↓
  What were the compact fluorescents replaced with?
  (*Specify*) ______________________________
  ↓
  When were the compact fluorescents replaced? ____________________ *(Specify Date)*
- ❑ Compact fluorescents were relocated to another part of facility.
- ❑ Number of fixtures with compact fluorescents was decreased.
- ❑ Number of fixtures with compact fluorescents was increased.
- ❑ Other (*Specify*) ______________________________

Reflectors

(*Complete a set of these questions for each area in which reflectors were installed. Use a page for each area in which reflectors were installed and inspected.)*

Edison's records show that you received a rebate to install reflectors in *(Specify Area)*.

R1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Were any reflectors in (*Specify* Area) affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply*.)

❑ No *Go to R2.*

❑ Yes

↓

What percentage of the rebated reflectors were affected? ________________________%

↓

What effect did the major changes have on the reflectors?

↓

❑ Reflectors were removed and not replaced.

❑ Reflectors were replaced with a different type of lighting equipment.

↓

What were the reflectors replaced with?

(*Specify*) ____

❑ Reflectors were relocated to another part of facility.

❑ Number of fixtures with reflectors was decreased.

❑ Number of fixtures with reflectors was increased.

❑ Other (*Specify*) ____

R2. Approximately what percentage of the rebated reflectors in (*Specify Area)* have been replaced in the past year as a result of general maintenance? ________________________________%

↓

For what reasons were the reflectors replaced? (*Check all mentioned.)*

❑ Poor maintenance and/or repair caused replacement.

❑ Reflectors had been improperly installed.

❑ Other *(Specify)* ____

R3. Besides the major renovations and maintenance changes that we asked about earlier, have any other actions occurred at this facility that resulted in the reflectors in (*Specify Area*) being removed or replaced?

❏ No *Go to Next Page.*
❏ Yes
↓
What actions were these? ______________________________
↓
What effect did the actions have on the reflectors?
↓
- ❏ Reflectors were removed and not replaced.
  ↓
  Why were the reflectors removed and not replaced?
  (*Specify*) ______________________________
  ↓
  When were the reflectors removed? ____________________ *(Specify Date)*
- ❏ Reflectors were replaced with different type of lighting equipment.
  ↓
  What were the reflectors replaced with?
  (*Specify*) ______________________________
  ↓
  When were the reflectors replaced? ____________________ *(Specify Date)*
- ❏ Reflectors were relocated to another part of facility.
- ❏ Number of fixtures with reflectors was decreased.
- ❏ Number of fixtures with reflectors was increased.
- ❏ Other (*Specify*) ______________________________

Adjustable Speed Drives

(*Complete a set of these questions for each area in which ASDs were installed. Use a page for each area in which ASDs were installed and inspected.)*

Edison's records show that you received a rebate to install adjustable speed drives in *(Specify Area)*.

ASD1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Were any adjustable speed drives in (*Specify Area*) affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply*.)

- ❑ No *Go to ASD2.*
- ❑ Yes

  ↓

  How many of the ASDs were affected? ______________________________

  ↓

  What effect did the major changes have on the ASDs?

  ↓

  - ❑ ASDs were removed and not replaced.
  - ❑ ASDs were replaced with a different type of drive.

    ↓

    What were the ASDs replaced with?
    (*Specify*) ______________________________
  - ❑ ASDs were relocated to another part of facility.

    ↓

    What use is being made of the relocated ASDs? ______________________________

    ____
  - ❑ Other (*Specify*) ______________________________

ASD2. Besides the major renovations and changes that we asked about earlier, have any other actions occurred at this facility that resulted in the ASDs in (*Specify Area*) being removed or replaced? (*Check all mentioned. Prompt if necessary*)

- ❑ No *Go to Next Page.*
- ❑ Yes

↓

What actions were these? ______________________________

↓

What effect did the actions have on the ASDs?

↓

- ❑ ASDs were removed and not replaced.

  ↓

  Why were the ASDs removed and not replaced?

  - ❑ ASDs had been improperly installed.
  - ❑ ASDs had “failed”.
  - ❑ ASDs had poor repair/maintenance record.
  - ❑ Load for ASDs changed.
  - ❑ Other (*Specify*) ______________________________

  ↓

  When were the ASDs removed? ____________________ *(Specify Date)*

- ❑ ASDs were replaced with a different type of drive.

  ↓

  Why were the ASDs replaced with a different kind of drive?

  - ❑ ASDs had been improperly installed.
  - ❑ ASDs had “failed”.
  - ❑ ASDs had poor repair/maintenance record.
  - ❑ Load for ASDs changed.
  - ❑ Other (*Specify*) ______________________________

  ↓

  What were the ASDs replaced with?
  (*Specify*) ______________________________

  ↓

  When were the ASDs replaced? ____________________ *(Specify Date)*

- ❑ ASDs were relocated to another part of facility.

  ↓

  What use is being made of the relocated ASDs? ____________________

  ____

- ❑ Other (*Specify*) ______________________________

High Efficiency Pumps

(*Complete a set of these questions for each area in which high efficiency pumps were installed. Use a page for each area in which high efficiency pumps were installed and inspected.)*

Edison's records show that you received a rebate to install high efficiency pumps in *(Specify Area).*

PUMP1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Were any high efficiency pumps in (*Specify* Area) affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply*.)

❑ No *Go to PUMP2.*
❑ Yes
↓
How many of the pumps were affected? ______________________________
↓
What effect did the major changes have on the high efficiency pumps?
↓
❑ Pumps were removed and not replaced.
❑ Pumps were replaced with a different type or size of pump.
↓
What were the pumps replaced with?
(*Specify*) ______________________________
❑ Pumps were relocated to another part of facility.
↓
What use is being made of the relocated pumps? ______________________________
____
❑ Other (*Specify*) ______________________________

PUMP2. Besides the major renovations and changes that we asked about earlier, have any other actions occurred at this facility that resulted in the high efficiency pumps in (*Specify Area*) being removed or replaced? (*Check all mentioned. Prompt if necessary*)

- ❑ No *Go to next page.*
- ❑ Yes

↓

What actions were these? ____________________

↓

What effect did the actions have on the high efficiency pumps?

↓

- ❑ Pumps were removed and not replaced.

  ↓

  Why were the pumps removed and not replaced?

  - ❑ Pumps had been improperly installed.
  - ❑ Pumps had "failed".
  - ❑ Pumps had poor repair/maintenance record.
  - ❑ Load for pumps changed.
  - ❑ Other (*Specify*) ____________________

  ↓

  When were the pumps removed? ____________________ *(Specify Date)*

- ❑ Pumps were replaced with a different type or size of pump.

  ↓

  Why were the pumps replaced with a different type of size of pump?

  - ❑ Pumps had been improperly installed.
  - ❑ Pumps had "failed".
  - ❑ Pumps had poor repair/maintenance record.
  - ❑ Load for pumps changed.
  - ❑ Other (*Specify*) ____________________

  ↓

  What were the pumps replaced with?
  (*Specify*) ____________________

  ↓

  When were the pumps replaced? ____________________ *(Specify Date)*

- ❑ Pumps were relocated to another part of facility.

  ↓

  What use is being made of the relocated pumps? ____________________

  ____

- ❑ Other (*Specify*) ____________________

Pump Improvements

(*Complete a set of these questions for each area in which pump improvements were made. Use a page for each area in which pump improvements were made.)*

Edison's records show that you received a rebate to improve the efficiency of pumps used in *(Specify Area).*

PI1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Were any of the pumps for which improvements made in (*Specify* Area) affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply*.)

❑ No *Go to PI2.*
❑ Yes
↓
If more than one pump, ask:
How many of the pumps were affected? ____
↓
What effect did the changes have on the pumps for which improvements were made?
↓
- ❑ Pumps were removed and not replaced.
- ❑ Pumps were replaced with a different type or size of pump.
  ↓
  What were the pumps replaced with?
  (*Specify*) ____
- ❑ Pumps were relocated to another part of facility.
  ↓
  What use is being made of the relocated pumps? ______________________________
  ____
- ❑ Other (*Specify*) ____

PI2. Besides the major renovations and changes that we asked about earlier, have any other actions occurred at this facility that resulted in the pumps for which improvements were made in (*Specify Area*) being removed or replaced? (*Check all mentioned. Prompt if necessary*)

- ❑ No *Go to next page.*
- ❑ Yes

  ↓

  What actions were these? ____

  ↓

  What effect did the actions have on the pumps?

  ↓

  - ❑ Pumps were removed and not replaced.

    ↓

    Why were the pumps removed and not replaced?

    - ❑ Pumps had been improperly installed.
    - ❑ Pumps had “failed”.
    - ❑ Pumps had poor repair/maintenance record.
    - ❑ Load for pumps changed.
    - ❑ Other (*Specify*) ____

    ↓

    When were the pumps removed? ______________________ *(Specify Date)*

  - ❑ Pumps were replaced with a different type or size of pump.

    ↓

    Why were the pumps replaced with a different type of size of pump?

    - ❑ Pumps had been improperly installed.
    - ❑ Pumps had “failed”.
    - ❑ Pumps had poor repair/maintenance record.
    - ❑ Load for pumps changed.
    - ❑ Other (*Specify*) ____

    ↓

    What were the pumps replaced with?
    (*Specify*) ____

    ↓

    When were the pumps replaced? ______________________ *(Specify Date)*

  - ❑ Pumps were relocated to another part of facility.

    ↓

    What use is being made of the relocated pumps? ______________________

    ____

  - ❑ Other (*Specify*) ____

HVAC Energy Management System

(*Complete a set of these questions for each area in which a HVAC EMS was installed. Use a page for each area in which a HVAC EMS was installed and inspected.)*

Edison's records show that you received a rebate to install an HVAC EMS in *(Specify Area)*.

EMS1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Was the HVAC EMS in (*Specify Area*) affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply.*)

- ❑ No *Go to EMS2.*
- ❑ Yes

  ↓

  What effect did the changes have on the EMS?

  ↓

  - ❑ EMS was removed and not replaced.
  - ❑ EMS was replaced with a different type of control system.

    ↓

    What was the EMS replaced with?
    (*Specify*) ______________________________

  - ❑ Other (*Specify*) ______________________________

EMS2. Besides the major renovations and changes that we asked about earlier, have any other actions occurred at this facility that affected the operation of the EMS in (*Specify Area*)? (*Check all mentioned. Prompt if necessary*)

- ❑ No *Go to next page.*
- ❑ Yes

  ↓

  What actions were these? ______________________________

  ↓

  What effect did these actions have on the EMS?

  ↓

  - ❑ EMS is completely bypassed.
  - ❑ EMS is only partially operational.
  - ❑ EMS is not used because it needs reprogramming.
  - ❑ EMS needs additional control points.
  - ❑ EMS was replaced with a different type of control sytem.

    ↓

    What kind of system was the replacement control system?______________________

  - ❑ Other (*Specify*) ______________________________

Energy Efficient Chillers

(*Complete a set of these questions for each area in which an energy efficient chiller was installed. Use a page for each area in which an energy efficient chiller was installed and inspected.)*

Edison's records show that you received a rebate to install an energy efficient chiller in *(Specify Area)*.

CHILL1. *ASK THIS QUESTION ONLY IF RESPONDENT ANSWERED "YES" TO ANY OF THE QUESTIONS IN SECTION 1.*

Was the energy efficient chiller in (*Specify* Area) affected by major changes in the facility's structure, equipment or operating hours? (*Check all that apply*.)

❑ No *Go to CHILL2*
❑ Yes
↓
What effect did the changes have on the energy efficient chiller?
↓
❑ Chiller was removed and not replaced.
❑ Chiller was replaced with a different type of cooling equipment.
↓
What was the chiller replaced with?
(*Specify*) ______________________________
❑ Other (*Specify*) ______________________________

CHILL2. Besides the major renovations and changes that we asked about earlier, have any other actions occurred at this facility that affected the operation of the energy efficiency chiller installed at this facility? (*Check all mentioned. Prompt if necessary*)

❑ No *Go to next page.*
❑ Yes
↓
What actions were these? ______________________________
____
↓
What effect did these actions have on the operation of the energy efficient chiller?
↓
❑ Chiller was removed and not replaced.
↓
Why was the chiller removed and not replaced?
❑ Chiller required major repair.
❑ Had to change to non-CFC refrigerant.
❑ There was a change to distribution system that required change to chiller.
❑ There was a change in cooling requirements.
❑ Other (*Specify*) ______________________________
↓
When was the chiller removed? ______________________________ *(Specify Date)*

- ❑ Chiller was replaced with a different type of chiller.

  ➔

  Why was the chiller replaced with a different type of chiller?

  - ❑ Chiller required major repair.
  - ❑ Had to change to non-CFC refrigerant.
  - ❑ There was a change to distribution system that required change to chiller.
  - ❑ There was a change in cooling requirements.
  - ❑ Other (*Specify*) ______________________________

  ➔

  What was the chiller replaced with?
  (*Specify*) ______________________________

  ➔

  When was the chiller replaced? ______________________________ *(Specify Date)*

- ❑ Other (*Specify*) ______________________________

Appendix E

SPREADSHEETS FOR SAMPLE SIZE CALCULATIONS

This appendix provides spreadsheets showing the parametrics for the sample size calculations. The parametrics differ primarily in the assumptions about the number of occurrences of a measure per site. The spreadsheets primarily show the results of calculations of sample sizes for four different values for occurrences of lighting measures per site: 1, 10, 50, 100.

Sample Size Calculations - Parametrics Run 1

Assume exponential distribution for survival function								
	z-value	Relative Precision	Accrual Time	Follow-Up Time	Cost Ratio	Rho	Cluster Size	Design Effect
Electronic ballasts	1.28	0.20	24	48	1.0	0.50	1	1.00
CFBs (modular)	1.28	0.20	24	48	1.0	0.50	1	1.00
T8 lamps	1.28	0.20	24	48	1.0	0.50	1	1.00
Delamping/Reflectors	1.28	0.20	24	48	1.0	0.50	1	1.00
HVAC EMS systems	1.28	0.20	24	48	1.0	0.50	1	1.00
High-Efficiency Chillers	1.28	0.20	24	48	1.0	0.50	1	1.00
ASDs (Commercial)	1.28	0.20	24	48	1.0	0.50	1	1.00
ASDs (Industrial)	1.28	0.20	24	48	1.0	0.50	1	1.00
Pumps	1.28	0.20	24	48	1.0	0.50	1	1.00
Pump system improvements	1.28	0.20	24	48	1.0	0.50	1	1.00
Ballasts	1.28	0.20	24	48	1.0	0.50	1	1.00
Lamps	1.28	0.20	24	48	1.0	0.50	1	1.00
Measure	Required Number of Failures	Mean Life (In Years)	Mean Life (In Months)	Lambda	Probability of Failure	Required Sample Size	Required Cluster Elements	Required Number of Sites
Electronic ballasts	41	10	120	0.00833	0.368	112	112	112
CFBs (modular)	41	12.2	146.4	0.00683	0.314	131	131	131
T8 lamps	41	5	60	0.01667	0.593	69	69	69
Delamping/Reflectors	41	10	120	0.00833	0.368	112	112	112
HVAC EMS systems	41	10	120	0.00833	0.368	112	112	112
High-Efficiency Chillers	41	20	240	0.00417	0.207	199	199	199
ASDs (Commercial)	41	10	120	0.00833	0.368	112	112	112
ASDs (Industrial)	41	10	120	0.00833	0.368	112	112	112
Pumps	41	9	108	0.00926	0.398	103	103	103
Pump system improvements	41	9	108	0.00926	0.398	103	103	103
Ballasts	41	10	120	0.00833	0.368	112	112	112
Lamps	41	10	120	0.00833	0.368	112	112	112
						1,386	1,386	1,386

Assume exponential distribution for survival function								
	z-value	Relative Precision	Accrual Time	Follow-Up Time	Cost Ratio	Rho	Cluster Size	Design Effect
Electronic ballasts	1.28	0.20	24	48	100.0	0.50	10	5.50
CFBs (modular)	1.28	0.20	24	48	100.0	0.50	10	5.50
T8 lamps	1.28	0.20	24	48	100.0	0.50	10	5.50
Delamping/Reflectors	1.28	0.20	24	48	100.0	0.50	10	5.50
HVAC EMS systems	1.28	0.20	24	48	100.0	0.50	1	1.00
High-Efficiency Chillers	1.28	0.20	24	48	100.0	0.50	1	1.00
ASDs (Commercial)	1.28	0.20	24	48	100.0	0.50	2	1.50
					100.0			
ASDs (Industrial)	1.28	0.20	24	48	100.0	0.50	2	1.50
Pumps	1.28	0.20	24	48	100.0	0.50	2	1.50
Pump system improvements	1.28	0.20	24	48	100.0	0.50	2	1.50
Ballasts	1.28	0.20	24	48	100.0	0.50	10	5.50
Lamps	1.28	0.20	24	48	100.0	0.50	10	5.50
Measure	Required Number of Failures	Mean Life (In Years)	Mean Life (In Months)	Lambda	Probability of Failure	Required Sample Size	Required Cluster Elements	Required Number of Sites
Electronic ballasts	41	10	120	0.00833	0.368	112	614	61
CFBs (modular)	41	12.2	146.4	0.00683	0.314	131	719	72
T8 lamps	41	5	60	0.01667	0.593	69	381	38
Delamping/Reflectors	41	10	120	0.00833	0.368	112	614	61
HVAC EMS systems	41	10	120	0.00833	0.368	112	112	112
High-Efficiency Chillers	41	20	240	0.00417	0.207	199	199	199
ASDs (Commercial)	41	10	120	0.00833	0.368	112	167	84
ASDs (Industrial)	41	10	120	0.00833	0.368	112	167	84
Pumps	41	9	108	0.00926	0.398	103	155	77
Pump system improvements	41	9	108	0.00926	0.398	103	155	77
Ballasts	41	10	120	0.00833	0.368	112	614	61
Lamps	41	10	120	0.00833	0.368	112	614	61
						1,386	4,511	988

Assume exponential distribution for survival function								
	z-value	Relative Precision	Accrual Time	Follow-Up Time	Cost Ratio	Rho	Cluster Size	Design Effect
Electronic ballasts	1.28	0.20	24	48	2500.0	0.50	50	25.50
CFBs (modular)	1.28	0.20	24	48	2500.0	0.50	50	25.50
T8 lamps	1.28	0.20	24	48	2500.0	0.50	50	25.50
Delamping/Reflectors	1.28	0.20	24	48	2500.0	0.50	50	25.50
HVAC EMS systems	1.28	0.20	24	48	2500.0	0.50	1	1.00
High-Efficiency Chillers	1.28	0.20	24	48	2500.0	0.50	1	1.00
ASDs (Commercial)	1.28	0.20	24	48	2500.0	0.50	2	1.50
ASDs (Industrial)	1.28	0.20	24	48	2500.0	0.50	2	1.50
Pumps	1.28	0.20	24	48	2500.0	0.50	2	1.50
Pump system improvements	1.28	0.20	24	48	2500.0	0.50	2	1.50
Ballasts	1.28	0.20	24	48	2500.0	0.50	50	25.50
Lamps	1.28	0.20	24	48	2500.0	0.50	50	25.50
Measure	Required Number of Failures	Mean Life (In Years)	Mean Life (In Months)	Lambda	Probability of Failure	Required Sample Size	Required Cluster Elements	Required Number of Sites
Electronic ballasts	41	10	120	0.00833	0.368	112	2,847	57
CFBs (modular)	41	12.2	146.4	0.00683	0.314	131	3,333	67
T8 lamps	41	5	60	0.01667	0.593	69	1,766	35
Delamping/Reflectors	41	10	120	0.00833	0.368	112	2,847	57
HVAC EMS systems	41	10	120	0.00833	0.368	112	112	112
High-Efficiency Chillers	41	20	240	0.00417	0.207	199	199	199
ASDs (Commercial)	41	10	120	0.00833	0.368	112	167	84
ASDs (Industrial)	41	10	120	0.00833	0.368	112	167	84
Pumps	41	9	108	0.00926	0.398	103	155	77
Pump system improvements	41	9	108	0.00926	0.398	103	155	77
Ballasts	41	10	120	0.00833	0.368	112	2,847	57
Lamps	41	10	120	0.00833	0.368	112	2,847	57
						1,386	17,443	962

Sample Size Calculations - Parametrics Run 4

Assume exponential distribution for survival function								
	z-value	Relative Precision	Accrual Time	Follow-Up Time	Cost Ratio	Rho	Cluster Size	Design Effect
Electronic ballasts	1.28	0.20	24	48	10,000	0.50	100	50.50
CFBs (modular)	1.28	0.20	24	48	10,000	0.50	100	50.50
T8 lamps	1.28	0.20	24	48	10,000	0.50	100	50.50
Delamping/Reflectors	1.28	0.20	24	48	10,000	0.50	100	50.50
HVAC EMS systems	1.28	0.20	24	48	10,000	0.50	1	1.00
High-Efficiency Chillers	1.28	0.20	24	48	10,000	0.50	1	1.00
ASDs (Commercial)	1.28	0.20	24	48	10,000	0.50	2	1.50
ASDs (Industrial)	1.28	0.20	24	48	10,000	0.50	2	1.50
Pumps	1.28	0.20	24	48	10,000	0.50	2	1.50
Pump system improvements	1.28	0.20	24	48	10,000	0.50	2	1.50
Ballasts	1.28	0.20	24	48	10,000	0.50	100	50.50
Lamps	1.28	0.20	24	48	10,000	0.50	100	50.50
Measure	Required Number of Failures	Mean Life (In Years)	Mean Life (In Months)	Lambda	Probability of Failure	Required Sample Size	Required Cluster Elements	Required Number of Sites
Electronic ballasts	41	10	120	0.00833	0.368	112	5,639	56
CFBs (modular)	41	12.2	146.4	0.00683	0.314	131	6,601	66
T8 lamps	41	5	60	0.01667	0.593	69	3,498	35
Delamping/Reflectors	41	10	120	0.00833	0.368	112	5,639	56
HVAC EMS systems	41	10	120	0.00833	0.368	112	112	112
High-Efficiency Chillers	41	20	240	0.00417	0.207	199	199	199
ASDs (Commercial)	41	10	120	0.00833	0.368	112	167	84
ASDs (Industrial)	41	10	120	0.00833	0.368	112	167	84
Pumps	41	9	108	0.00926	0.398	103	155	77
Pump system improvements	41	9	108	0.00926	0.398	103	155	77
Ballasts	41	10	120	0.00833	0.368	112	5,639	56
Lamps	41	10	120	0.00833	0.368	112	5,639	56
						1,386	33,608	959

Appendix F

CUSTOMER NOTIFICATION LETTER

Southern California Edison Company
300 NORTH LONE HILL AVENUE
SAN DIMAS, CALIFORNIA 91773

August 4, 1995

<<SVCNAME>>
<<SVCADDR>>
<<SVCCITY>>, CA <<SVCZIP>>

Dear Edison Customer:

You received a rebate in 1993 from Edison's Hardware Rebate Program, for the installation of high-efficiency lighting or space conditioning equipment. Your facility at the address above is one of a small group of commercial locations Edison has selected to help us analyze the energy savings actually being achieved by this type of equipment. We have hired the engineering firm of ADM Associates to carry out this analysis for us.

To do the analysis, ADM will need to perform an on-site survey of your facility. Accordingly, you will be contacted soon by a representative of ADM Associates who will seek to set a date and time for the survey.

We would appreciate your cooperation in allowing us to conduct this survey, because we selected facilities that we felt would do the most to help us improve our methods of estimating energy savings. Please be assured, however, that the data we collect from you will be held in strictest confidence and will not be disclosed outside of Edison.

If you have any questions regarding this project, please call Marty Morse, our Edison project manager, at (909) 394-8575 or call Marla Sullivan, the Scheduling Coordinator at ADM, at (800) 556-2128.

Thank you for your valuable time and cooperation.

Sincerely,

Marian V. Brown
Manager, Measurement and Evaluation

GBID: <<SMPLID>>

Appendix G

HAZARD FUNCTIONS AND SURVIVAL FUNCTIONS FOR COMMERCIAL MEASURES

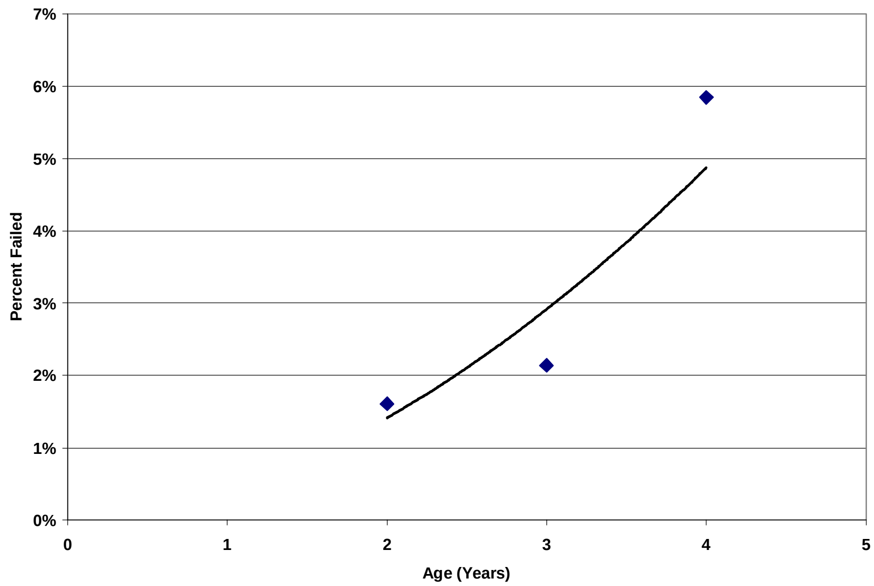
This appendix provides the data used for the hazard function analyses of the commercial measures and plots of the estimated hazard functions and survival functions. Plots are provided for the following measures:

- T8 lighting fixtures
- T8 lamps
- Electronic ballasts
- Compact fluorescent fixtures
- Compact fluorescent lamps
- Delamping/reflectors
- Adjustable speed drives

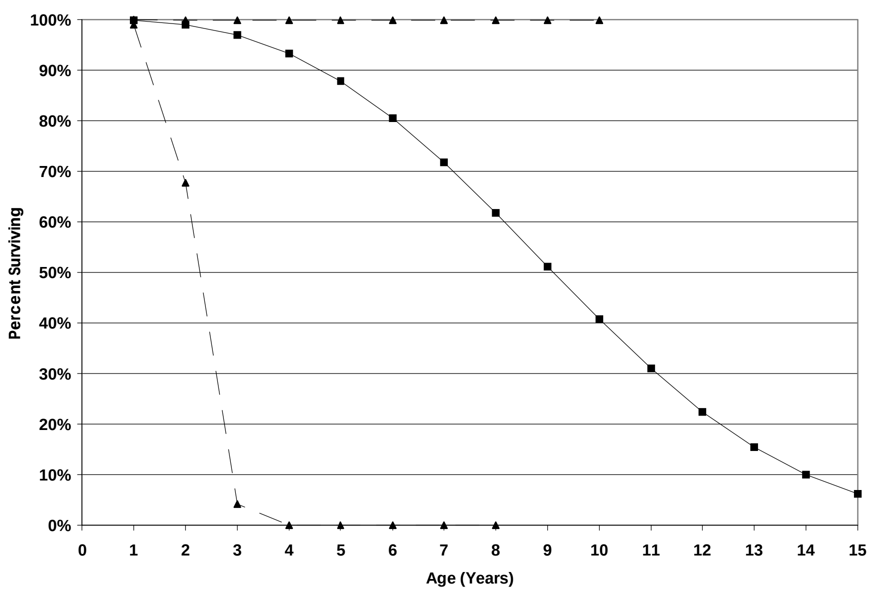
The numbers of removals/failures for HVAC EMS and for high efficiency chillers were not sufficient to support hazard function analysis.

Data for Calculating Hazard Rates for Commercial T8 Fixtures

Year	*Fixtures at Start of Year*	*Fixtures Removed/Failed during Year*	*Hazard Rate (Rate of Removal/Failure)*
1	2,613	-	0.00%
2	2,613	42	1.61%
3	2,571	55	2.14%
4	2,516	147	5.84%



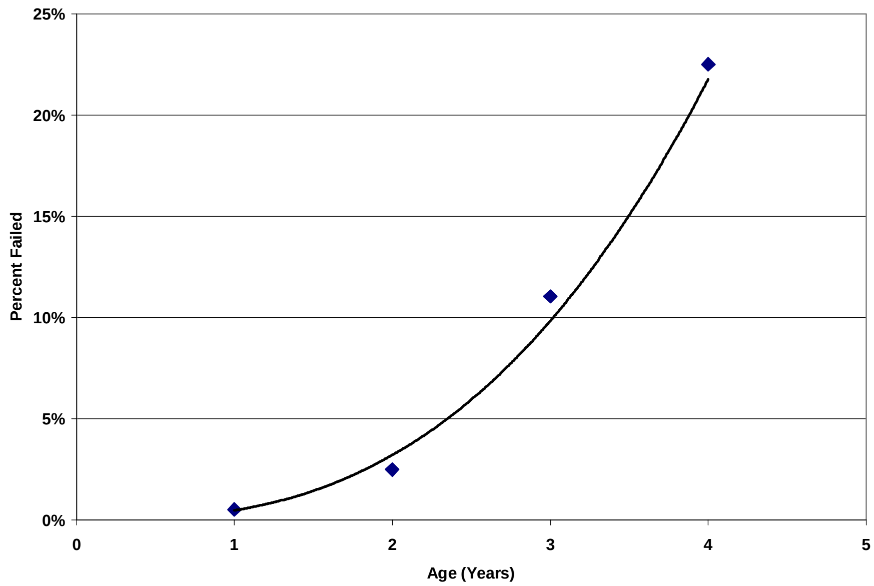
Plot of Hazard Rates for T8 Fixtures in Commercial Sector



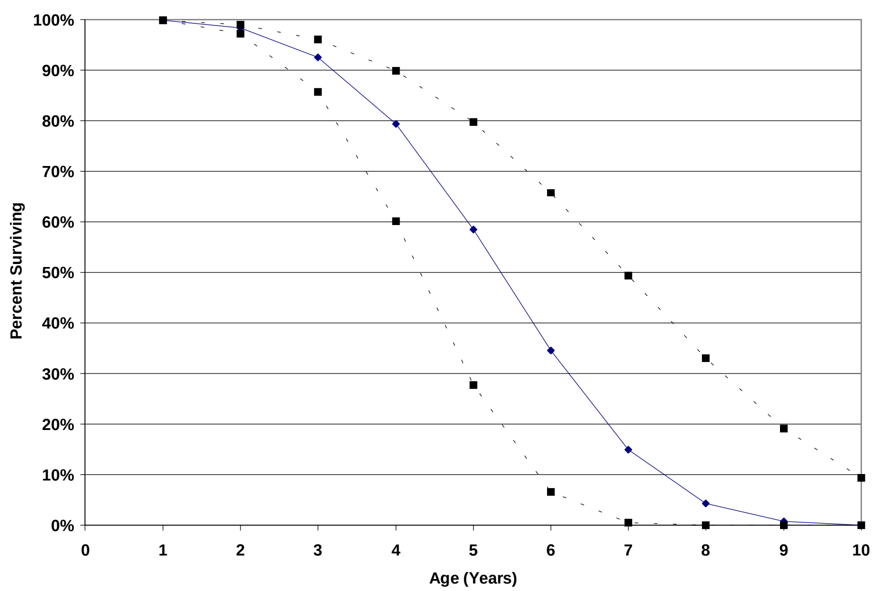
Survival Function Plot for T8 Fixtures in Commercial Sector

Data for Calculating Hazard Rates for Commercial T8 Lamps

Year	Lamps at Start of Year	Lamps Removed/Failed during Year	Hazard Rate (Rate of Removal/Failure)
1	6,667	35	0.52%
2	6,632	166	2.50%
3	6,466	714	11.04%
4	5,752	1,294	22.50%



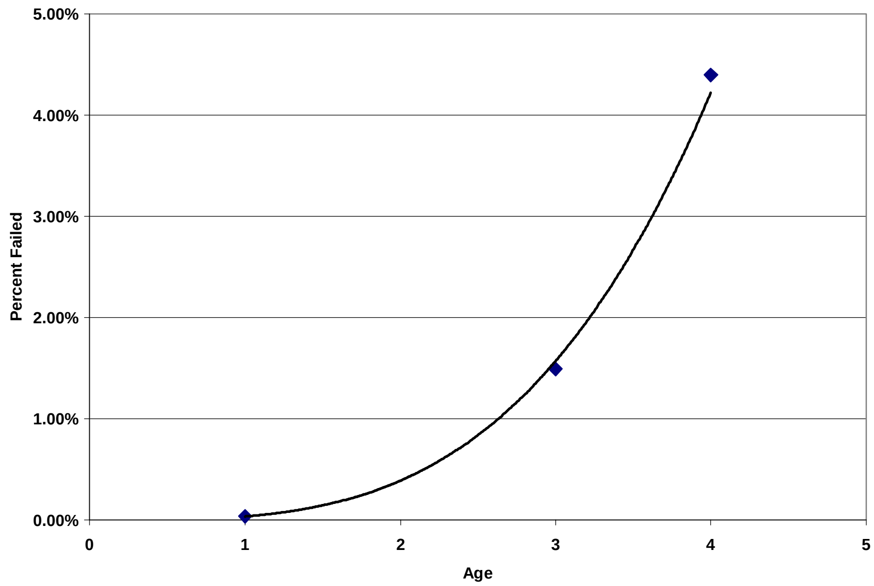
Plot of Hazard Rates for T8 Lamps in Commercial Sector



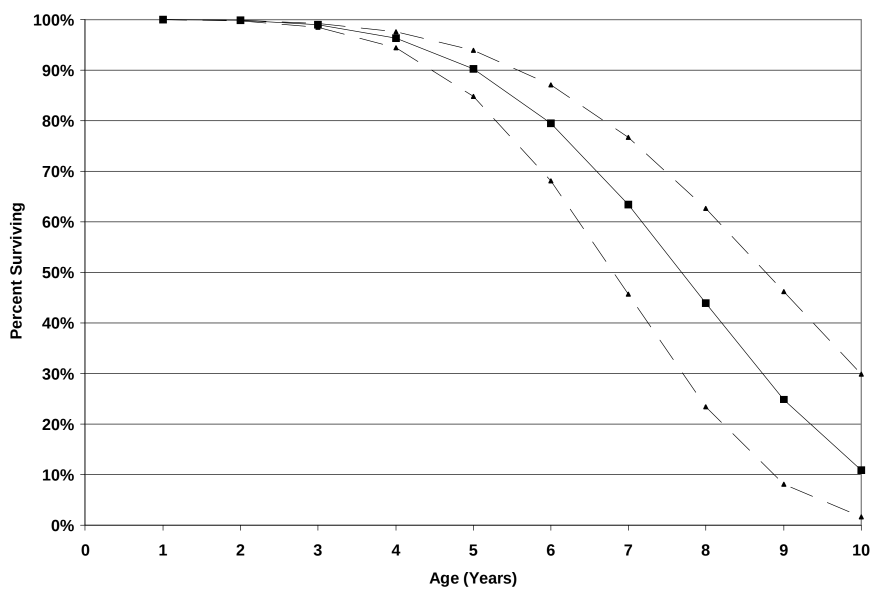
Survival Function Plot for T8 Lamps in Commercial Sector

Data for Calculating Hazard Rates for Commercial Electronic Ballasts

Year	*Ballasts at Start of Year*	*Ballasts Removed/Failed during Year*	*Hazard Rate (Rate of Removal/Failure)*
1	2,749	1	0.04%
2	2,748	-	0.00%
3	2,748	41	1.49%
4	2,707	119	4.40%



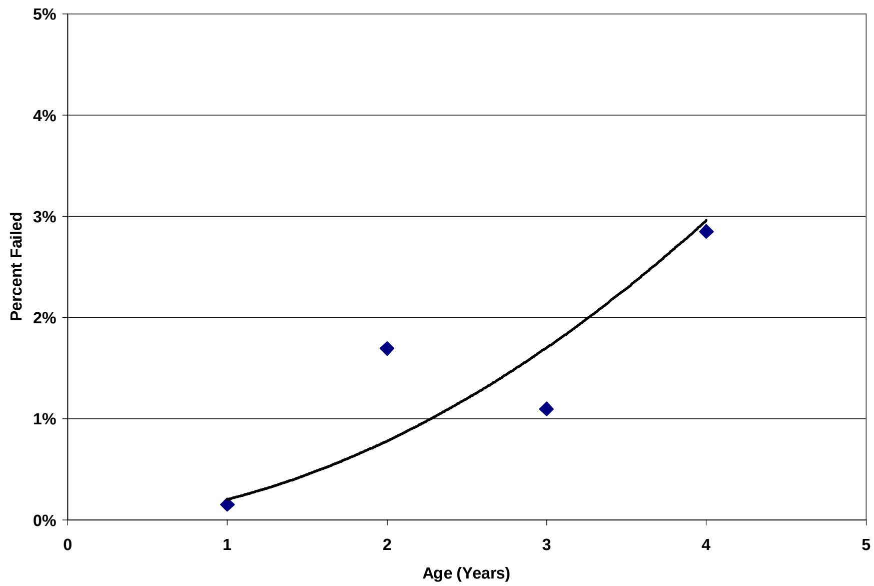
Plot of Hazard Rates for Electronic Ballasts in Commercial Sector



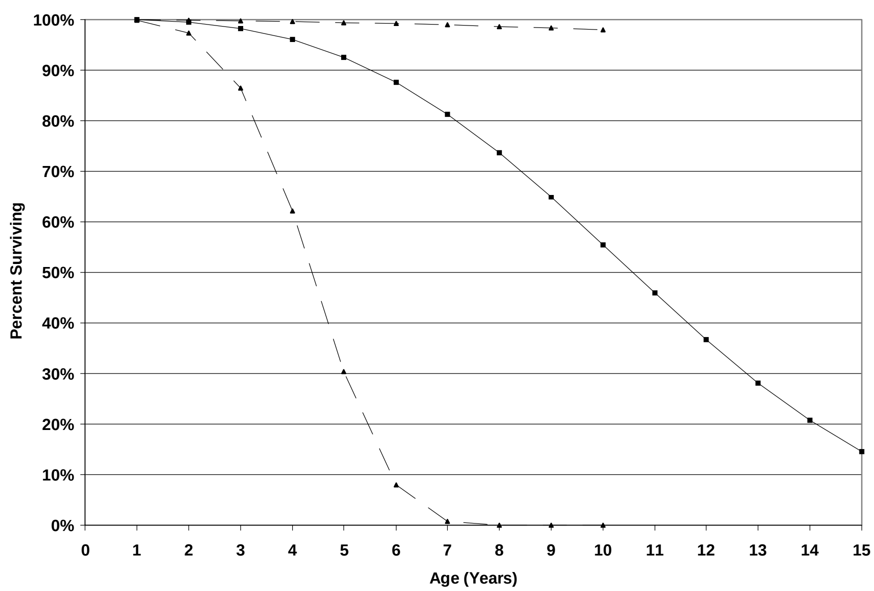
Survival Function Plot for Electronic Ballasts in Commercial Sector

Data for Calculating Hazard Rates for Commercial CF Fixtures

Year	*Fixtures at Start of Year*	*Fixtures Removed/Failed during Year*	*Hazard Rate (Rate of Removal/Failure)*
1	1,301	2	0.15%
2	1,299	22	1.69%
3	1,277	14	1.10%
4	1,263	36	2.85%



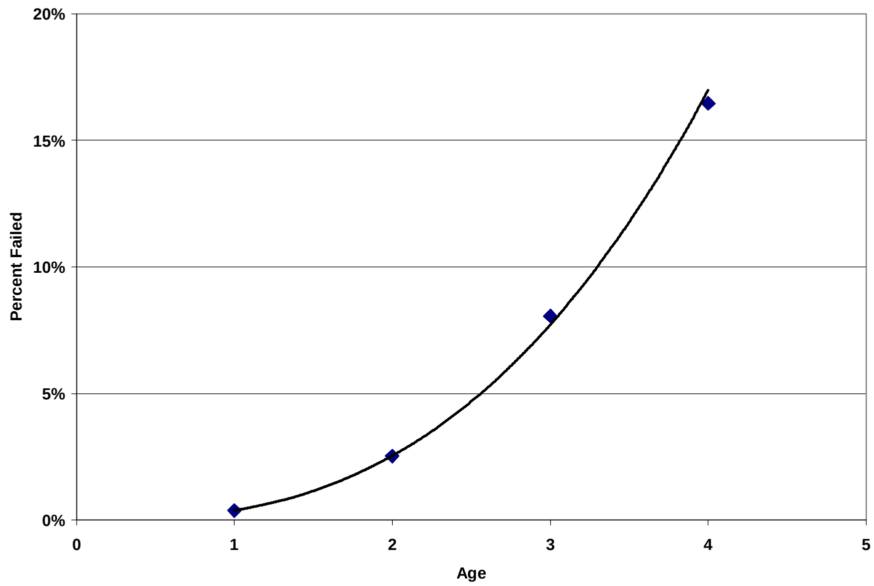
Plot of Hazard Rates for CF Fixtures in Commercial Sector



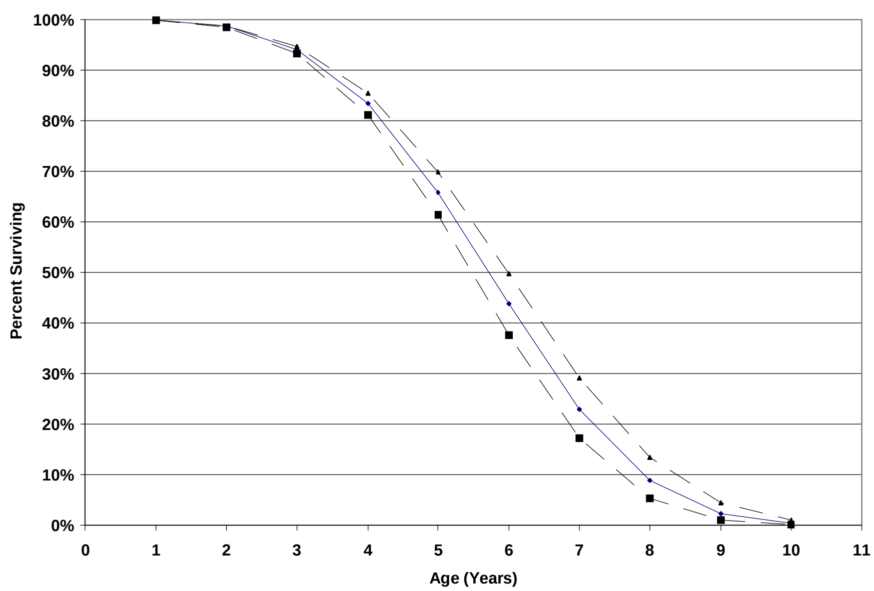
Survival Function Plot for CF Fixtures in Commercial Sector

Data for Calculating Hazard Rates for Commercial CF Lamps

Year	Lamps at Start of Year	Lamps Removed/Failed during Year	Hazard Rate (Rate of Removal/Failure)
1	1,586	6	0.38%
2	1,580	40	2.53%
3	1,540	124	8.05%
4	1,416	233	16.45%



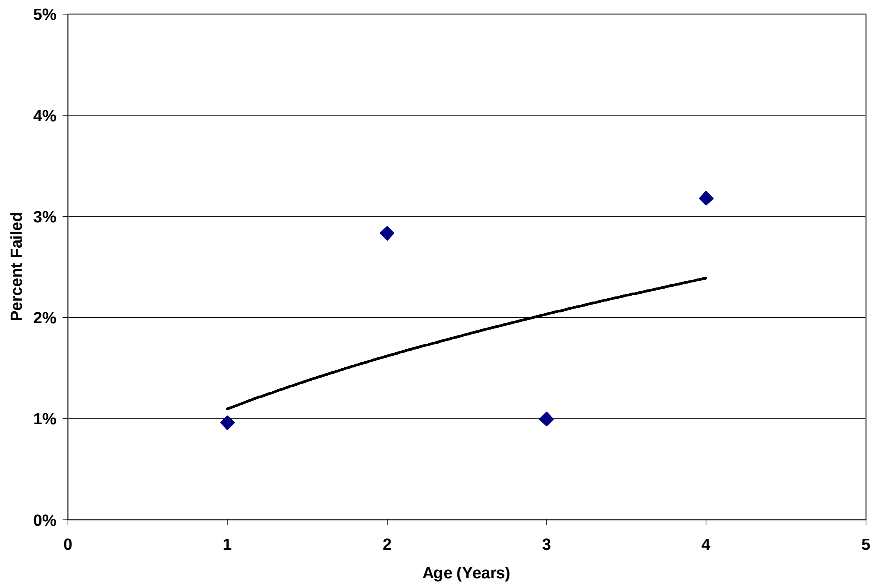
Plot of Hazard Rates for CF Lamps in Commercial Sector



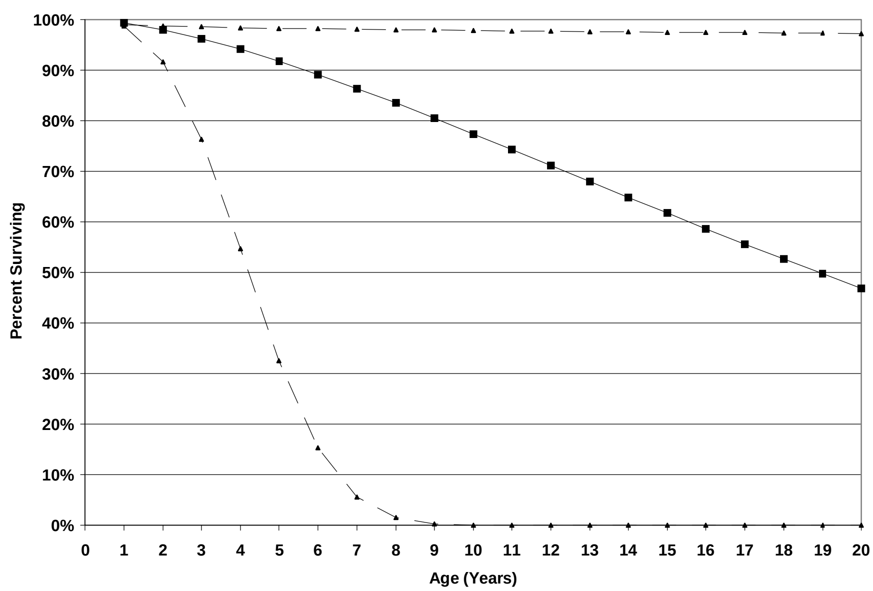
Survival Function Plot for CF Lamps in Commercial Sector

Data for Calculating Hazard Rates for Commercial Delamping/Reflectors

Year	*Lamps at Start of Year*	*Lamps Removed/Failed during Year*	*Hazard Rate (Rate of Removal/Failure)*
1	1,354	13	0.96%
2	1,341	38	2.83%
3	1,303	13	1.00%
4	1,290	41	3.18%



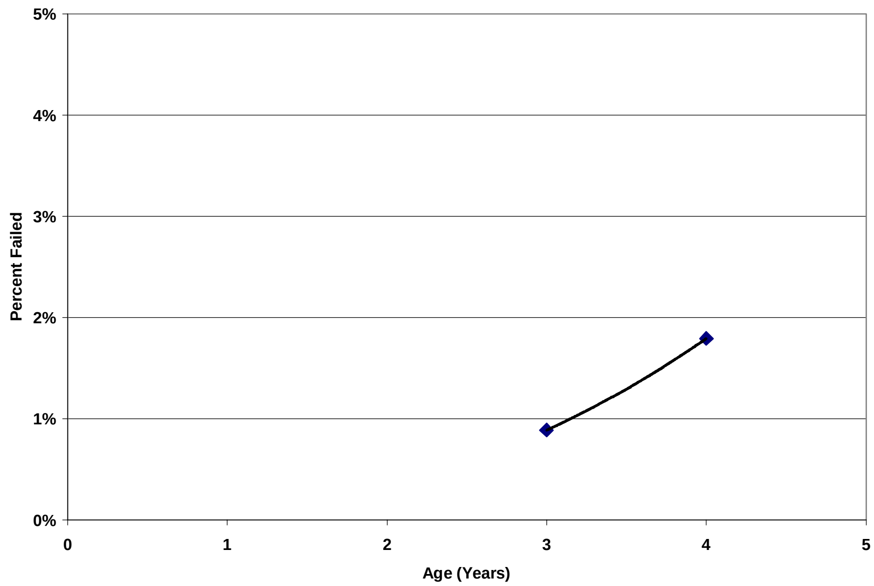
Plot of Hazard Rates for Delamping/Reflectors in Commercial Sector



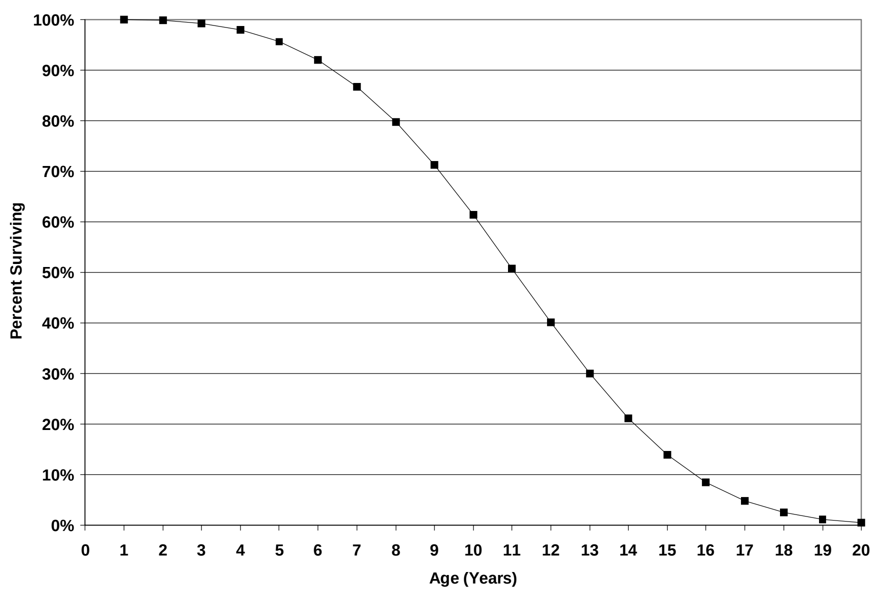
Survival Function Plot for Delamping/Reflectors in Commercial Sector

Data for Calculating Hazard Rates for Commercial ASDs

Year	*ASDs at Start of Year*	*ASDs Removed/Failed during Year*	*Hazard Rate (Rate of Removal/Failure)*
1	225	-	0.00%
2	225	-	0.00%
3	225	2	0.89%
4	223	4	1.79%



Plot of Hazard Rates for ASDs in Commercial Sector



Survival Function Plot for ASDs in Commercial Sector

Appendix H

HAZARD FUNCTIONS AND SURVIVAL FUNCTIONS FOR INDUSTRIAL/AGRICULTURAL MEASURES

This appendix provides the data used for the hazard function analyses of the industrial/agricultural measures and plots of the estimated hazard functions and survival functions. Plots are provided for the following measures:

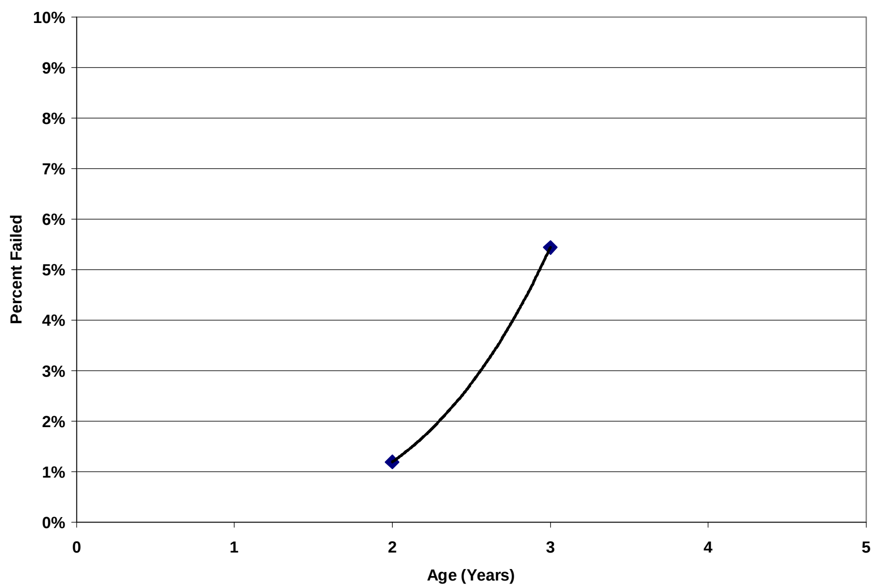
- T8 lighting fixtures
- T8 lamps
- Electronic ballasts
- Pumps/pump system improvements
- Adjustable speed drives

For the following measures, the numbers of removals/failures were not sufficient to support hazard function analysis.

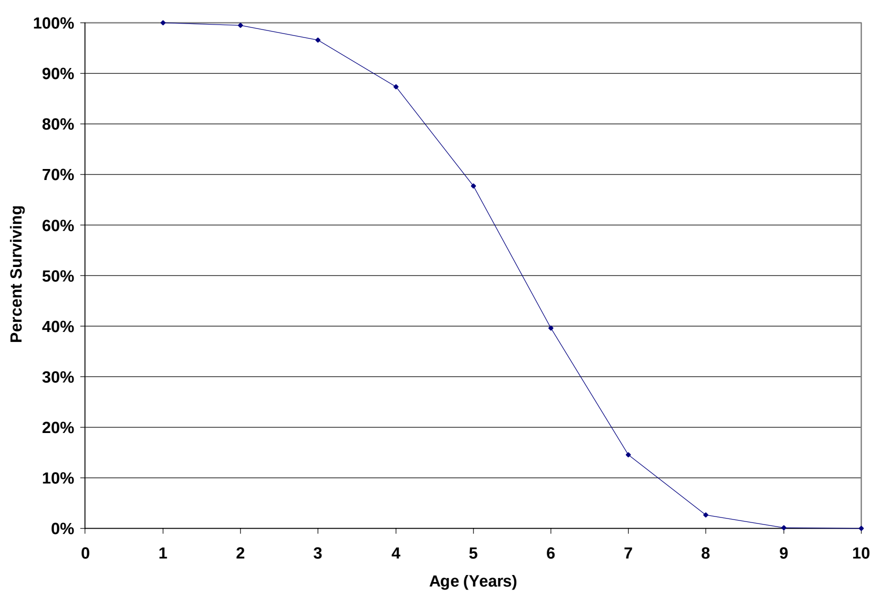
- Lighting EMS
- Injection molding machines
- Plastic extrusion equipment
- Process cooling
- Process equipment insulation
- High efficiency chillers
- Air compressors

Data for Calculating Hazard Rates for Industrial T8 Fixtures

Year	Fixtures at Start of Year	Fixtures Removed/Failed during Year	Hazard Rate (Rate of Removal/Failure)
1	1,005	-	0.00%
2	1,005	12	1.19%
3	993	54	5.44%



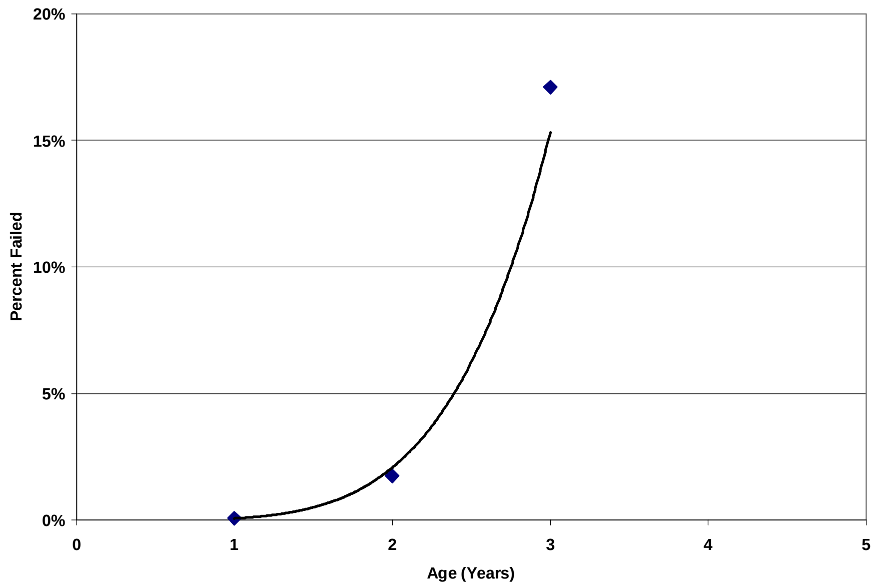
Plot of Hazard Rates for T8 Fixtures in Industrial Sector



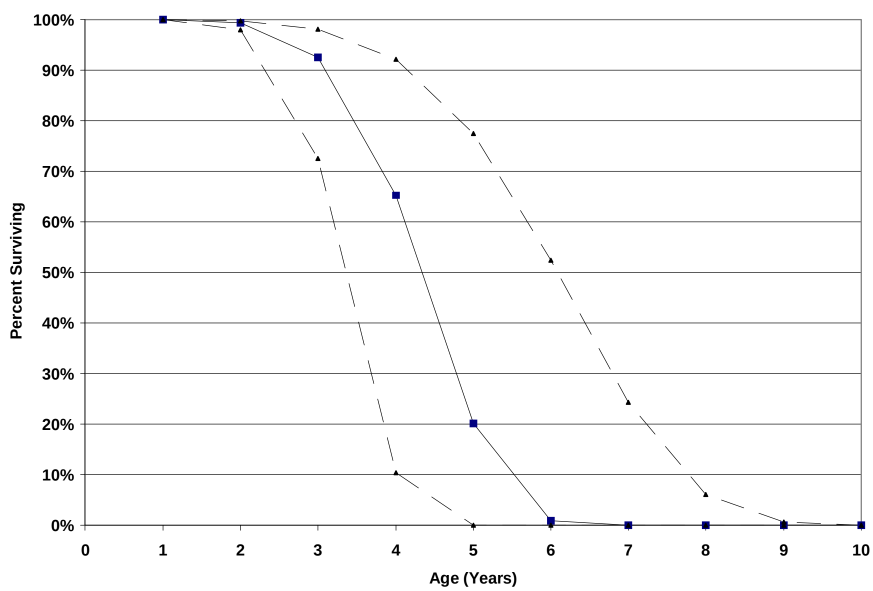
Survival Function Plot for T8 Fixtures in Industrial Sector

Data for Calculating Hazard Rates for Industrial/Agricultural T8 Lamps

Year	*Lamps at Start of Year*	*Lamps Removed/Failed during Year*	*Hazard Rate (Rate of Removal/Failure)*
1	2,753	2	0.07%
2	2,751	48	1.74%
3	2,703	462	17.09%
4			



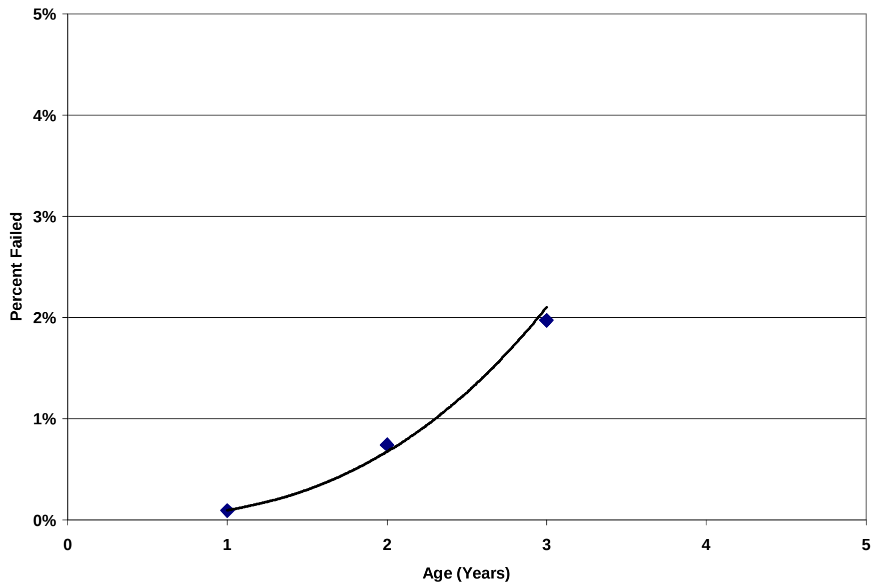
Plot of Hazard Rates for T8 Lamps in Industrial/Agricultural Sector



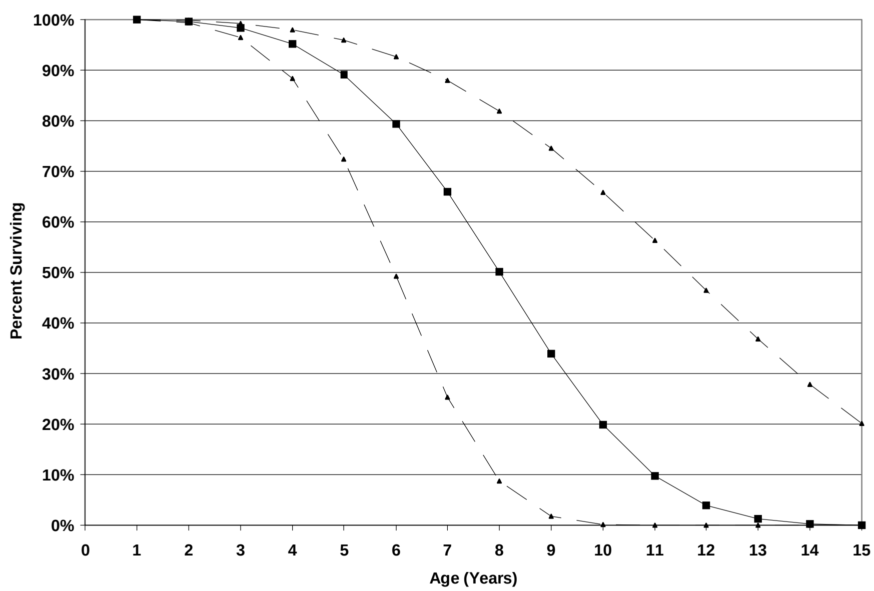
Survival Function Plot for T8 Lamps in Industrial/Agricultural Sector

Data for Calculating Hazard Rates for Industrial/Agricultural Electronic Ballasts

Year	Ballasts at Start of Year	Ballasts Removed/Failed during Year	Hazard Rate (Rate of Removal/Failure)
1	1,073	1	0.09%
2	1,072	8	0.75%
3	1,064	21	1.97%
4			



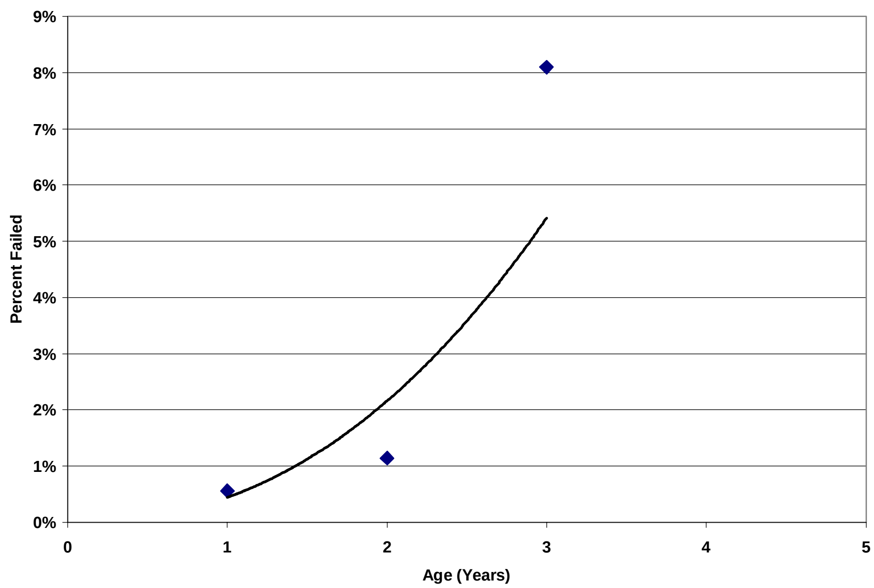
Plot of Hazard Rates for Electronic Ballasts in Industrial/Agricultural Sector



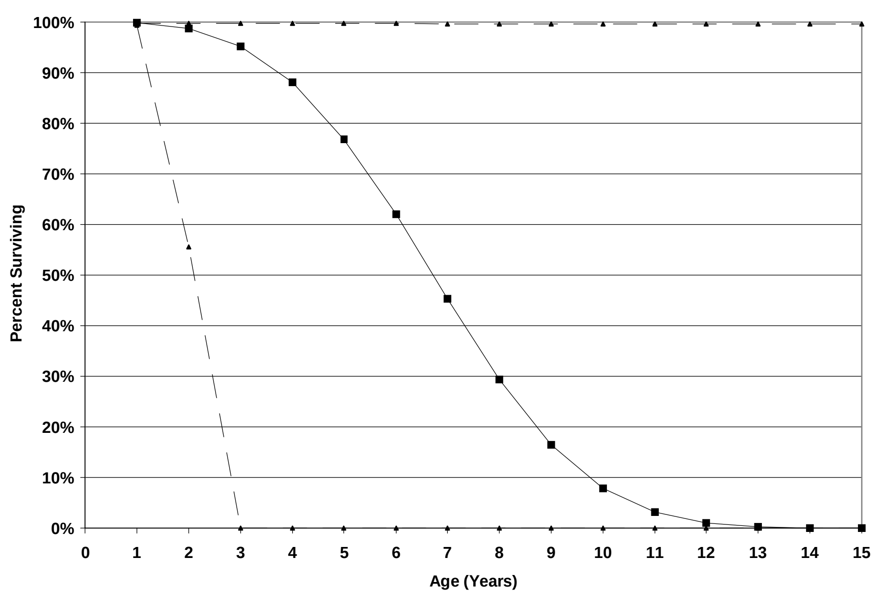
Survival Function Plot for Electronic Ballasts in Industrial/Agricultural Sector

Data for Calculating Hazard Rates for Industrial/Agricultural Pumps and Pump System Improvements

Year	Pumps at Start of Year	Pumps Removed/Failed during Year	Hazard Rate (Rate of Removal/Failure)
1	176	1	0.57%
2	175	2	1.14%
3	173	14	8.09%



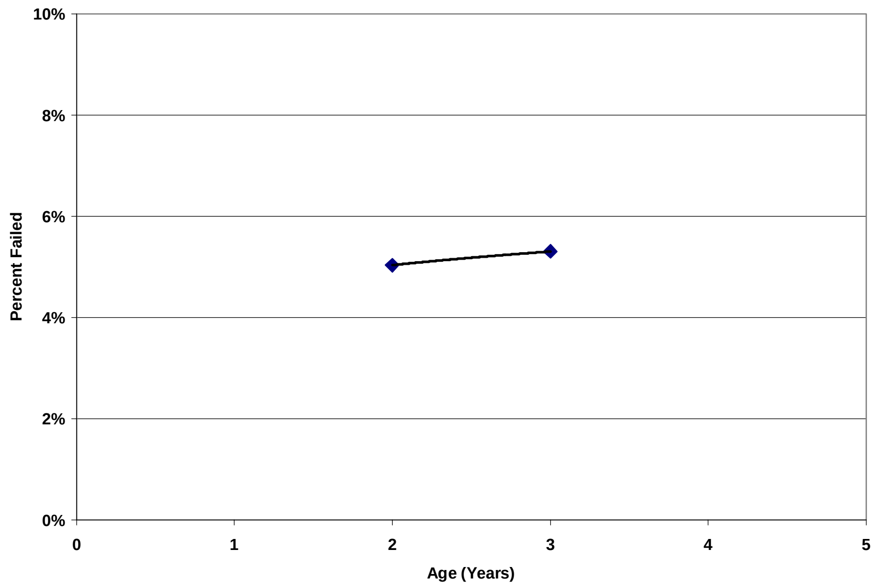
Plot of Hazard Rates for Pumps in Industrial/Agricultural Sector



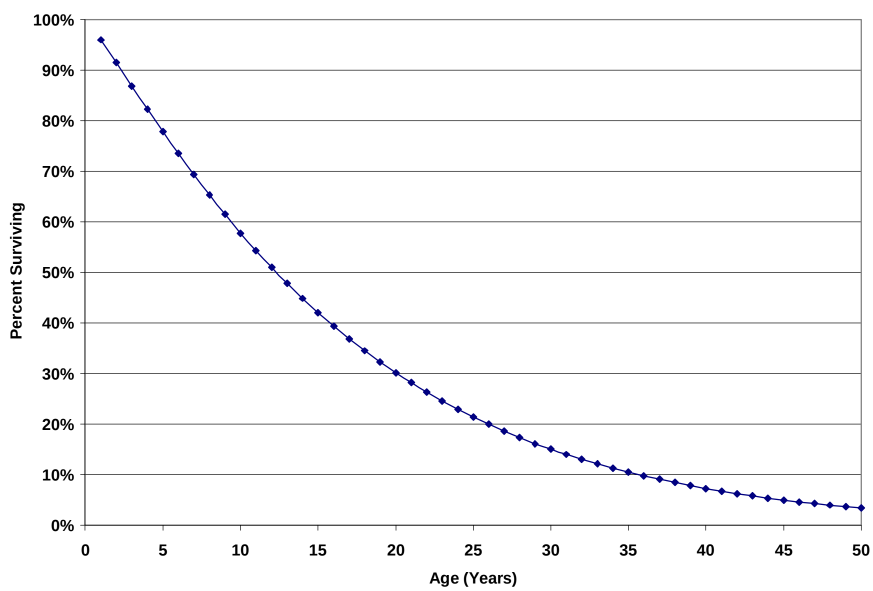
Survival Function Plot for Pumps in Industrial/Agricultural Sector

Data for Calculating Hazard Rates for Industrial/Agricultural ASDs

Year	*Lamps at Start of Year*	*Lamps Removed/Failed during Year*	*Hazard Rate (Rate of Removal/Failure)*
1	139	-	0.00%
2	139	7	5.04%
3	132	7	5.30%
4			



Plot of Hazard Rates for ASDs in Industrial/Agricultural Sector



Survival Function Plot for ASDs in Industrial/Agricultural Sector

Appendix I

PROTOCOL TABLES 6 AND 7

This appendix provides the information requested in Tables 6 and 7 of the M&E Protocols.

I.1 Information Required per Table 6 of M&E Protocols

The information required per Table 6 of the M&E Protocols is reported in Table I-1.

1. *Identify the studied measure and the end use it belongs to.*
   This information is provided in Columns (1) and (2) of Table I-1.
2. *Identify the ex ante expected useful life and the source of the ex ante expected useful life.*
   This information is provided in Columns (3) and (4) of Table I-1.
3. *Identify the ex post expected useful life estimated in the study.*
   This information is provided in Column (6) of Table I-1.
4. *Identify the ex post expected useful life to be used by the utility in the third and fourth earnings claim.*
   This information is provided in Column (8) of Table I-1.
5. *Identify the standard error associated with the ex post expected useful life.*
   Because the survival functions for the measures are not symmetric, the standard error does not provide meaningful information on the spread around the estimated median life. The information on the spread around the estimated value is provided by the lower and upper bounds of the confidence interval, reported in Columns (5) and (7) of Table I-1.
6. *Provide the 80% confidence interval associated with the ex post expected useful life.*
   This information is provided in Columns (5) and (7) of Table I-1.
7. *Provide the p-value associated with the ex post expected useful life.*
   The p-value is 20%.
8. *Provide the realization rate for the adopted ex post expected useful life. This is defined as the ratio of the adopted ex post expected useful life to the ex ante expected useful life.*
   This information is provided in Column (9) of Table I-1.
9. *Identify all the "like" measures associated with the studied measure.*
   This information is provided in Column (10) of Table I-1.

Table I-1. Required Information per Protocols Table 6

Measure	*End Use*	*SCE Ex Ante Useful Life*		*Estimated Median Life*			*Ex Post EUL for 3rd & 4th Earnings Claim*	*Realization Rate*	*"Like" Measures*
		Value	*Source*	*80% Lower bound*	*Estimated Median*	*80% Upper bound*			
Commercial Sector									
T8 lighting fixtures	Lighting	11	1997 AEAP, Table C	2.24	9.11	> 100	11	1.00	None
T8 lamps	Lighting	5	Protocol, App. F, Table 1	4.31	5.37	6.96	5	1.00	None
Electronic ballasts	Lighting	10	Protocol, App. F, Table 1	6.82	7.80	8.78	7.80	0.78	None
CF fixtures (modular)	Lighting	12	Protocol, App. F, Table 1	4.38	10.51	78.43	12	1.00	None
CF lamps	Lighting	2.2	Protocol, App. F, Table 1	5.48	5.73	5.99	5.73	2.60	None
Delamping/reflectors	Lighting	10	Protocol, App. F, Table 1	4.20	18.85	> 100	10	1.00	None
Adjustable speed drives	Motors	10	Protocol, App. F, Table 1	**	11.13	**	10	1.00	None
HVAC EMS	HVAC	15	Protocol, App. F, Table 1	**	*	**	15	1.00	None
Chillers	HVAC	20	Protocol, App. F, Table 1	**	*	**	20	1.00	None
Industrial Sector									
T8 lighting fixtures	Lighting	11	1997 AEAP, Table C	**	9.18	**	11	1.00	None
T8 lamps	Lighting	5	Protocol, App. F, Table 1	3.36	4.32	6.08	5	1.00	None
Electronic ballasts	Lighting	10	Protocol, App. F, Table 1	5.97	7.94	11.65	10	1.00	None
Adjustable speed drives	Motors	10	Protocol, App. F, Table 1	**	12.31	**	10	1.00	None
Lighting EMS	Lighting	15	Tracking System	**	*	**	15	1.00	None
Injection molding machines	Process	15	Tracking System	**	*	**	15	1.00	None
Plastic extrusion equipment	Process	15	Tracking System	**	*	**	15	1.00	None
Process cooling	Process	15	Tracking System	**	*	**	15	1.00	None
Process equipment insulation	Process	15	Tracking System	**	*	**	15	1.00	None
High efficiency chillers	Process	20	Protocol, App. F, Table 1	**	*	**	15	1.00	None
Air compressors	Process	15	Tracking System	**	*	**	15	1.00	None
Agricultural Sector									
Pumps/pump system improvements	Pumping	15	1997 AEAP, Table C	2.05	6.72	> 100	15	1.00	None
Adjustable speed drives	Motors	10	Protocol, App. F, Table 1	**	12.31	**	10	1.00	None

I.2 Information Required per Table 7 of M&E Protocols

This section provides the information required per Table 7 of the M&E Protocols.

1. *a. Study Title and Study ID No.*

   Study title is:
   Southern California Edison
   1993-1994
   Commercial/Industrial/Agricultural
   Energy Efficiency Incentives Program
   Fourth Year Retention Study

   Study ID No. is:
   CEC Study Id #529A,B,C

´ *b. Program, Program years, and program description*

   Program is:
   Commercial/Industrial/Agricultural
   Energy EfficiencyIncentives Program

   Program Years are 1993 and 1994. Program Year 1995 is excluded per retroactive waivers (cf. Appendix J).

   Program Description:
   This study examined the retention rates and effective useful lives for measures installed by commercial, industrial, or agricultural customers of SCE who participated in the 1993 and 1994 Energy Management Hardware Rebate Programs. These customes received financial incentives for installing eligible energy efficiency measures.

´ *c. End Uses and Measures Covered:*

   The sectors, end uses and measures covered were as listed in Table I-2.

´ *d. Methods and Models Used: Describe the final model specification used for the study. Where applicable, indicate the study location of the competing class or types of models that were estimated but were not selected. State why the final specification was chosen.*

   Data for the study were collected through a longitudinal survey effort over four years. Data on whether installed measures were still in place and opearable were collected through on-site visits and telephone surveys over the four-year period.

   The data collected were directly tabulated to determine the percent retention for each measure. Another objective of the study was to estimate effective useful life (EUL) for each measure and to determine if the estimated EULs were different from expected EULs. Because the early retention rates for the different measures were relatively high, direct estimation of survival functions from the collected data was not informative. However, hazard functions could be estimated for some of the measures, and corresponding survival functions could be developed using the estimated hazard functions. For measures where there was a relatively small number of failures, the hazard analysis could not be performed.

Table I-2. End Uses and Measures Covered by Sector

Commercial Sector	
T8 lighting fixtures	Lighting
T8 lamps	Lighting
Electronic ballasts	Lighting
CF fixtures (modular)	Lighting
CF lamps	Lighting
Delamping/reflectors	Lighting
Adjustable speed drives	Motors
HVAC EMS	HVAC
Chillers	HVAC
Industrial Sector	
T8 lighting fixtures	Lighting
T8 lamps	Lighting
Electronic ballasts	Lighting
Adjustable speed drives	Motors
Lighting EMS	Lighting
Injection molding machines	Process
Plastic extrusion equipment	Process
Process cooling	Process
Process equipment insulation	Process
High efficiency chillers	Process
Air compressors	Process
Agricultural Sector	
Pumps/pump system improvements	Pumping
Adjustable speed drives	Motors

´ e. *Analysis Sample Size: Provide the number of customers, number of installations, number of measures (if different) and the number of observations in the analysis and time periods of data collection. If different for different units of analysis, a summary table should be provided.*

Table I-3 shows the number of customers included in the study from each sector and program year.

Table I-3. Final Sample of Sites for Retention Study

	1993 Commercial	*1993 Industrial/ Agricultural*	*1994 Commercial*	*1994 Industrial/ Agricultural*	*All Sites*
Total Number of Sites	356	179	253	149	937
Numbers of Sites with Specified Measures					
ASDs	78	49	64	42	233
T8 Lamps	145	59	114	41	359
Electronic Ballasts	98	52	114	41	305
Compact Fluorescent Bulbs	79		50		129
Delamping/Reflectors	72		28		100
Chillers	17		21		38
HVAC Energy Management Systems	94		84		178
Pump Improvements		26		31	57
Pump Replacements		48		50	98
Lighting EMS				11	11
Injection molding machines				24	24
Plastic extrusion equipment				6	6
Process cooling				7	7
Process equipment insulation				9	9
High efficiency chillers				7	7
Air compressors				18	18

The number of measures for the analysis was greater because of multiple occurrences of a measure at sites. The numbers of measure occurrences in the analysis sets are shown in Table I-4 for the commercial sector and in Table I-5 for the industrial/agricultural sectors.

Table I-4. Numbers of Measure Occurrences in Analysis Set for Commercial Sector

Type of Measure	*1993*	*1994*	*Combined*
T8 lighting fixtures	1,237	1,376	2,613
T8 lamps	3,136	3,531	6,667
Electronic ballasts	1,316	1,433	2,749
CF fixtures (modular)	816	485	1,301
CF lamps	1,008	578	1,586
Delamping/reflectors	852	502	1,354
HVAC EMS	96	82	178
Chillers	25	13	38
Adjustable speed drives	129	96	225

Table I-5. Numbers of Measure Occurrences in Analysis Set for Industrial/Agricultural Sectors

Type of Measure	*1993*	*1994*	*Combined*
T8 lighting fixtures	659	346	1,005
T8 lamps	1,836	917	2,753
Electronic ballasts	697	376	1,073
Adjustable speed drives	73	66	139
Lighting EMS		11	11
Injection molding machines		27	27
Plastic extrusion equipment		8	8
Process cooling		6	6
Process equipment insulation		5	5
High efficiency chillers		5	5
Air compressors		18	18

2. *a.Identify the specific data sources used for each data element.*

Data for the study were collected through a longitudinal survey effort over four years. The data that were collected through on-site visits and telephone surveys over the four-year period were used to determine the removals/failures and percent retention for each measure.

´ b. *Diagram and describe the data attrition process commencing with the program database for participants. Specific numbers and decision points for inclusion and exclusion should be provided. Where differerent data sources are used (e.g., surveys and program records), appropriate attrition categories should be used (e.g., response rates for surveys).*

The steps involved in preparing the various data sets used for the measure retention analysis are depicted in Figures I-1 and I-2.

´ c. *Describe the internal/organizational data quality checks and data quality procedures used to match customers and surveys, participation records, and any other data used in the analysis.*

As discussed below with respect to sampling, several files were provided by SCE that contained information on the customers who participated in the 1993 and 1994 Energy Management Hardware Rebate Programs. Each participant was identified by the PREMNO9 identifier that SCE uses for geographical locations; each PREMNO9 identifies a unique customer location. This PREMNO9 was used as the key by which to match customer information across program files and SCE's customer information files. Matches were inspected manually for verification purposes.

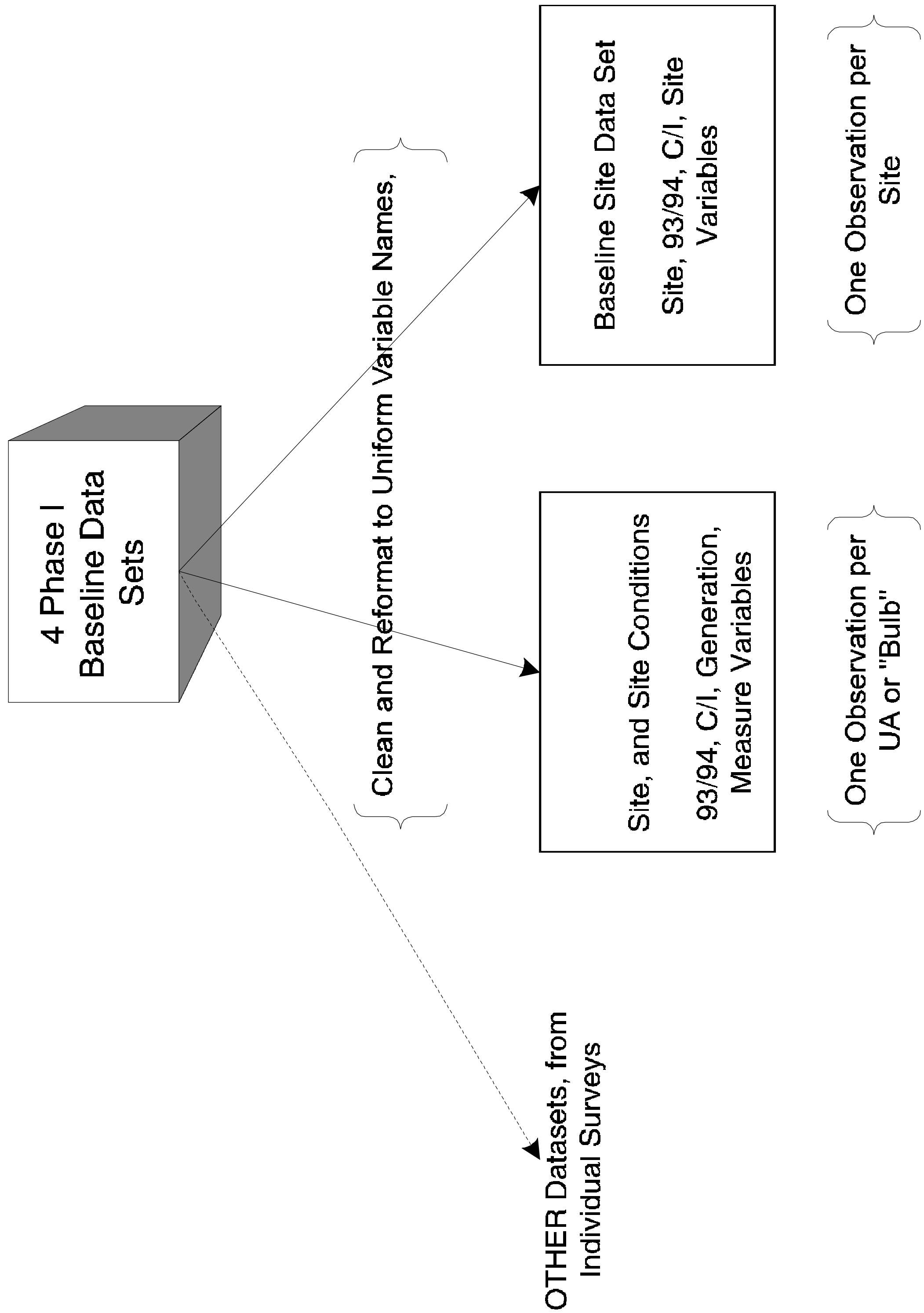


Figure I-1. Baseline Data Sets

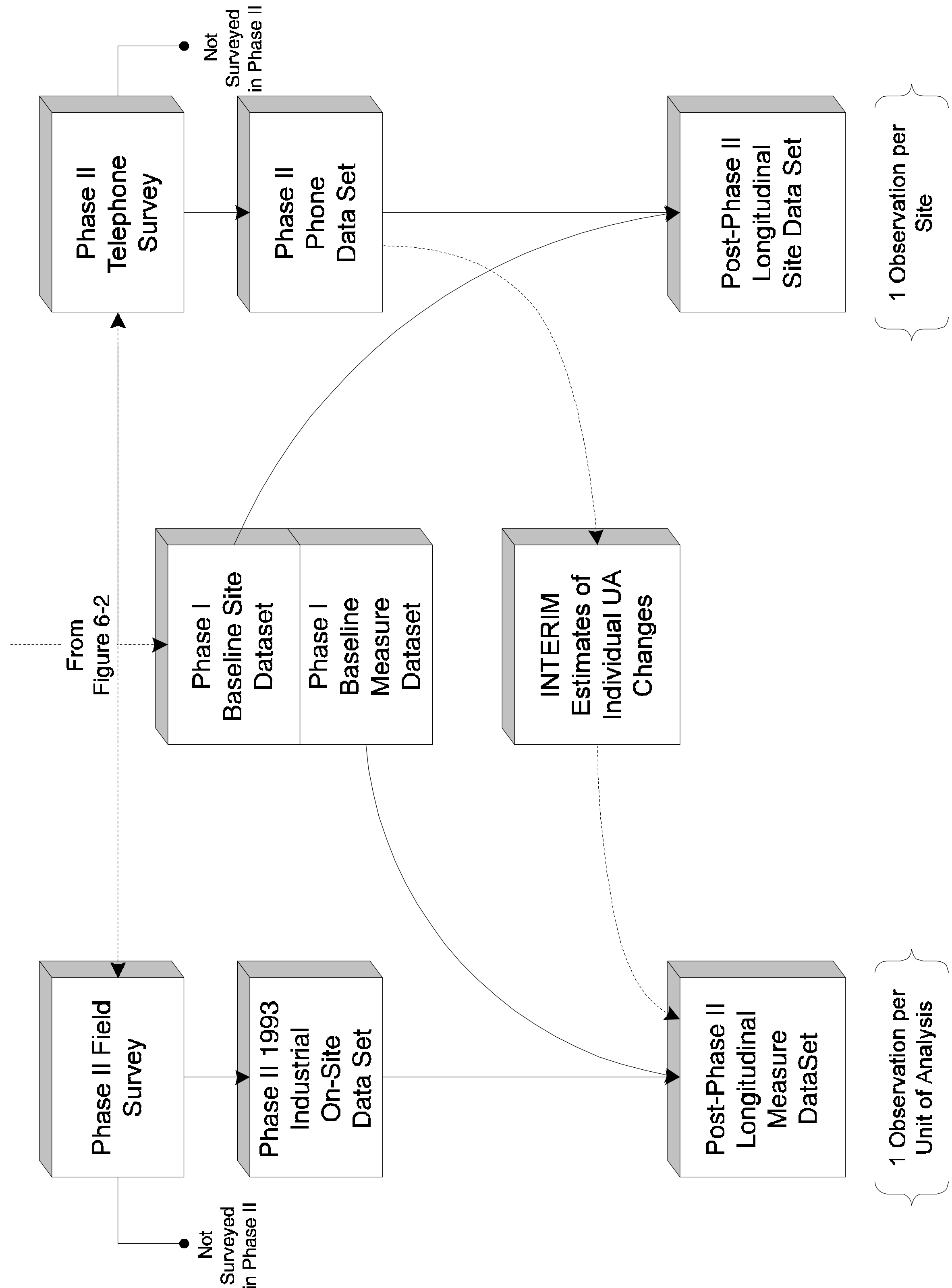


Figure I-2. Creation of Longitudinal Site and Measure Data Sets

´ d. *Provide a summary of the data collected specifically for the analysis but not used, the reasons for them not being used, and a documentation of where those data reside.*

The instruments that were used for the on-site and telephone data collection are provided in Appendices A, B and D of the final report. These instruments show all of the data that were collected for the analysis. The major items that were used for the analysis were the removal/failure data. Other data were not used in the quantitative analysis, but were used to verify that the removal/failure data was accurate.

3. a. *Sampling procedures and protocols: Describe the sampling procedures and protocols used. Information provided should include the sampling frame (e.g., eligible population), sampling strategy (e.g., random, stratified, etc.), sampling basis (e.g., customers, installation, rebate issued), and stratification criteria (e.g., geographic, etc.). Specific data and formulas should be used to present sampling goals and achieved results.*

The analytical framework for the development of the sample design for the study was provided by survival analysis techniques. Survival analysis pertains to the analysis of data that correspond to the time from a well-defined time origin until the occurrence of some particular event or end-point. For this study, the time origin is defined by the installation of a measure under the EMHR program, while the end-point is defined by the removal or failure of the measure or the discontinuance of its use.

The measure survival data were expected to have several features that warranted special treatment in preparing the sample design.

- The measure survival data would probably not be symmetrically distributed and cannot be reasonably represented by a normal distribution.
- The survival data would be *right-censored* in that the removal/failure/discontinuance end-points will not be observable for some of the installed measures.
- The survival data for some types of measures (e.g., lighting measures) would likely be affected by clustering. That is, a single customer may have multiple occurrences of a particular type of measure (e.g., T8 lamps). For a single customer, there can be expected to be some homogeneity in the lifetimes for the particular type of measure, since they were all installed at the same time and were subject to similar operational conditions. Because of this homogeneity, a sample of clustered measure occurrences provides less information than a similar sample that does not show such homogeneity.

A sample design for addressing these and other features of the data was developed through the following steps.

- First, the number of removals/failures required to meet the precision/confidence specifications for each type of measure was determined.
- Second, the probability of removal/failure for each type of measure over the period of the study was determined and applied to the required number of removals/failures to determine the number of points required in the sample.
- Third, the required sample size was adjusted to account for the effects of clustering.
- Fourth, sample points for a measure were allocated among facilities.

Sampling frames for selecting the sample sites for the different types of measures were created by extracting various items of data from three sets of files.

- The first set of files included the "Coupon Files" for 1993 and 1994 EMHRP participants that had been created by the Pine Company. The file for 1993 contained information for (approximately) the 1,000 largest coupons for program participants in that year. The 1994 Coupon file contained information for about 1,250 coupons. In creating these files, the Pine Company disaggregated some of the measures on the original coupons, thus providing a higher degree of measure resolution. For example, Lighting System Replacement was broken down into its component parts (i.e., fixture, lamp, ballast, reflector, etc.) to facilitate the identification of measures for this study.
- The second set of files included measure-based files (FRAME3B for 1993 and Frame3AB for 1994) that contained information on *all* measures installed by EMHRP participants in the two program years.
- The third set of files included a customer-based file (CUSTINC) that contained information on the *customers* who were EMHRP participants.

The number of sample points required for any particular measure was divided equally between 1993 and 1994 participants. For each type of measure, EMHRP participants in each year were stratified according to business sector and size.

- With the business sector stratification, participants were separated into a commercial customer class and an industrial/agricultural customer class.
- Within each measure/sector grouping, customers were further stratified according to size using a program category variable developed by SCE program staff. Agricultural customers were assigned to an "A" category. Commercial and industrial customers were assigned to categories according to their kW demand.[1]

  – Small (S) included C&I customers with demand between 0 and 49 kW.

  – Medium (M) included C&I customers with demand between 50 and 499 kW.

  – Large (L) included C&I customers with demand of 500 kW or more.

  If the program category assignment for a customer was not available on the SCE files, the customer was assigned to an Unknown (U) category.

Data were available on the SCE files regarding the kWh savings associated with a measure. For most measures, sample points for a measure were allocated to program categories in proportion to the distribution of savings. However, for some types of measures, the required sample size exceeded the number of customer facilities available on the sampling frame. For example, the sample size calculations design called for 199 sample points allocated to commercial locations that installed high efficiency chillers, of which 100 would be allocated to 1993 participants and 99 to 1994 participants. However, in actuality there were only 30 sites where high efficiency chillers were installed under the 1993 program.

[1] The program category assignments were generally available on the CUSTINC file.

Accordingly, this left 70 sample points to be reallocated among measures for the commercial sector. Since the original sample sizes satisfied the confidence/precision requirements that SCE desired, the increases in sample sizes for the various measures in effect improved the precision with which the measure lifes are estimated.

´ b. *Survey information: Survey instruments should be provided. Response rates should be presented. Reasons for refusals should be presented in tabular form. Efforts to account for or test for non-response bias should be presented, as well as corrections to account for the bias.*

The instruments that were used for the on-site and telephone data collection are provided in Appendices A, B and D of the final report.

For a longitudinal data set as was developed for this study, the important consideration is the degree of attrition among customers in the sample as time passes. Table I-6 reports the overall attrition from the sample at the end of 1998 (i.e., the end of the four years of data collection).

Table I-6. Overall Attrition from Sample as of End of 1998

Disposition of Contact	*1993*		*1994*	
	Commercial	*Industrial/ Agricultural*	*Commercial*	*Industrial/ Agricultural*
1 – No Answer			3	
4 – Not in service			2	
20 – Complete	313	176	239	142
22 – Permanent Refusal	3			1
23 – Site Closed	2	2		2
24 – Business Closed	1	1	6	2
25 – Building Torn Down	1			2
99 – Not Complete	4		3	
Totals	324	179	253	149

´ c. *Statistical descriptions. For the key variables that were used in the final models, provide descrptive statistics for the participant group, and, when present, for the comparison group.*

The key variable for the analysis of retention is the number of removal/failures that occur for a measure over a specified time period. The removal/failure rates over a four-year period are summarized for the various measures in Table I-7.

Table I-7. Four-Year Removal/Failure Rates for C/I/A EE Incentives Program Measures

Type of Measure	*Percentage of Measures Removed, Failed or Replaced within Four Years*
Commercial Measures	
T8 lighting fixtures	9.3%
T8 lamps	33.1%
Electronic ballasts	5.9%
CF fixtures (modular)	5.7%
CF lamps	25.4%
Delamping/reflectors	7.8%
HVAC EMS	1.1%
Chillers	0.0%
Adjustable speed drives	2.7%
Industrial Measures	
T8 lighting fixtures	6.6%
T8 lamps	19.1%
Electronic ballasts	2.8%
Adjustable speed drives*	10.1%
Lighting EMS	9.1%
Injection molding machines	18.5%
Plastic extrusion equipment	37.5%
Process cooling	0.00%
Process equipment insulation	20.0%
High efficiency chillers	0.00%
Air compressors	16.7%
Agricultural Measures	
Pumps/pump system improvements	10.3%
Adjustable speed drives*	10.1%

*Numbers are for all ASDs in both industrial and agricultural sectors.

4. a. *Describe procedures used for the treatment of outliers, and missing data points.*

The basic information required for the analysis was whether a measure had failed or been removed within the time span of the study period. For an individual measure, a removal/failure is essentially a binary 0-1 decision for purposes of analysis. The problem of outliers would arise primarily at the aggregate level if there appeared to be a disproportionate percentage of removals/failures. The possibility of outlier percentages was examined on a measure-by-measure basis. No excessively high rates of removal/failure were detected.

´ *b.Describe what was done to control for the effects of background variables, such as economic, political activity, etc.*

For each of the sites in the sample, information was collected regarding major changes in the facility's structure, equipment, or operating hours. The responses given to these questions on tenancy changes, building and HVAC renovations, and lighting system changes provided data that was used in analyzing whether there were aggregate economic or political events affecting the sample sites. It was assumed that such events would manifest at the site level. As Table I-5 showed, the overall attrition of sites from the sample was low, indicating that there were no major economic or political events that would introduce bias into the data used for analysis of measure life.

´ *c. Describe procedures used to screen data for inclusion into the final analysis dataset. Show how many customers, installations or observations were eliminated with each screen.*

No screens were used to eliminate customers, installations, or observations from the longitudinal data set that was used for the analysis. The numbers of sites and measures used for the analysis were as reported in Tables I-3, I-4, and I-5.

´ *d. Model Statistics. For all final models, provide standard model statistics in a tabular form.*
The final models used for estimating median useful lives for various measures were established by estimating hazard functions for each such measure, using power curve fits for a hazard function defined by a Weibull distribution. The summary statistics for the various models fitted are shown in Table I-8.

Table I-8. Summary of Hazard Function Estimation

Type of Measure	*Power Curve Fit*			*Weibull Distribution Parameters*	
	a	*b*	*R-squared*	*α (Scale)*	*β (Shape)*
Commercial Measures					
T8 lighting fixtures	0.0041	1.7860	0.8419	0.001472	2.7860
T8 lamps	0.0047	2.7594	0.9896	0.001250	3.7594
Electronic ballasts	0.0004	3.4369	0.9997	0.000092	4.4369
CF fixtures (modular)	0.0021	1.9205	0.8196	0.000719	2.9205
CF lamps	0.0038	2.7392	0.9997	0.001016	3.7392
Delamping/reflectors	0.0110	0.5630	0.2721	0.007038	1.5630
Adjustable speed drives	0.0006	2.4405	1.0000	0.000174	3.4405
Industrial Measures					
T8 lighting fixtures	0.0009	3.7391	1.0000	0.000019	4.7391
T8 lamps	0.0007	4.9292	0.9969	0.000118	5.9292
Electronic ballasts	0.0010	2.8029	0.9968	0.000263	3.8029
Adjustable speed drives	0.0461	0.1274	1.0000	0.040891	1.1274
Pumps/pump system improvements	0.0045	2.2660	0.8359	0.001378	3.2660
Adjustable speed drives	0.0461	0.1274	1.0000	0.040891	1.1274

´ *e. Specification: Refer to the section(s) of the Study that present the initial and final model specifications that were used, the rationale for each, and the documentation for the major alternative models used. In addition, the presentation of the specification should address, at a minimum, the following:*

1) describe how the model specification and estimation procedures recognize and address heterogeneity of customers (i.e., cross-sectional variation)

2) discuss the factors, and their associated measures, that are omitted from the analysis, and any tests, reasoning, or special circumstances that justify their omission.

The model specifications used for the study are presented and discussed in Section 3.1 (theoretical considerations) and Sections 3.2.2, 3.3.2, and 3.4.2. The illustrative example is provided in Section 3.2.2.

For some measures, the numbers of removals/failures observed over the four-year period were too small to support estimation of hazard functions. The measures for which this occurred include HVAC EMS and high efficiency chillers in the commercial sector and lighting EMS, injection molding, process cooling, insulation on process equipment, air compressors, and high efficiency chillers for process in the industrial sector.

´ *f. Error in measuring variables: Describe whether and how this issue was addressed, and what was done to minimize the problem (e.g., response bias, measurement errors, etc.)*

Because the removal/failure variable is binary, the issue of measurement error was not considered to affect the results of the analysis.

´ *g. Influential data points. Describe the influential data diagnostics that were used, and how the identified outliers were treated.*

For some measures, the hazard plots showed a sawtooth pattern over the three- or four-year period of study (i.e., low, high, low, high). With this pattern, a low or a high point could move the fitted regression line. This phenomenon was most apparent for delamping/reflectors, where the r-squared for the power curve fit was relatively low because of the sawtooth pattern to the data. Further data collected over time will allow for better determination of the appropriate hazard function.

´ *h. Missing data: Describe the methods used for handling missing data during the analysis phase of the study.*

Missing data was not a problem for this analysis, except in the sense that some measures showed few removals/failures.

´ *i. Precision: Present the methods for the calculation of standard errors.*

Because the survival functions for the measures studied are not symmetric, the standard error does not provide meaningful information on the spread around the estimated median life. The information on the spread around the estimated value is provided by the lower and upper bounds of the confidence interval.

An 80% confidence interval for the estimated median life of a measure was calculated as follows. The regression fit of the power curve coefficients was used to report the values of the estimated coefficients associated with the 80% confidence levels. Thus, the power curve regression analysis for each measure provided three sets of parameters for the Weibull hazard rate function: the “best” fit parameters and parameters for the upper and lower bounds of the 80% confidence interval for the estimated coefficients. In effect, the analysis provided an estimate of the “best” hazard function and survival function for a measure, plus estimates of the functions for the upper and lower bounds of the 80% confidence interval.

Appendix J

RETROACTIVE WAIVER PERMITTING EXCLUSION OF 1995 PROGRAM

This appendix provides the retroactive waiver excluding the 1995 C/I/A EEI Program from the study requirement.

SOUTHERN CALIFORNIA EDISON COMPANY
REQUEST FOR RETROACTIVE WAIVER
1995 COMMERCIAL, INDUSTRIAL AND AGRICULTURAL
ENERGY EFFICIENCY INCENTIVE PROGRAMS

Approved November 13, 1996

PARAMETER

Lines 3 and 4 of Table 8A,"Impact and Persistence Studies Required for an Earnings Claim for PG&E, SDG&E, and SCE*, specifying the filing of first-year impact analyses of the energy-efficiency incentive (EEI) programs in the commercial, industrial, and agricultural (CIA) sectors.

PROTOCOL REQUIREMENT

Table 8A of the Protocols requires first-year impact studies for the 1995 CIA EEI programs.

WAIVER ALTERNATIVE

Waive the requirement for impact studies of these programs for 1995.

RATIONALE

With only 8 Customers participating in the 1995 program, no shareholder payments in question, and a study of the 1996 program scheduled, there is really no ratepayer value provided by requiring a 1995 load impact study. It is reasonable to treat t 995 as a skip year for evaluation of this very small program.

There are no earnings (and no penalties) associated with these programs. The Nonresidential EEI portfolio achieved 49% of the forecast Performance Earnings Basis ("PEB"). Since the portfolio did not achieve the minimum 75% performance standard, this program was not entitled to earnings, and none were claimed. Since the actual PEB was well above zero, there are no penalties. Edison's ability to spend DSM funds and to accrue resource benefits in 1995 was slowed by the substantial challenges Edison faced from the Internal Revenue Service's proposed change in the treatment of DSM expenses for tax purposes.

PROGRAM SUMMARY

	CEEI[1]
Number of Participants	8[2]
Administrative Costs	$322,000
Incentive Costs	$62,000
Total Program Costs	$384,000
Net Resource Benefits	$1,315,000

1 There were no EEI program results from the industrial and Agricultural sectors in 1995.

2 All but one of the measures installed were lighting end uses: the other was refrigeration.