SOUTHERN CALIFORNIA EDISON

An *EDISON INTERNATIONAL*℠ Company

1994 Commercial CFL Manufacturers' Rebate Persistence Study ID 529D

March 1999

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CONTENTS

EXECUTIVE SUMMARY iv

INTRODUCTION 1
OBJECTIVES 1
DATA COLLECTION 1

METHODOLOGY 3
EVALUATION METHODS 3
MODELING METHODS 5
Linear Models 10
Exponential Models 10
Survival Models 11
Cluster Sample Variances 12
Modular vs. Integral 12

ANALYTICAL RESULTS 13
DESCRIPTIVE STATISTICS 13
WEIGHTING 14

EUL ESTIMATES 17
Fixtures 17
Bulbs 20

APPENDIX A – M & E Protocols Required Tables 22
TABLE 6 – Results Used to Support PY94 Second Earnings Claims 22
TABLE 7 – Documentation of Protocols For Data Quality and Processing 24

APPENDIX B 28
Supplementary Tabulations on Bulb Retention 28

APPENDIX C 29
Description of Programs, Spreadsheets, Output and Data Files 29

APPENDIX D 31
Fixture Survival Function Model Output 31

TABLES

Table 1 – Initial Field Inspection Counts 4
Table 2 – Persistence Inspection Counts and Results 4
Table 3 – Percent Evaluable 13
Table 4 – Distribution of Evaluated Fixtures and Bulbs 14
Table 5 – Frequency of Segments by Number of Inspected Fixtures Category 15
Table 6 – Weight Calculation 15
Table 7 – Predicted Fixture EUL (Years) 19
Table 8 – Predicted Bulb EUL (Years) 20
Table 9 – Weighted Percent of Bulbs Remaining at 2.7 Years by Bulb and Fixture Type and Location 28

FIGURES

Figure 1 – Endpoint Models, Linear and Exponential Functional Forms 7
Figure 2 – Piecewise Models, Linear and Exponential Functional Forms 8
Figure 3 – Survival Models, Log Normal Distribution 9
Figure A-1 – 1994 Commercial CFL Lighting Program Persistence Estimation Data 26

EXECUTIVE SUMMARY

This research performs a measure retention study for Edison's 1994 Commercial CFL Manufacturer's Rebate Program. The evaluation estimates expected useful lives (EULs) for fixtures covered in the program and compares them to *ex ante* EUL estimates filed earlier. In addition bulb EULs are also estimated. A follow-up inspection sample was used to determine retention with inspectors looking for tags applied in the first-year evaluation. Statistical models were used to extrapolate the retention rates to the time when half the units will remain.

KEY FINDINGS

Fixtures

- Fixture EUL estimates are particularly sensitive to model specification and assumptions about the future pattern of survival. Too little time had passed at the inspection to make reliable estimates of EUL. Integral screw-in units, which have much shorter expected lives, are an exception to this and robust estimates could be developed.
- EULs were estimated using a variety of approaches and produced point estimates which range 4.3-9.4 years overall, with wide confidence intervals due both to the distant period tested in the extrapolated forecast and larger sampling errors due to cluster sampling.
- EULs for integral units are estimated at 2.7-3.1 years with 80% confidence intervals which would suggest *ex ante* estimates of 2.2 years are too conservative.
- With the great deal of uncertainty with predicting fixture EULs after only 2.7 years has elapsed from installation on average, there is no basis for rejecting the overall *ex ante* EUL estimate of 12.2 years for modular CFL fixtures or the program overall.

Bulbs

- Bulb EULs are estimated to be 2.8 years +/- .2 years.
- Forecasts are not particularly sensitive to model specification.
- Prior predictions of 2.2 years are conservative.

1994 Commercial CFL Manufacturers' Rebate Persistence Study

INTRODUCTION

OBJECTIVES

Measurement and evaluation protocols adopted by the California Public Utilities Commissions require utilities making earnings claims to substantiate these claims with measure retention studies. This study reports the results of a 3rd/4th year retention study for SCE's 1994 Manufacturer's Rebate Commercial CFL Program. That program distributed over 320 thousand subsidized compact fluorescent fixtures and bulbs.

The objectives of this study are to:

- To estimate the extent to which these fixtures were still in place at the time of our second inspection
- To estimate the expected useful lives (EULs) of these fixtures and bulbs, and
- To compare EUL fixture estimates to *ex ante* EUL estimates at the 20% significance level (*80% confidence level*).

Ex ante estimates were filed at 12.2 years for fluorescent hardwire fixtures and modular screw-in units with replaceable lamps. *Ex ante* estimates were 2.2 years for integral, screw-in, disposable units, which have a fixture EUL tied to lamp life. This latter lamp type accounted for only 4.2 percent of program savings and 4% of bulbs.

DATA COLLECTION

A follow-up inspection sample was conducted from November 1996 through March 1997 to measure retention of program measures. The fixtures inspected were originally tagged as part of the research connected with the First-Year Program Evaluation research that was conducted in November 1995-January 1996. Inspectors had applied tags to lighting fixtures and bulbs and mapped where these tagged units were located among hundreds or thousands of other fixtures at the customer site, so that they could be relocated at the follow-up inspection. Fixture and bulb retention could be measured separately. Inspectors also tested the operation of the lamps, when possible (lighting on timers couldn't be checked for its operation).

Retention is defined as the fixture being located in the same place with the same unit tag. Inspectors made no attempt to determine whether fixtures removed due to remodeling were recycled for use at another part of the site as we think the possibility is not likely. It would also be hard to determine given the numerous maintenance and construction employees making such decisions. Operability is required in the retention definition, but does not appear to be an important retention consideration. We found 100 percent of tested bulbs were operable, although only 56 percent of bulbs could be tested because the balance were controlled by photosensors or timers.

We are satisfied that this approach to measuring retention was successful because of our over 95% ability to locate and inspect units for this evaluation. This method is far superior to a telephone conversation with a site representative asking them to estimate what percent of hundreds of program bulbs among possibly thousands of all types of bulbs at the site had failed and when. We found that this approach was suitable for the large commercial sites that participated in this program.

With only 2.7 years passing on average from installation to the current inspection we are unsatisfied that enough time has elapsed to make precise estimates of fixture lives from the available data. Nor have we found alternative data sources that would be applicable to a commercial program of this type. Enough time has passed for estimating bulb life and for integral screw-in fixtures whose lives are tied to bulb life alone.

METHODOLOGY

EVALUATION METHODS

This research used:

- a follow-up sample to determine retention of fixtures and bulbs
- modeling to forecast EULs, and
- weighting and statistics for cluster samples

Follow-up on-site inspections were made in December 1996-March 1997 for a panel of bulbs and fixtures tagged as part of an earlier study of this program (Decision Sciences' SCE 1994 Commercial CFL Evaluation: First Year Impact Evaluation Report, Study ID # 561, February 1996). Tagged on-site inspections were selected as a superior methodology to mail or telephone follow-up surveys that would have to inquire about the status of hundreds of program bulbs and fixtures at these commercial customers' sites. During the first round of visits, Decision Sciences' inspectors tagged installed program product on both fixture and bulb as modular products can have bulbs replaced while the fixture (*ballast*) remains in service. These tags were applied during November 1995-January 1996 in anticipation of the follow-up inspections which were conducted on average 360 days later. By that time an average of 970 days (2.7 years) had passed since the installation of these bulbs and fixtures. Inspectors identified the fixtures from information prepared in the earlier inspection and recorded bulb and fixture status (e.g., present, removed, damaged, not present, different CFL bulb, etc) and tested operation if possible. Inspectors did not try to determine the date when specific fixtures were removed and or bulbs replaced. With an average of 300 total program bulbs per segment it would be unlikely that customers would remember consistently when specific units had been changed or that a knowledgeable customer contact could be found at all. Thus we know all fixtures were operating at the first-year inspection and some fraction were not operating or still present at the second inspection.

The sample of fixtures impaneled for follow-up inspection was the result of a multi-step sampling process used to identify installed program product. This program used manufacturers' rebates to achieve low administrative cost and a substantial market transformation. Program invoices tracked sales from manufacturers to distributors and TAG data forms tracked product to end-user purchases. Inspectors identified usage segments (*groups of fixtures in a common location with a common method of control*) at cooperative customer sites for follow-up evaluation in the first-year evaluation.

Table 1 summarizes data from the 203 customer locations that were visited during the first year's study. At 152 of these sites, inspectors found CFL program product in 210 identified usage segments. Note that the inspectors tagged fixtures in segments only where they were given permission to do so and had ease of access. In all, inspectors tagged 681 fixtures in 163 usage segments at 113 locations. These fixtures, segments and locations constituted the sample frame for the planned persistence follow-up inspections.

Table 1 – Initial Field Inspection Counts

	Customer Locations	Usage Segments	Tagged Fixtures
1st Field Inspections			
Dec 1995 - Jan 1996			
End-user sample locations inspected	203		
No product found	(51)		
CFL Program product found	152	210	
Persistence tags and marks applied	113	163	681

Table 1 presents the results of the Persistence Study follow-up visits.

Table 2 – Persistence Inspection Counts and Results

	Customer Locations	Usage Segments	Tagged Fixtures
2nd Field Inspections			
Dec 1997 - Apr 1998			
Inspection Visit Status			
Locations not visited	(3)	(3)	(14)
Persistence locations inspected	110	160	667
Fixture Inspection Status			
Could not locate or identify			(32)
Could not Inspect			(5)
Fixtures Inspected			630
Fixture Inspection Results			
Out of Service…			
Removed, no replacement lighting			(68)
Damaged not working			(1)
Empty (no bulb)			(2)
In Service…			
Total bulbs found in fixtures…			559
Originals			353
CFL replacements (*like-for-like*)			197
Non-CFL replacement			9

Table 2 shows that of the 113 persistence frame locations, three were unavailable for follow-up inspections. Decision Sciences' inspectors were able to visit 110 locations to determine the status of 667 fixtures. The results of these inspections are shown in the rightmost column of Table 2. Figure A-1 (see Appendix A) provides a dataflow diagram of the sample and inspection datasets that comprise the initial and follow-up observations for this study.

The resulting sample cannot be considered a probability sample. As such, installed bulb type distributions derived from the original Program Invoice Tracking file were used to weight this sample to make it more representative of the program population. Further, this sample is a cluster sample of fixtures with a common type and use (e.g., room lighting, exit signs, etc.) that were aggregated into usage segments at the customer site. Fixtures were not selected independently and cluster sampling formulas are applied in the calculation of sampling errors.

Several techniques were used to assess EULs for the modular and integral fixtures and bulbs, including survival analysis, linear and exponential (constant percent, continuously compounded decay) models. With only 2.7 years of time elapsed for modular models and only one follow-up, considerable uncertainty surrounds the estimates. EULs are quite sensitive to assumptions made about the shape of decay in retention. For integral units, 2.7 years was sufficient to test the *ex ante* estimate with its shorter expected 2.2 year life.

MODELING METHODS

Beyond the reporting of retention results for this inspection sample, this study goal is to estimate the half-life of the measures in the field, the elapsed time at which 50% of program units remain, which is the definition used for EUL. With only 2.7 years of time elapsing since installation, a forecast needs to be made well into the future for fixtures expected to live more than 12 years. Under these circumstances the forecast will be sensitive to the functional form of the estimating equation.

Traditionally, analysts would use survival techniques to extrapolate from observed measure failures to date using a hazard function fit to a selected cumulative density function and a procedure such as SAS's PROC LIFEREG. While we use that approach here, we use two alternatives too, because of the nature of this data. Too short a time period has elapsed and we couldn't determine the date of removal so the fixtures not retained are interval censored, having failed/been removed sometime between inspections. Retained fixtures are right censored with an unknown future date of failure. Some tested survival models didn't converge to a solution with this data. Further, we believe the survival models are not the best choice for making future forecasts when so few failures have been observed.

These data might be conceptualized as simply three data points, sample estimates of the percent remaining at three time points. All fixtures were alive at installation and these inspection fixtures were also alive at the first inspection[1] which averaged 600 days or 1.7 years[2] later. At the second inspection some percentage of fixtures/bulbs failed and we don't know when. This second inspection was on average 360 days later. The inter-quartile range (25^{th}-75^{th} percentile) of the dates for the first inspection was only 13 days and the same range for the second inspection date was only 33 days, so during the period when deaths could occur we have little variation on dates. Installation date varied more with an inter-quartile range of 242 days. With so little variation in the data we have the choice of fitting models to the endpoints of the period or piecewise (i.e. Installation-Inspection 1 and then from Inspection 1 – Inspection 2). The objective is not to find the closest fit to the observed data we have, but rather to make the best forecast of program measure half-life which occurs beyond the range of our data. As we will see below the observed data don't provide enough variation to choose among the alternatives based on fit.

No single functional form is an obvious choice for this particular retention curve. The concave pattern of survival to the origin observed here is unusual except in cases where too little time has elapsed to observe the L-shaped pattern that is usually observed in measure life studies. The predominant cause of failure to retain fixtures in the commercial sector is architectural change, so patterns from engineering or other third-part studies are not likely to predict specific patterns for this study. As a result we have modeled several ways using endpoint or piecewise fits and linear, exponential, and selected survival analysis models showing how the result is dependent on the assumptions made.

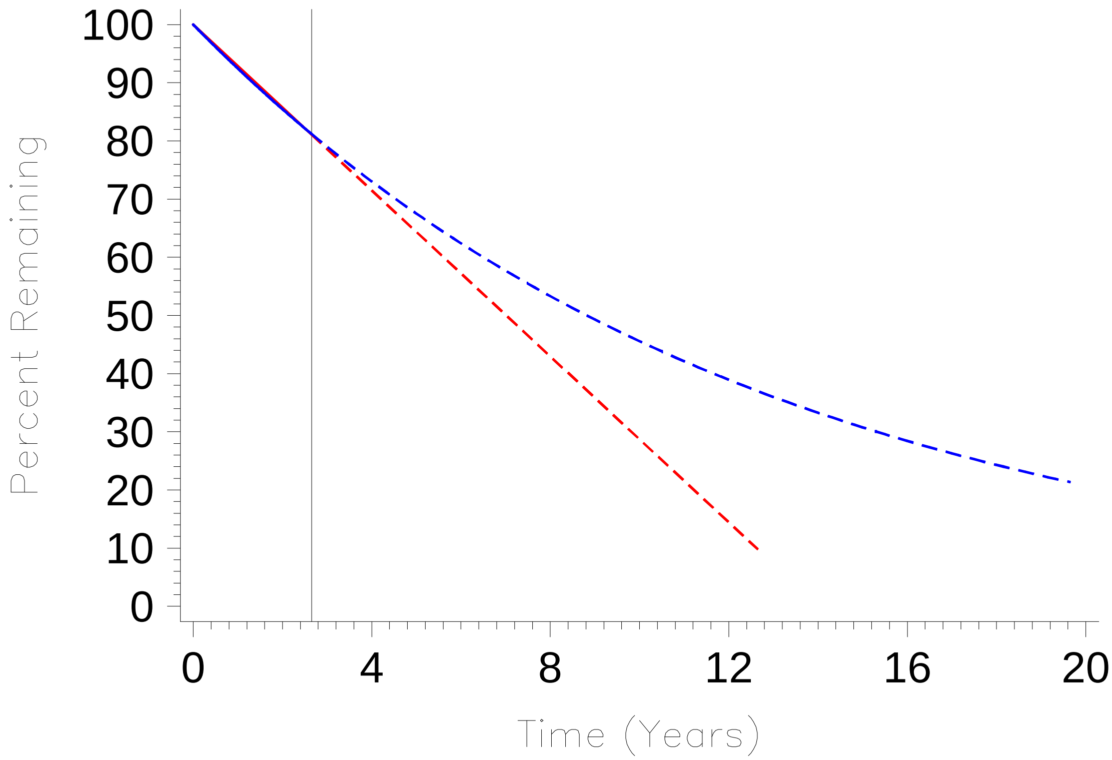
---

[1] Recall that the First-Year Evaluation was quite conservative on counting installed measures. Only measures installed and still working at the first inspection were counted in estimating program savings.

[2] Program product at customer sites from an earlier pilot program conducted in the Coachella Valley is included in this retention study, inspectors couldn't distinguish fixtures by year. As the same types of fixtures were covered this should not effect the retention analysis and may even increase the period of observation which is a benefit. Note that 30 percent of fixture installation dates weren't known about even distributed between Coachella Valley and other locations. We imputed missing installation dates using the median separately for Coachella Valley and Other due to the difference the pilot program made in determining date installed.

The graphs on the next pages portray a picture of the modeling alternatives under these circumstances, with endpoint models, piecewise models and a survival curve. The first graph Figure 1, shows endpoint models for linear and exponential functional forms.

Figure 1 – Endpoint Models, Linear and Exponential Functional Forms



The vertical reference line at 2.7 years delimits the border between the observed and forecast periods. In the observed period the difference between a linear and exponential model is nearly undetectable. In the forecast period an exponential form diverges from the linear form, estimating longer EULs and shows a pattern more like that seen product in failure research. The linear function assumes the average absolute decline per year will proceed into the future. The exponential function assumes that the average, continuously compounded percent decline will continue into the future. We would need substantially more failures, 35% or more, to distinguish between these models.

In Figure 1, the point estimate of EUL would be found by finding the time value at which the survival curve intersects with a horizontal line at the 50% remaining level. You can easily see EUL will be much longer when the Exponential model is used. Our experience suggests that survival curves stop their quick drop off after a time and the rate of decline slows forming an L-shaped pattern.

Figure 2 – Piecewise Models, Linear and Exponential Functional Forms

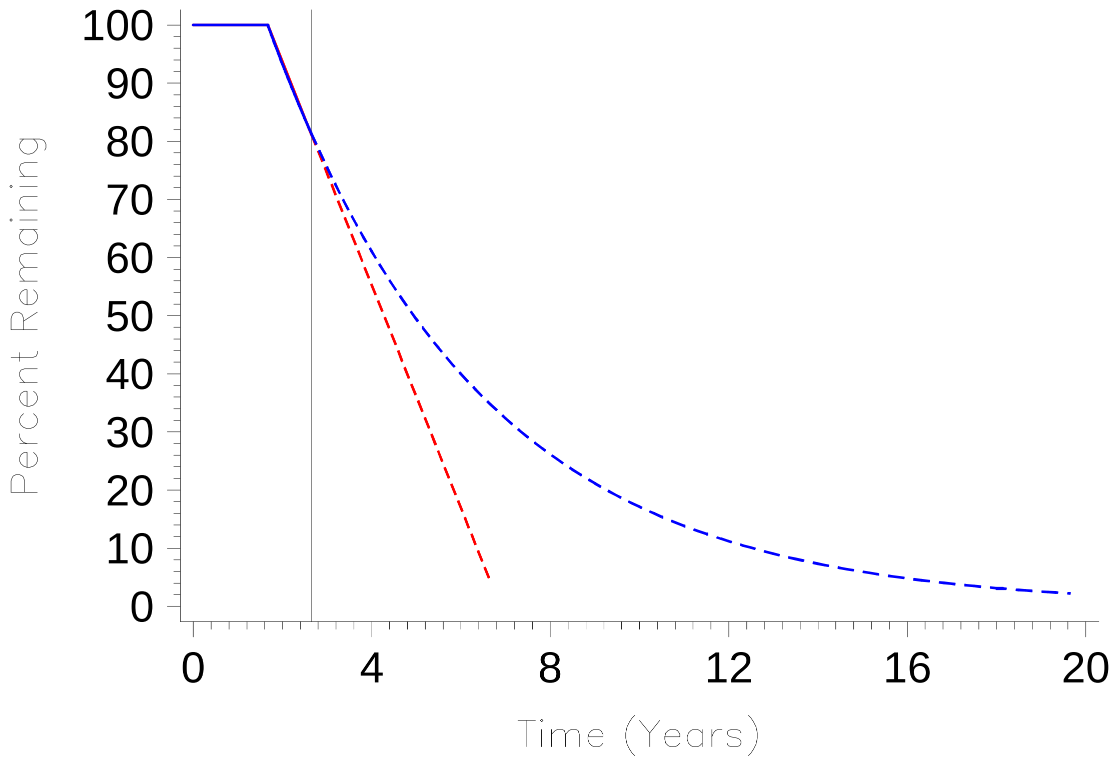


Figure 2 graphs linear and exponential models using a piecewise fit to the observed three data points. Again the difference between a linear and exponential model is nearly undetectable during the observed period but diverges as elapsed time increases. In this modeling alternative estimated EULs are shorter because the estimated slope between inspection periods is steeper. The assumption in this graph is that the rates of decline observed between the two inspections will continue into the future and that this is a better assumption than the alternative that the average rate of decline since installation (as illustrated by Figure 1) will continue. The question is whether it is better to forecast using average decline between endpoints over 2.7 years or to use the decline rate for nearly 1 year between inspections to forecast the future.

What is needed is another data point 6-8 years after installation, which would easily distinguish among these modeling alternatives. For the moment we can conduct sensitivity analyses and rely on our expertise to predict the future.

Figure 3 – Survival Models, Log Normal Distribution

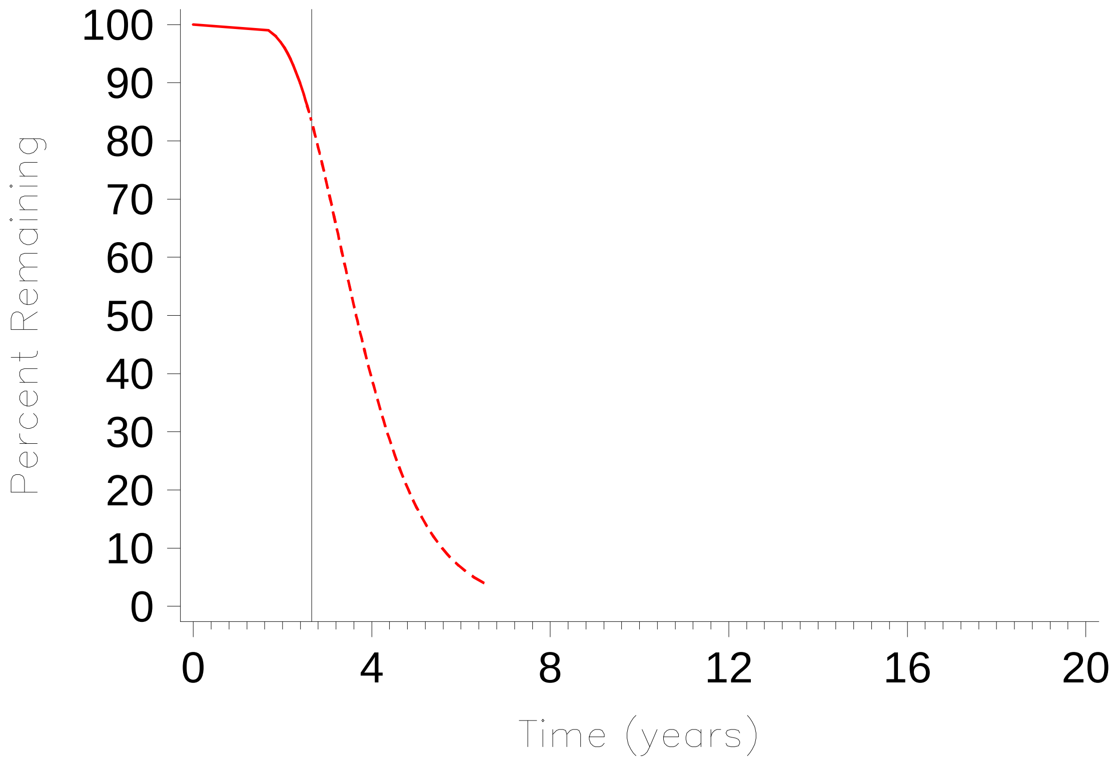


Figure 3 shows that a survival model fit to the observed data using SAS™ PROC LIFEREG and the log normal distribution is closer to a piecewise fit than the endpoint model. It is trying to fit the limited amount of observed data and is using the rate of decline observed between inspections. The survival model fits the cliff in the data and drops at a rate even more quickly than a piecewise linear model. A survival model allows for a change in the rate of change, a point of inflection. Linear models hold change constant and exponential models hold the percent change constant at a fixed level.

The best way to forecast into a distant and uncertain future is unclear. Each of these five types of modeling alternatives will make a good forecast only if the assumptions about the future rates of change embodied in the model hold. The exponential models are the ones capable of allowing the L-shaped pattern to develop, which we believe would be observed, if enough time had elapsed. So, we favor them over the alternatives in this situation.

Linear Models

If we denote the three time points as t_1, t_2, and t_3 and the percent retained as y_1, y_2, and y_3 then the slope is determined by

Endpoint model: Slope = $(y_3 - y_1) / (t_3 - t_1)$

Piecewise model: Slope = $(y_3 - y_2) / (t_3 - t_2)$

with slope for the first piecewise segment of zero.

For example, if we have 80 percent retention after two years, the rate of decline estimated is 10 percent per year. If alternatively we use a piecewise fit and spread the decline over one year the rate of future decline is 20 percent per year or double that estimated by the endpoint model. Comparing the two linear models in Figure 1 and in Figure 2 shows the impact on forecast.

Exponential Models

Exponential models hold the percent change fixed, where the percent remaining is given by…

$$\text{Percent Remaining} = 100 * \exp (g * dt)$$

where

g = the constant proportion change

dt = the change in time

If we denote the three time points as t_1, t_2, and t_3 and the percent retained as y_1, y_2, and y_3 then the percent change is determined by…

Endpoint model: Percent Change = $100 * \ln (1+y_3 - y_1) / (t_3 - t_1)$

Piecewise model: Percent Change = $100 * \ln (1+y_3 - y_2) / (t_3 - t_2)$

with change for the first piecewise segment of zero.

For example, if we have 80 percent retention after 2 years, the percent rate of decline estimated is 9 percent. If alternatively we use a piecewise fit and spread the decline over one year the rate of future decline is 18 percent or double that estimated by the endpoint model. Comparing the two exponential models in Figure 1 and in Figure 2 shows the impact of assumptions on forecast.

Survival Models

Survival modeling first fits a hazard function (the probability the unit will fail in time period t, given that it has survived to that time) to the data. The cumulative percent failing is fit to the parameters of a selected cumulative density function as a function of time t and sometimes other parameters (*see SAS/STAT User Guide, Volume 2 for more details*). Survival at time t has the probability of 100 - the accumulated hazard to that point.

The use of a model probability density function allows survival analysis to make predictions beyond the scope of the data. These distribution functions can change the rate of decline and in the change of the change in the rate of decline (2nd derivative) allowing for an inflection point and is more flexible than the prior two model types. Some probability distributions allow for declining, constant and even accelerating rates of failure. Below we report results for the Log Normal, Logistic, and Weibull distributions to demonstrate that this variety of alternatives all estimate similar EULs based on these data. However, when we view Figure 3, we see that fitting a survival model to a short segment of a survival period can cause the estimated function to twist downward in the forecast period to estimate a rate of decline faster than even a piecewise linear model. We have likened this tendency to its assuming a piecewise fit, because its trying to fit the limited data observed to date rather than make the best forecast of the future retention experience.

Hints that survival models may not be appropriate come from evidence that the tests with the gamma distribution don't converge. No survival analysis converged for integral screw-in fixtures for any tested distribution with a sample size of 79. Note too that all failures were interval censored and that all remaining data were right censored. The biggest drawback of using the survival models is having no data point far enough in to the future to have the functions bend to fit the declining rate of decline that we predict will occur.

While it is possible to introduce covariates into the survival model, we have chosen to use none, although we report results separately by fixture type and for a weighted distribution of fixtures and bulbs. We do this because the objective of this study is to estimate a median, the EUL. We want to use the predicted quantiles (50th percentile in particular) and their standard errors to predict EUL. Using covariates would complicate the prediction procedure without providing precision benefits.

Cluster Sample Variances

The inspection sample is a cluster sample. Several fixtures (*an average of 4.1 per segment*) were selected from among all the program measures in the segment (*on average, 300 per segment*). More bulbs were selected when more measures were in the segment. As the fixtures were not selected independently, the common simple random sample formulas for sample variance don't apply. If architectural renovation occurs all the fixtures in a segment may be replaced producing an estimate that is noisier than a simple random sample and one that may be biased in the case of unequal clusters such as this sample.

The estimation formulas below for calculating upper and lower boundaries of the 80% confidence interval as required by evaluation protocols take into account this sample structure. The variance of the ratio estimate of percent retained is

$$\text{Variance} \quad r = 1/x^2 \left[(\Sigma (y_a{}^2 + y^2 / a) + r^2 (\Sigma (x_a{}^2 + x^2 / a) - 2\, r\, (\Sigma (y_a\, x_a - yx / a)\right]$$

where…

a = index of the segment and count of number of segments

$x = \Sigma x_a$ the sum of all units tracked on all a segments

$y = \Sigma y_a$ the sum of all retained units tracked on all a segments

r = the ratio estimate of percent units retained = y/x

x_a= the sum of all units tracked on this segment

$y_{a=}$ the sum of all retained units tracked on this segment

This formula was used below in the calculations for sampling error.

Modular vs. Integral

Modular CFL units predominated the measures distributed under this rebate program. Some integral units were also included in the program. Integral units fail when the bulb fails regardless of whether the ballast was still working. So, EUL estimates for integral units were estimated to be only 2.2 years versus 12.2 years for modular fixtures. As our sample is not a probability sample we need to control for this different type of unit which accounted for about 4 percent of program units and savings. We control for these differences by weighting the data to be representative of the installed population.

The only integral units found in the retention sample were the Feit 18 watt, integral unit, model ESL18. This is not surprising as this model accounted for eleven thousand of the thirteen thousand integral units in the program (85 percent). These units will be treated separately in the weighting discussed below.

ANALYTICAL RESULTS

DESCRIPTIVE STATISTICS

The follow-up sample included 113 customer sites with 163 lighting segments and 681 fixtures. The inspectors were successful in performing follow-up evaluations over 95 percent of the time. Among the units not evaluable, reasons were about equally split between not being able to visit site and not being able to identify or inspect units at a visited site as shown in Table 3.

Table 3 – Percent Evaluable

	Fixtures		Bulbs	
Inspection Result	Count	Percent	Count	Percent
Site Not Visited	14	2.1%	14	2.1%
Visited: Not Evaluable	15	2.2%	13	1.9%
Visited: Evaluable	652	95.7%	654	96.0%
Total	681	100.0%	681	100.0%

Note: Not Evaluable for fixtures includes unable to inspect or identify and empty fixtures; for bulbs it includes unable to inspect or identify.

Table 4 shows that among the evaluable units 79 percent of fixtures and 54 percent of bulbs were retained. Fixtures were primarily not retained due to removals, often as the result of remodeling. Integral fixture failures, whose unit life is linked to bulb life, accounted for most of the rest of fixture failures.

Table 4 – Distribution of Evaluated Fixtures and Bulbs

	Fixtures		Bulbs	
Retention Status	Count	Percent	Count	Percent
Retained	516	79.1%	353	54.0%
Not Retained…				
Different CFL bulb			163	24.9%
Different Integral unit	34	5.2%	34	5.2%
Not present/removed	92	14.1%	92	14.1%
Damaged	1	0.2%	1	0.2%
Empty no CFL			2	0.3%
Replaced with incandescent	9	1.4%	9	1.4%
Not Retained Subtotal	136	21%	301	
Total	652	100.0%	654	100.0%

Reasons for bulb failures were different. Changes in modular bulbs and integral unit bulb replacements were collectively twice as important as unit removals in accounting for total original bulb removals. Note that these are unweighted percentages and just report the raw distribution in our sample.

WEIGHTING

The sample of fixtures identified is not a probability sample of the units installed under the program. Considerable effort was necessary to track manufacturers rebated product to its final installation. Moreover, it is not cost effective to take a random sample of all fixtures when on-site inspections must be performed. This original sample selected for the First-Year Evaluation was a cluster sample of fixtures on common lighting segments with like lighting units. Inspectors could visit a smaller number of sites and identify cluster of fixtures throughout the site. Operational considerations were important too, segments average thee hundred fixtures each and some sites had up to sixteen thousand program fixtures. There were many large commercial sites, particularly in the hospitality segment. Not all fixtures in a segment were sampled for follow-up evaluation, but keeping the tagged fixtures clustered together improved the chances that units could be found again on the second inspection visit. Our rate of evaluability was 95% on re-inspection.

Table 5 shows that 55 percent of sampled segments had only 1-2 fixtures tagged, 22 percent had 3-5 fixtures tagged and 16 percent had 6-10 fixtures tagged on the segment. Only a few segments had a large number of fixtures tagged. The mean was 4.1 fixtures inspected per segment versus an average of 311 and median of 30 program fixtures per segment.

Table 5 – Frequency of Segments by Number of Inspected Fixtures Category

Number of Tagged Bulbs per Segment	Percent Distribution
1	38.0
2	17.1
3 - 5	21.5
6 - 10	15.8
11 - 15	3.8
16- 20	2.5
21 +	1.3
Total	100.0

Variance estimation takes the lack of independence between bulb and fixture retention into account when computing confidence intervals.

The tracking system for manufacturer rebates accounted for units by wattage class category. This system's totals were used in the First-Year Evaluation to produce estimates by wattage class. The estimates from that report for units installed were used to weight the fixtures in the current follow-up sample to make them more representative of the program population. Table 6 shows the percent distribution of the population and the follow-up sample by watt class and integral/modular unit type. The rightmost column reports the resulting weight.

Table 6 – Weight Calculation

Watt Class	Type	Population	Count	Sample	Weight
4-13	Modular	56.4	374	57.4	0.9834
14-20	Modular	10.3	66	10.1	1.0175
14-20	Modular	4.0	79	12.1	0.3301
21+	Modular	23.9	133	20.4	1.4364
All Classes	Modular	100.0	652	100.0	1.0000

Note that the estimate of integral units comes from a separate tabulation on the tracking system and that the small 45+ watt category in the First-Year Evaluation, Table 3 has been combined with the 21+ watt class for lack of sample in the inspection data.

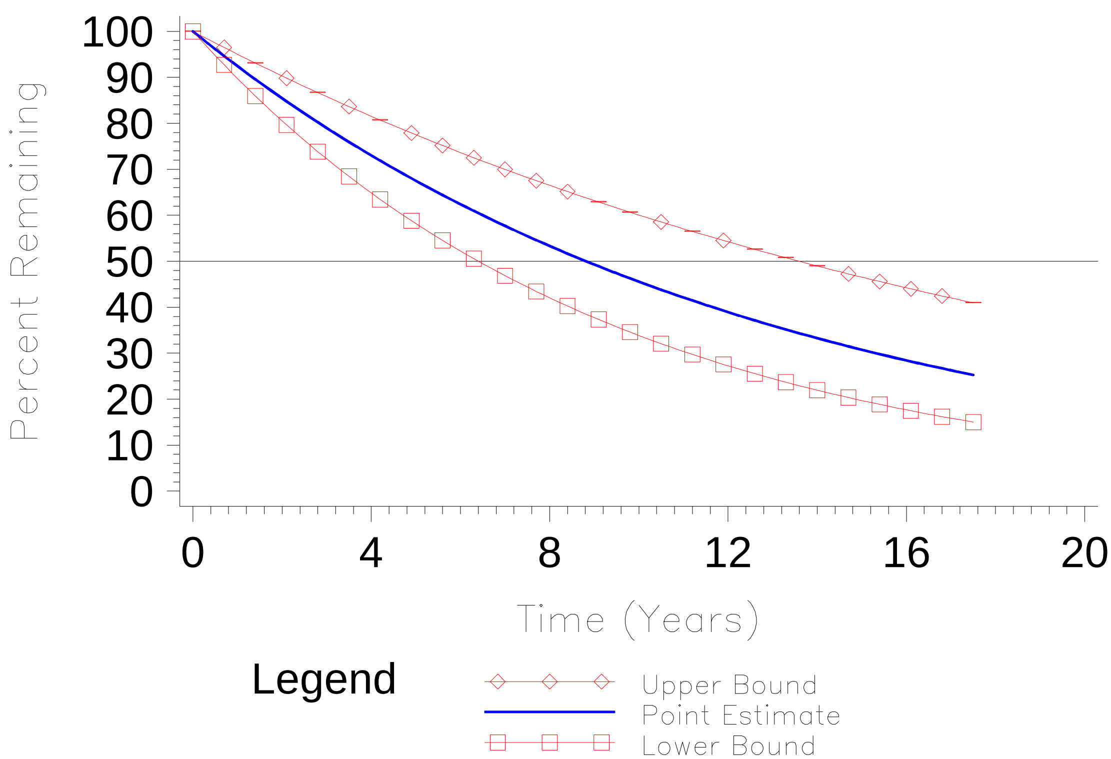
Feit 18 watt, integral units model ESL18 accounted for eleven thousand of the thirteen thousand integral units subsidized by the program. They are the only integral units found in the inspection sample. The integral units are over represented in the sample given their percent distribution in the population and are given a weight of .33. Given their lower expected life it is important to represent their proportion properly. This overrepresentation may have derived from a pilot project in the Coachella Valley emphasizing such units, an area where we were able to track program product more readily. Conversely, 21+ watt units are underrepresented and have been weighted to compensate for this.

EUL ESTIMATES

FIXTURES

Fixture lives were estimated using the linear, exponential and survival analysis models discussed in the methodology section above, solving for the median life. Upper and lower bounds were calculated using the sampling error reported from the parameter estimate or the prediction error reported from the survival model. Figure 4 shows how the point estimates and upper and lower confidence bounds are determined for the simple exponential endpoint model. That model is based on a single parameter, the percent remaining at the second inspection.

Figure 4 – EUL Prediction, Endpoint Exponential Model



We estimated the point estimate and the bounds of the 80 percent confidence interval for percent remaining which are defined as +/- 1.28 standard errors based on the cluster sample formula described above. We then solved for the rates of decline for each value (–5.1%, -7.9%, and –10.8% for the upper bound, point estimate, and lower bound respectively). Figure 4 plots these rates of decline. The EULs reported are the times at which the estimated percent remaining equals 50% for each curve.

Survival model output from SAS™ PROC LIFEREG provides estimates for quantiles and their standard errors. Sampling errors are up to three times larger for this cluster sample than for a simple random sample of like size. As survival models don't take into account clustering, reported confidence bounds for survival models are based on the reported standard error at the 50th percentile multiplied by 1.28 multiplied by the estimated design effect (deff) for the cluster sampling.

Estimates are made for Modular Units, Integral Units and All Unit Types weighted to be representative of the program fixture population. Table 7, on page 19, shows a wide range of estimates as expected depending on unit type and statistical model.

The endpoint models predict longer lives than the piecewise models. For example, for modular fixtures the linear endpoint model predicts an EUL between 5.5 and 11.7 years, while the piecewise linear model predicts 3.7 - 6.0 years and the survival models predict even lower EULs. Note that the 'dc' entry for the integral unit survival models means the model didn't converge. The forecasts vary markedly depending on analyst's choice of what model predicts the future best, as too little time has elapsed to choose among these shapes with the observed data. We believe the endpoint, exponential model is the most likely to approximate the future based or product hazard shapes observed elsewhere. It is possible, however, that architectural renovations in the commercial sector have hastened the removal of program product at a rate faster than that due to physical degradation. The survival models estimate similar EULs regardless of distribution (Log-Normal, Logistic, or Weibull) used. We doubt that the survival models provide good EUL forecasts given the limited data and the convergence problems experienced in searching for solutions may signal the instability of their results.

With more integral units failing (43%) during the study period, we can be more definite in our conclusions. EUL estimates lower bounds for integral units exceed the *ex ante* estimate of 2.2 years with point estimates of 2.7 - 3.1 years. Neither interval censored nor assumed midpoint survival models converged for this small sample of integral units, so the alternative models are used to make EUL forecasts. The *ex ante* estimate was conservative.

Table 7 – Predicted Fixture EUL (Years)

	Endpoint Models			Piecewise Models		
Model Type…	Lower Bound	Mean	Upper Bound	Lower Bound	Mean	Upper Bound
Modular Fixtures						
Linear	5.5	7.5	11.7	3.7	4.4	6.0
Exponential	6.6	9.4	15.3	4.1	5.2	7.3
Survival Curve						
Logistic				3.1	3.4	3.6
Log Normal				3.2	3.6	4.1
Weibull				3.1	3.4	3.8
Integral Fixtures						
Linear	2.5	2.9	3.6	2.5	2.7	2.9
Exponential	2.5	3.1	4.0	2.5	2.7	3.1
Survival Curve						
Logistic				dc	dc	dc
Log Normal				dc	dc	dc
Weibull				dc	dc	dc
All Fixtures						
Linear	5.3	7.1	10.5	3.6	4.3	5.6
Exponential	6.4	8.8	13.6	4.0	4.9	6.7
Survival Curve						
Logistic				3.1	3.4	3.6
Log Normal				3.2	3.6	4.1
Weibull				3.1	3.4	3.8

For all units combined, the EUL estimates are essentially similar to those for the modular bulbs that represent 96 percent of the total. Estimates range widely and the model we believe is lowest risk in forecast includes the *ex ante* estimate in its confidence interval. There is not sufficient evidence to reject the null hypothesis that they are the same at the 80 percent confidence level. More follow-up research would be necessary to make a tighter forecast. This retention question begs for more data over a longer time period.

The cluster mean where cluster sizes vary is a ratio estimate. This mean can be biased due to the lack of independence among observations. The overall weighted retention ratio estimate after 2.7 years was 81.1 percent. The mean of among the segments, which are nearly independent (there are only 1.3 lighting segment clusters per customer) was 81.2 percent and the segment means weighted by bulb type was also 81.1 percent. With so little variation among these methods of calculating the percent retained ,we conclude that the bias is of little concern. Our analysis does, however, recognize that cluster sampling entails higher estimate variances.

One other type of sensitivity analysis was performed to test the sensitivity of results to outlying observations. One customer site, a golf course, had 16,000 program units installed (5% of the program total). Due to remodeling a golf course green, 47 percent of the 34 fixtures tracked were removed. This is a consequence of having our segment tags in too concentrated a space. We know that 47 percent of this site's bulbs weren't actually removed. Dropping this one site from our analysis to test sensitivity raised overall retention rate at 2.7 years from 81.1 percent to 82.7 percent. This change would raise expected EUL by 8 –10 percent, so our results are sensitive to the lack of independence among sampling elements. True retention rates may be somewhat higher than estimated in Table 7.

BULBS

Bulb lives were likewise estimated using the linear, exponential and survival analysis models. Upper and lower bounds were calculated using the sampling error reported from the parameter estimate or the prediction error reported from the survival model. The overall weighted retention after 2.7 years was 53.7 percent. Combined results are reported because bulb lives are estimated to be the same for different unit types.

Table 8 shows that all estimation techniques produce point estimates within .3 years of one another. Endpoint models produce estimates .1 - .2 years (up to 7 percent) higher than the piecewise models.

Table 8 – Predicted Bulb EUL (Years)

	Endpoint Models			Piecewise Models		
Model Type…	Lower Bound	Mean	Upper Bound	Lower Bound	Mean	Upper Bound
All Bulbs						
Linear	2.6	2.9	3.2	2.6	2.7	2.9
Exponential	2.5	3	3.5	2.6	2.8	3
Survival Curve						
Logistic				2.7	2.8	2.9
Log Normal				2.7	2.8	2.9
Weibull				2.7	2.8	2.9

Survival models produce estimates similar to the piecewise fit models which is why they are grouped under that category. The results are not particularly sensitive to model specification, when the forecast need only be extrapolated from 53.6 percent remaining to estimate the time at which only 50 percent will remain. Earlier estimate that bulbs would last only 2.2 years are conservative.

The appendix provides some additional retention percentages by watt class of the bulbs and whether the bulbs were used in indoor or outdoor applications. These statistics are not needed for EUL estimation, but may be of more general interest to researchers studying the durability of these measures in the commercial sector.

APPENDIX A – M & E Protocols Required Tables

TABLE 6 – Results Used to Support PY94 Second Earnings Claims

1. Measure: Commercial CFL lighting fixtures installed under SCE's 1994 Manufacturer's Rebate Program from various manufacturers and wattages for the end-use lighting.
2. Ex Ante: The *ex ante* EUL, expected useful life for these measures: Modular screw-in and hardwire fixtures 12.2 years Integral screw-in fixtures 2.2 years Combined 11.8 years Note: combined estimate is weighted mean of two measure types with weights of 95.8% and 4.2% respectively. Stated program EUL filed by SCE was 12.0 years. *Ex ante* estimates of 12.2 for modulars and 2.2 for integrals are listed in CPUC Protocol Table F based on the CADMAC measure life study.
3. Ex Post: The *ex post* EUL, expected useful life for these measures: Modular screw-in and hardwire fixtures 9.4 years INTEGRAL SCREW-IN FIXTURES 3.1 YEARS Combined 8.8 years Based on the endpoint exponential model, which is expected to best predict the future survival curve.
4. Ex Post EULs to be Used in Earnings Claims: The *ex post* EUL to be used in future earnings claims for these measures: Modular screw-in and hardwire fixtures 12.2 years Integral screw-in fixtures 3.1 years Combined 12.0 years Modular and combined *ex post* EUL estimates are not different from *ex ante* estimates at the 80% confidence level. Integral unit EUL estimates are higher but the combined EUL is to be used in future earnings claims and that remains at 12.0 years.

5. Standard Errors: : The standard errors for these models are based on the parameter estimate of the percent remaining at the time of the second inspection. This is expressed in terms of the percent remaining. The standard error are: Modular screw-in and hardwire fixtures 5.1% Integral screw-in fixtures 6.1% Combined 4.8% These standard errors are plugged into survival functions for the appropriate confidence interval to determine the point at which 50% would be remaining.
6. 80% Confidence Interval: The *ex post* EUL, expected useful life for these measures was: Modular screw-in and hardwire fixtures 6.6 – 15.3 years Integral screw-in fixtures 2.5 – 4.0 years Combined 6.4 – 13.6 years
7. P-value – for the combined program *ex post* estimate of 8.8 compared to the filed *ex ante* estimate of 12.0 years the p-value equals .33 for the two-tailed or would require a 67% confidence interval.
8. Realization Rate: Realization rate for the combined program estimate which will be used in future earnings claims is equal to 1.0 as the *ex ante* estimate of EUL will continue to be used.
9. Like Measures: not applicable

TABLE 7 – Documentation of Protocols For Data Quality and Processing

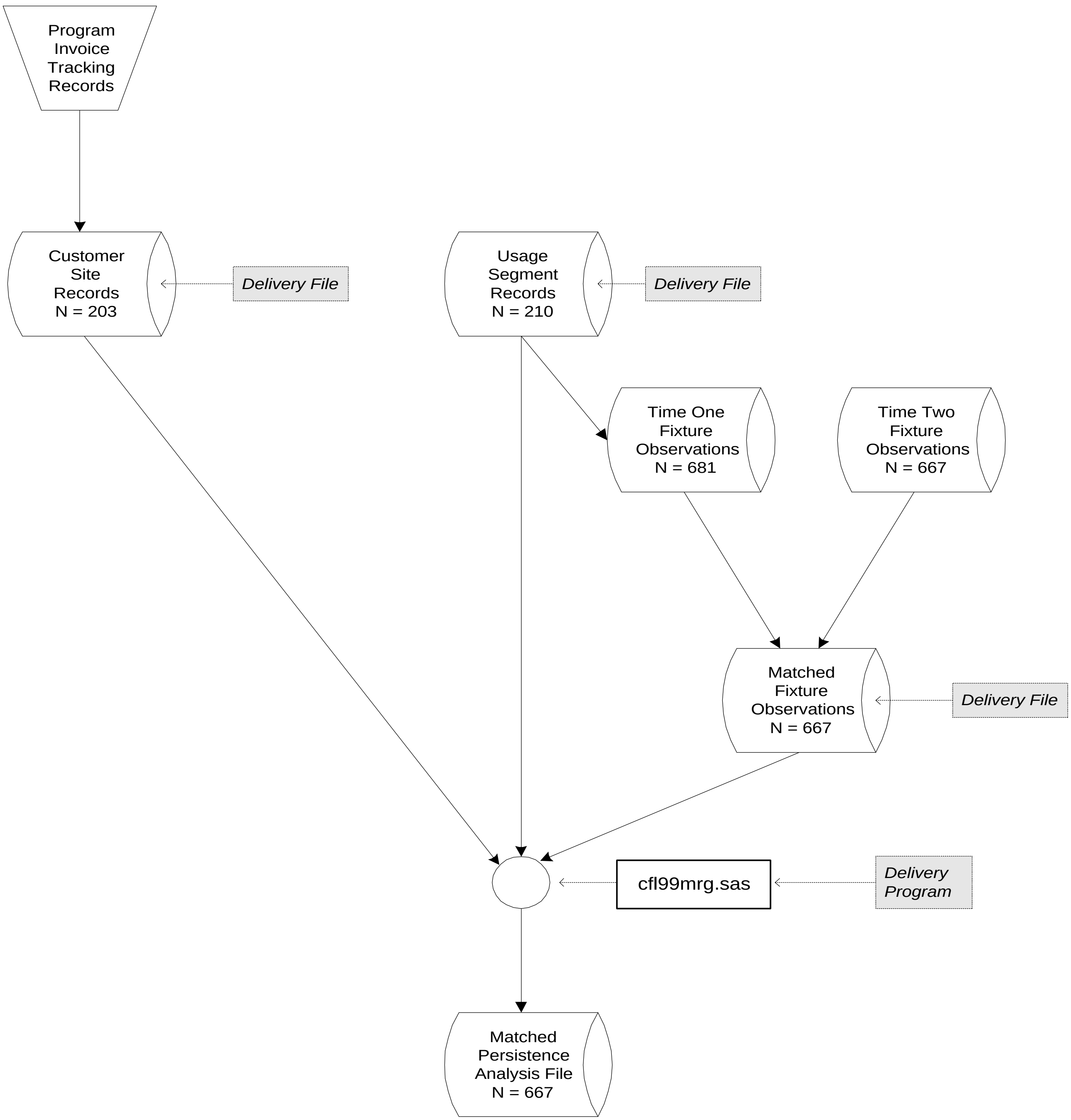
A. OVERVIEW INFORMATION

1. Study Title and Study ID: Southern California Edison 1994 Commercial CFL Manufacturers Rebate Program Retention Study ID 529 D
2. Program, Program Year or Years, and Program Description: The 1994 Manufacturers Commercial Compact Fluorescent Lamp Program provided financial incentives directly to CFL Manufacturers to sell compact fluorescent equipment in Southern California Edison territory at discounted prices. In all, approximately 320,000 units were distributed under this program.
3. End-Uses and/or Measures Covered: Compact fluorescent fixtures, lamp assemblies, and bulbs used in commercial environments.
4. Method(s) and Model(s) Used: The methodology employed in this report consists of the estimation of EULs (effective useful life) of program product using alternative survival estimation strategies.
5. Program Participants: Program participants included manufacturers, primary and secondary distributors, as well as product end-users who purchased discounted CFL equipment within Edison territory.
6. Analysis of Sample Size: The sample used for this persistence study was the population of 113 customer locations which consisted of 163 lighting segments and 681 fixtures previously identified (*during the first year impacts evaluation*) for follow-up persistence inspections.

B. DATABASE MANAGEMENT

1. Flow Chart Illustrating Relationships between Data Elements: See Figure A-1, PY 1994 Commercial CFL Lighting Program Persistence Estimation
2. Specific Data Sources: Edison program tracking records, telephone books, and commercial sources were originally used to develop a frame of program participants including company names, addresses, and telephone numbers. Additional end-user customers identified by distributor survey respondents. Persistence study data included records collected as part of the first year impacts study and data collected during re-inspection follow-up visits.
3. Data Attrition Process:. Of the 113 sites identified for follow-up during the first year impact evaluation, 3 sites were not visited for various reasons including business closure, denial of permission and administrative convenience. A total of 3 lighting segments and 14 fixtures were lost to follow-up at these sites.
4. Internal/Organizational Data Quality Checks and Procedures: Data entry operations were subject to visual review and double-punch verification for key identifying variables and quantities. Follow-up data was keyed into spreadsheets from the transcribed inspection records.
5. Summary of the Data Collected but Not Used: None.

Figure A-1 – 1994 Commercial CFL Lighting Program Persistence Estimation Data



C. SAMPLING

1. Sampling Procedures and Protocols: Persistence inspections were attempted at all customer sites where initial inspections occurred and program product was found and marked for follow-up.
2. Survey Information: No new surveys were conducted for this persistence study.
3. Statistical Descriptions: Not applicable.

D. DATA SCREENING AND ANALYSIS

1. Procedures Used for Treatment of Outliers, Missing Data Points, and Weather Adjustment: Not applicable.
2. Controlling for the Effects of Background Variables: Not applicable.
3. Procedures Used to Screen Data: Not applicable.
4. Regression Statistics: Not applicable.
5. Specification: Not applicable.
6. Error in Measuring Variables: Not applicable
7. Autocorrelation: Not applicable.
8. Heteroskedasticity: Not applicable.
9. Collinearity: Not applicable.
10. Influential Data Points: Not applicable.
11. Missing Data: Follow-up data was obtained during follow-up inspections for 96% of fixtures tracked. Missing data resulted primarily from customer refusals for re-inspection and inability to track a few of the tagged fixtures at visited customer sites. Missing data should be similar to the included data and combined with this low incidence of missing, non-response bias should be minimal. The tracked fixture data was also weighted by bulb class proportions estimated from the original rebate tracking system to reflect program totals correctly.
12. Precision: With only two data points the endpoint and piecewise models fit any linear or curvilinear model that includes these points perfectly. The forecast uncertainty derives from estimates of the percent remaining estimated from the inspection data. Confidence limits for that measure were derived using appropriate variance estimates for a cluster sample of lighting segments at customer's sites. For survival models precision was estimated from the standard errors reported from the SAS™ PROC LIFEREG models; the width of the confidence interval (80%) selected by CADMAC; and an adjustment for the design effect from using a cluster sample where observations are not distributed independently of one another.

APPENDIX B

SUPPLEMENTARY TABULATIONS ON BULB RETENTION

This appendix reports some additional tabulations on retention of bulbs by bulb wattage and fixture type and by location of the lighting application. Table 9 reports the mean bulbs retained at 2.7 years as of the time of the second inspection. The table shows that bulbs in outdoor locations, in the 4-14 watt class were retained only 44 percent of the time compared to 53.7 percent retained overall. These bulbs were usually used along walkways and obviously were more susceptible to damage.

Table 9 – Weighted Percent of Bulbs Remaining at 2.7 Years by Bulb and Fixture Type and Location

Watt Class	Type	Inside	Outside	All
4-13	modular	73.4%	44.4%	51.1%
14-20	modular	69.4%	70.6%	69.7%
14-20	integral	55.6%	57.7%	56.9%
21+	modular	53.0%	51.5%	52.6%
Total		62.2%	47.3%	53.7%

For other watt classes differences between indoor and outdoor retention were not so pronounced. Integral screw-in and modular units over 21 watts which were used in room applications most often were also retained at a lower rate than the 14-20 watt modular units.

Table 5 of the First Year Evaluation Report showed that 77 percent of 4-13 watt bulbs were located in outdoor applications. Over 80 percent of remaining bulb classes were located in indoor applications. We note that weighting by bulb watt class essentially controls for indoor/outdoor distribution of bulbs and fixtures in the program population due to this relationship.

Hours of operation may have had some impact on retention. Outside bulbs averaged 4,581 hours of operation annually according to Table 5 of the First Year Evaluation Report, which was 40% higher than expected hours of operation. However, 21+ watt bulbs were used only 1,675 hours per year or 50 percent less than expected, but they still showed lower rates of retention.

APPENDIX C

DESCRIPTION OF PROGRAMS, SPREADSHEETS, OUTPUT AND DATA FILES

SAS Programs

ANALY01.SAS	Preliminary Crosstabs on Inspection 2 File - MPANALY
BULBCLS2.SAS	Crosstabs for Weight Calculation
CLUSTFRQ.SAS	Frequency by Cluster Size - Tracked Fixtures, Table 3
CLUSTMN2.SAS	Weighted Means Fixture Retention, Time Intervals, Total and by Cluster
CLUSTMN3.SAS	Sensitivity Test Wgtd. Means Approximate Cluster Size Weighting
CLUSTMN4.SAS	Weighted Means Bulb Retention, Time Intervals, Total and by Cluster, Bulb Survival Curves
CUST312.SAS	312
CUSTMTCH.SAS	Validation Crosstab - Model Number by manufacturer and wattage
GRAPHC.SAS	Produces Figures 1, 2, and 4, Survival Curves (CGM Output)
MANUF.SAS	Crosstab to Look For Integral Screw-in Manufacturers and Wattages
PERSISTA.SAS	Survival Estimates - Fixtures
RAWFREQ.SAS	Crosstabs of Fixture and Bulb Status - Tables 1 and 2
VALUES.SAS	Formats for MPANALY File Variables

SAS Data Files

CFLTAG.SD2	TAG Form from Customer Invoices - Model Numbers at Sites for Invoices Found
MPANALY.SD2	Inspection 2 Analysis File - Bulb and Fixture Status
MRG_98.SD2	Preliminary Merge File
SEG_CFL.SD2	Segment Information Record
SEGMTFRM.SD2	Counts of Total Bulb Types by Wattages for Segment
SITEFRM.SD2	Site Info - Source of City and ZIP Code Info

Spreadsheets

CLUSTMN2.XLS	Calculation of Cluster variances and DEFF- Fixture Retention
CLUSTMN4.XLS	Calculation of Cluster variances and DEFF- Bulb Retention
EULCFL2.XLS	Endpoint, Piecewise, Survival Curve Equations - Fixtures
EULCFL3.XLS	Only
RAWFREQ.XLS	Crosstabs of Fixture and Bulb Status - Tables 1 and 2
WEIGHTS.XLS	Weight Calculation

Program Output

BULBCLS2.LST	Output: Crosstabs for Weight Calculation
CLUSTMN2.LST	Output: Weighted Means Fixture Retention, Time Intervals, Total and by Cluster
CLUSTMN3.LST	Weighting
CLUSTMN4.LST	Cluster, Bulb Survival Curves
PERSISTA.LST	Output: Survival Estimates - Fixtures
CUST312.LST	312
RAWFREQ.LST	Tables 1 and 2

APPENDIX D

FIXTURE SURVIVAL FUNCTION MODEL OUTPUT

Output from SAS PROC LIFEREG

1. Modular Fixtures – Weibull Distribution
2. Integral Screw-in Fixtures – Weibull Distribution
3. All Fixtures – Weibull Distribution
4. Modular Fixtures – Log-normal Distribution
5. Integral Screw-in Fixtures – Log-normal Distribution
6. All Fixtures – Log-normal Distribution
7. Modular Fixtures – Logistic Distribution
8. Integral Screw-in Fixtures Interval Censored – Logistic Distribution
9. Integral Screw-in Fixtures Midpoint Estimate of Failure– Logistic Distribution
10. All Fixtures – Logistic Distribution

Notes: All models were weighted. Models did not converge when predictions and std are not reported in the lower panel. Integral models were interval censored for failures, except for one test using a midpoint time for failures to test whether these models would converge using such a model – they didn't converge in any attempt.

Modular Fixtures - Weibull

Lifereg Procedure

```
Data Set           =WORK.CFLMRG
Dependent Variable=Log(LOWER)
Dependent Variable=Log(UPPER)
Weight Variable    =WEIGHT
Noncensored Values=     0  Right Censored Values=    475
Left Censored Values=   0  Interval Censored Values=  99

Log Likelihood for WEIBULL -308.3754702

Variable  DF   Estimate  Std Err ChiSquare  Pr>Chi Label/Value

INTERCPT   1 7.19910763 0.027688  67601.94  0.0001 Intercept
SCALE      1 0.17231092 0.015897                   Extreme value scale
parameter
```

OBS	_PROB_	SCREWIN	PREDTIME	STD
1	0.25	0	1079.69	17.7737
2	0.50	0	1256.33	29.1781
3	0.75	0	1415.72	45.3560

Integral Fixtures - Weibull

Lifereg Procedure

```
Data Set           =WORK.CFLMRG
Dependent Variable=Log(LOWER)
Dependent Variable=Log(UPPER)
Noncensored Values=     0  Right Censored Values=     45
Left Censored Values=   0  Interval Censored Values=  34

Log Likelihood for WEIBULL -73.03486506

Variable  DF   Estimate  Std Err ChiSquare  Pr>Chi Label/Value

INTERCPT   1 7.05648717 0.058066  14768.43  0.0001 Intercept
SCALE      1 0.29424171 0.048371                Extreme value scale parameter
```

All Fixtures - Weibull

Lifereg Procedure

```
Data Set           =WORK.CFLMRG
Dependent Variable=Log(LOWER)
Dependent Variable=Log(UPPER)
Weight Variable    =WEIGHT
Noncensored Values=      0  Right Censored Values=    520
Left Censored Values=    0  Interval Censored Values= 133

Log Likelihood for WEIBULL -339.3241618

Variable  DF   Estimate  Std Err ChiSquare  Pr>Chi Label/Value

INTERCPT   1 7.20488004 0.027938  66504.78  0.0001 Intercept
SCALE      1   0.184656 0.016296                   Extreme value scale parameter
```

OBS	_PROB_	PREDTIME	STD
4	0.25	1069.36	17.9143
5	0.50	1257.90	29.4440
6	0.75	1429.66	46.2825

```
                    Modular Fixtures - Log Normal
                         Lifereg  Procedure

Data Set          =WORK.CFLMRG
Dependent Variable=Log(LOWER)
Dependent Variable=Log(UPPER)
Weight Variable   =WEIGHT
Noncensored Values=     0  Right Censored Values=    475
Left Censored Values=   0  Interval Censored Values=  99

Log Likelihood for LNORMAL -305.8060058

   Variable  DF   Estimate  Std Err ChiSquare  Pr>Chi Label/Value

   INTERCPT   1 7.18876243 0.032314  49491.65  0.0001 Intercept
   SCALE      1 0.30694212 0.027391                   Normal scale parameter

             OBS    _PROB_    SCREWIN    PREDTIME     STD

               1     0.25        0        1076.78    21.5630
               2     0.50        0        1324.46    42.7984
               3     0.75        0        1629.11    79.3092
```

```
                         Integral Fixtures - Log Normal
                               Lifereg  Procedure

Data Set          =WORK.CFLMRG
Dependent Variable=Log(LOWER)
Dependent Variable=Log(UPPER)
Noncensored Values=     0  Right Censored Values=     45
Left Censored Values=   0  Interval Censored Values=  34

Log Likelihood for LNORMAL -71.82058938

   Variable  DF   Estimate  Std Err ChiSquare  Pr>Chi Label/Value

   INTERCPT   1 6.94759733  0.06494  11445.77  0.0001 Intercept
   SCALE      1 0.42615165  0.06449                   Normal scale parameter


                         All Fixtures - Log Normal
                               Lifereg  Procedure

Data Set          =WORK.CFLMRG
Dependent Variable=Log(LOWER)
Dependent Variable=Log(UPPER)
Weight Variable   =WEIGHT
Noncensored Values=     0  Right Censored Values=    520
Left Censored Values=   0  Interval Censored Values= 133

Log Likelihood for LNORMAL -337.3310726

   Variable  DF   Estimate  Std Err ChiSquare  Pr>Chi Label/Value

   INTERCPT   1 7.19530167 0.032643  48587.35  0.0001 Intercept
   SCALE      1 0.33073767 0.027822                   Normal scale parameter

                    OBS    _PROB_    PREDTIME     STD

                      4     0.25      1066.59   21.8441
                      5     0.50      1333.15   43.5178
                      6     0.75      1666.33   81.9044
```

Modular Fixtures - Logistic

Lifereg Procedure

Data Set =WORK.CFLMRG
Dependent Variable=LOWER
Dependent Variable=UPPER
Weight Variable =WEIGHT
Noncensored Values= 0 Right Censored Values= 475
Left Censored Values= 0 Interval Censored Values= 99

Log Likelihood for LOGISTIC -310.8832051

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi	Label/Value
INTERCPT	1	1234.26142	23.55043	2746.733	0.0001	Intercept
SCALE	1	144.196502	12.63205			Logistic scale parameter

OBS	_PROB_	SCREWIN	PREDTIME	STD
1	0.25	0	1075.85	16.0811
2	0.50	0	1234.26	23.5504
3	0.75	0	1392.68	35.1543

Integral Fixtures - Logistic Interval Censor

Lifereg Procedure

Data Set =WORK.CFLMRG
Dependent Variable=LOWER
Dependent Variable=UPPER
Noncensored Values= 0 Right Censored Values= 45
Left Censored Values= 0 Interval Censored Values= 34

Log Likelihood for LOGISTIC -74.49616669

Variable	DF	Estimate	Std Err	ChiSquare	Pr>Chi	Label/Value
INTERCPT	1	1026.16631	46.98798	476.9381	0.0001	Intercept
SCALE	1	190.88385	29.21534			Logistic scale parameter

```
                    Integral Fixtures - Logistic Midpoint
                              Lifereg  Procedure

Data Set          =WORK.CFLMRG
Dependent Variable=ELP_TIME
Censoring Variable=CENSOR
Censoring Value(s)=     1
Noncensored Values=    34  Right Censored Values=     45
Left Censored Values=   0  Interval Censored Values=   0

Log Likelihood for LOGISTIC -274.2515988

Variable  DF   Estimate  Std Err ChiSquare  Pr>Chi Label/Value

  INTERCPT    1 1010.94234 48.47757  434.8817  0.0001 Intercept
  SCALE       1 198.680229 28.72609                   Logistic scale parameter


                         All Fixtures - Logistic
                              Lifereg  Procedure

Data Set          =WORK.CFLMRG
Dependent Variable=LOWER
Dependent Variable=UPPER
Weight Variable   =WEIGHT
Noncensored Values=     0  Right Censored Values=    520
Left Censored Values=   0  Interval Censored Values= 133
Log Likelihood for LOGISTIC -342.0277874

  Variable  DF   Estimate  Std Err ChiSquare  Pr>Chi Label/Value

  INTERCPT    1 1232.80504 23.32502  2793.476  0.0001 Intercept
  SCALE       1 151.748823   12.676                   Logistic scale parameter

                      OBS     _PROB_     PREDTIME       STD

                        4       0.25      1066.09    16.0866
                        5       0.50      1232.81    23.3250
                        6       0.75      1399.52    34.8884
```