**DEMAND ANALYSIS WORKING GROUP (DAWG)**
**Large California Utility Demand Forecasting Process Comparison**
Draft Materials – for Discussion at November 9, 2010 DAWG Meeting

| 1. What is the basic methodology of your forecasting process? Econometric, time-series, end-use, other | |
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| LADWP | Econometric model is used for Residential, Commercial and industrial. Intra-departmental which is mostly Water Pumping is a simple long-term average with no growth factor. Owens Valley, which is aggregated sales of all the sectors, is a time trend model with monthly dummy variables. Streetlight is a time trend model with the savings from LED lighting installations netted out. PHEV is based on the CEC 2009 IEPR forecast. |
| PG&E | PG&E primarily uses econometric multiple linear regression modeling methodology to forecast demand. When appropriate, time-series terms on errors are added to the model to improve the model fit to the observed demand data. |
| SCE | All models are Econometric, except residential customer additions, which is modeled and forecast according to a household stock adjustment model.<br><br>SCE's methodology, the models, all historical data on all the variables, and regression results throughout the appropriate time period are provided in publicly available workpapers in ERRA, GRC, FERC and IEPR proceedings. |
| SDG&E | Mostly econometric models with end-use input models in the background used as adjustments. Some time-series models are used for miscellaneous sub-groups. |
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| 2. At what level of disaggregation is your forecast developed? Sectors (residential, commercial, etc.), subareas in the service territory | |
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| LADWP | Residential-Commerical-Industrial-Owens Valley-streetlight-Intradepartmental-PHEV<br><br>We use weighted-average weather variables to pick up a climate zone effects. |
| PG&E | PG&E develops regression model based forecasts for the residential, commercial, industrial and agricultural classes. When needed, the class level forecast is disaggregated into subclasses using historic spreading factors (e.g., residential class sales disaggregated into residential individually metered and residential master metered subclass sales). |

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| SCE | The forecast is prepared at the Customer/Revenue Class disaggregation level (residential, commercial, industrial, government, agriculture, street light). Residential models are developed at the County level. |
| SDG&E | The forecast is broken out into residential, commercial, industrial, military, lighting and agriculture sub-groups. |
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| **3. What are the key drivers, and which data sources (source/vintage) are used for these? Econ-demo, commercial floor space, etc.** | |
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| LADWP | UCLA Anderson Forecast for Employment, personal income and Consumption.<br>DOF Demographic unit for population.<br>McGraw-Hill Construction for construction activity |
| PG&E | PG&E's models are estimated based on historic billing data; each model uses a unique set of drivers. Examples from the January 2010 forecast cycle:<br><br>Residential Sales Model:<br>10 years of monthly class sales history<br>Real Personal Income (Moody's Analytics)<br>Real Residential Average Rate (PG&E/Moody's Analytics)<br>Heating & Cooling Degree Days (PG&E)<br>Daylight Hours (National Oceanic and Atmospheric Administration)<br>Energy Crisis Dummy<br><br>Commercial Sales Model:<br>10 years of monthly class sales history<br>PG&E Territory Service Industry Employment (Moody's Analytics)<br>Real Commercial Average Rate (PG&E/Moody's Analytics)<br>Cooling Degree Days<br>Monthly Dummy Variables<br><br>Industrial Sales Model:<br>10 years of quarterly class sales history<br>PG&E Territory Manufacturing Employment (Moody's Analytics)<br>Real Industrial Average Rate (PG&E/Moody's Analytics)<br>Quarterly Dummy Variables |

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| | Agricultural Sales Model:<br>10 years of quarterly class sales history<br>1-year lagged sales<br>Quarterly Cumulative Rainfall Totals (The Weather Channel/CA DWR)<br>Quarterly Dummy Variables<br><br>PG&E produces forecasts based on average year temperature data (heating and cooling degree days). The temperature data has been escalated to account for climate change, but the change is slight in the near term. (See #8). |
| SCE | Residential Customer Class: key drivers are real income per capita, retail electricity price, heating and cooling degree days. Source for real income is Moody's Economy.Com. Vintage is not an issue since the income forecast is updated monthly by Economy.Com.<br><br>Commercial Customer Class: key drivers are commercial services employment per commercial class customer, retail electricity price, heating and cooling degree days. Source: Global Insight. Vintage is not an issue since the employment forecast is updated monthly by GI and customers are updated monthly by SCE.<br><br>Industrial Customer Class: key drivers are manufacturing employment per industrial square feet, retail electricity price, and cooling degree days. Source: Global Insight and McGraw-Hill. Forecast vintage is not an issue since the employment forecast is updated monthly by GI; floor stock is updated annually by McGraw-Hill.<br><br>Other Public Authority Customer Class: government employment per government building square feet, retail electricity price, and cooling degree days. Source: Global Insight and McGraw-Hill. Forecast vintage is not an issue since the employment forecast is updated monthly by GI; floor stock is updated annually by McGraw-Hill.<br><br>Agriculture Customer Class: agriculture employment per agriculture class customer, and rain fall. Source: Global Insight and SCE. Vintage is not an issue since the employment forecast is updated monthly by GI and customers area updated monthly by SCE.<br><br>Street Lighting: primary driver is the number of residential customers and seasonal dummies. |
| SDG&E | We use a blend of Moody's, IHS Global Insight, California Department of Finance and U.S. Energy Information Administration (EIA). We generally use the most recent vintage of household, income, price and employment information from each source. |
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| **4. How is peak demand estimated? Separate peak model vs. converted from energy forecast** | |
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| LADWP | OLS Regression temperature response model is built using recent weekday summer data. We run a historical simulation through the model that gives us a distribution of peak events. We estimate the distribution using the Central Limit Theorem. Growth in peak is based on underlying NEL forecast adjusted for the Huffman bill and PHEV forecast.<br><br>The result is very similar to a load factor forecast. The above methodology gives me more understanding of the factors causing the peak specifically intensity and length of the heat storm. |
| PG&E | PG&E employs a separate peak demand model. A forecast of monthly demand peaks is created using an econometric model with the following drivers:<br>10 years of monthly system peak history<br>Heating & Cooling Degree Days (PG&E)<br>Number of Residential Accounts (PG&E)<br>PG&E Territory gross metro product (Moody's Analytics)<br>Energy Crisis Dummy<br>Monthly Dummy Variables |
| SCE | Peak Demand is modeled, estimated and forecast separate from energy. It involves a three-step process. First, for each summer season, daily load is regressed against temperature to derive base load and temperature-sensitive components. Second, historical base load and temperature-sensitive components are regressed against annual energy and annual number of customers, respectively. Finally, the annual peak demand components are forecast using the models just described according to the previously developed forecast of sales and customers. |
| SDG&E | SDG&E's monthly peak model is a regression model that uses energy (from energy forecast), A/C usage and seasonal variables. |
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| **5. How are efficiency and distributed generation incorporated in the forecast? Post-processed vs. parameterized in the mode** | |
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| LADWP | Post processed. I have tried parameterized models but LADWP financial planning models are set up to handle the output. |

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| PG&E | PG&E's process for building in energy efficiency and distributed generation into its demand forecasts includes both "parametric" (embedded) and "post-processed" (incremental) elements. This is accomplished through a review of historical data, public documents, and commission decisions to ensure that the approach is transparent, understandable, and meets public policy targets and goals. Please see # 6 below for further details. |
| SCE | Total cumulative EE and DG by customer class are explicitly represented within the regression models by adding them to recorded kWh sales and creating a consumption variable used as the dependent variable in the econometric model. |
| SDG&E | Models are based on total demand or consumption (included is solar and self-served load). Adjustments for the impacts of energy efficiency are a post model adjustment. |
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| 6. **How are efficiency and DG impacts estimated? Efficiency/DG staff or forecaster developed? What historical period is used and which data are used to create the historical record? How is measure decay handled?** | |
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| LADWP | Formula is unmitigated forecast + Long-term average EE and DG installed – EE and DG objectives.<br><br>Objectives historically have been higher than maximum achievable in the Energy Efficiency Potential Study.<br><br>Objectives set at by AB 2021 which is 10% of load by 2016 so it basically 1% a year.<br><br>On decay, assume that measures are replaced by equivalent measures. Do not have good data on decay to do anything more sophisticated. |
| PG&E | PG&E attempts to be as transparent as possible in the incorporation of energy efficiency and distributed generation (DG) assumptions. For this reason, PG&E relies heavily on public documents that are easily accessible. As an example, in its latest round of forecasts (January 2010 cycle), PG&E relied on the CEC publication California Energy Demand 2010-2020 (CED) and the CPUC Decision 08-07-047 for its assumptions. Demand data is broken out into four major customer class components, and regression equations are estimated with either 10 years worth of monthly or quarterly data. Similarly, 10-years worth of data from the CED is examined to estimate the level of conservation and DG "embedded" in the recorded data and therefore captured by the regressions. The data "embedded" is then compared to the goals pronounced by the CPUC to obtain estimates of "incremental" conservation and DG, or in other words, amounts not captured by the regressions and projected forward. |

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| | The CPUC stated that it would study the amount and effect of decay in D.09-09-047. PG&E cannot predict when the study will be released or its current status. Since the decay phenomenon is part of the billed usage data that is used to develop the customer class regressions, it should be implicitly built into the forecast. |
| SCE | The forecast of DG is calculated from SCE inventory of customer generating systems interconnected to the grid for the purpose of meeting own energy requirements.<br><br>The DG inventory includes systems on-line, under construction or with current plans to install. The description of each facility includes customer description, nameplate capacity in kilowatts (KW), probable bypass KW, capacity factor and on-line date. The DG inventory provides the information necessary to produce a short-term forecast of bypass DG capacity. Separate forecasts are developed for thermal and solar and renewable systems.<br><br>Energy efficiency savings are based on program savings reported in the March 31 Reports beginning in 1991. Recent March 31 Reports to the CPUC can be found on the SCE website. For 2006 through 2008 efficiency is taken from the Final 2006-2008 Energy Efficiency Program Plans And Program Solicitation Selections submitted to the CPUC. For 2009, efficiency is from EE Bridge Funding. Year 2010 to 2103 is from SCE Compliance filing (2401-E dated 11-23-2009). Efficiency for the 2013 through 2020 is from CPUC Total Market Gross Goals decision D 08-07-047. Post 2020 efficiency estimates are from the Long-Term Energy Efficiency Potentials for California Building and Industry Report, March 2009.<br><br>Annual energy efficiency savings are distributed to the months using hourly load shapes supplied by KEMA. SCE EE and forecast staff collaborate on the quantification of SCE program efficiency savings.<br><br>Pre 2006 program decay is based upon appliance life calculations. Post 2006 program decay is assumed to be taken-up by future federal/state appliance and building standards and market transformations. |
| SDG&E | Energy efficiency is provided by SDG&E EE staff and self-served load is developed by the forecasting staff. 20 years of historical information is typically used in a forecast. Energy efficiency adjustments are a post model process that accounts for the difference between projected cumulative program impacts (including decay) and the historical trend of impacts implicitly included in the unadjusted forecast. |
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| 7. **Is there a distinction made between "committed" and "uncommitted" efficiency impacts in your forecast? If so, how is this distinction made and how is it handled in the forecast? Is there a separate "uncommitted" forecast?** | |
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| LADWP | No distinction. EE and DG are only incorporated through 2016. After 2016 EE and DG are treated as a resource. I believe the IRP is looking at EE and DG beyond 2016 so that might be considered an uncommitted forecast but it is not in the Load Forecast document. |
| PG&E | To PG&E's understanding, the distinction between committed and uncommitted energy efficiency impacts refers to conservation programs that are currently funded and programs that are unfunded. This is not a distinction that PG&E makes in developing its demand forecasts. The CPUC has ordered that all planning and forecasts undertaken must include the energy efficiency goals, and the longer term goals (beyond 2012) extend beyond the current funding cycle. |
| SCE | No distinction is made between "committed" and "uncommitted" efficiency in regard to the development of the long term forecast. |
| SDG&E | Yes, there is a distinction, thereby presenting a fully mitigated forecast and an unmitigated forecast. |
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| **8. Is climate change incorporated in your forecast? If so, how?** | |
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| LADWP | Yes. Use shorter time periods and more recent data to create weather-normal variables. NOAA recommends thirty years. We are using ten-year moving average. Each year oldest data dropped and newest data added. |
| PG&E | PG&E does incorporate climate change into its load forecasts. Through collaboration with the National Center for Atmospheric Research (NCAR), PG&E created a climate change scenario that could be incorporated into its energy, peak, and gas throughput forecasts. This was done by "downscaling" NCAR's national model results to PG&E's area and converting these results into degree days. PG&E then ran Monte Carlo simulations of the NCAR scenarios to obtain a mean outcome in terms of degree days. These degree days are then built into the forecast projections instead of using the typical "normal" degree days that would otherwise be assumed. |
| SCE | No. |

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| SDG&E | No, not yet. |
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| **9. Are separate forecasts made depending on planning purpose?** | |
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| LADWP | I produce a Net, Gross and unmitigated forecast. This allows planners to change underlying EE and DG assumptions. PHEV is also forecast separately as a class. |
| PG&E | Occasionally, PG&E produces forecasts based on alternative scenarios, such as with economic drivers under alternative economic outlook scenarios or alternative temperature cases. |
| SCE | No. SCE management adopts a single forecast of retail sales and system peak demand. The forecast may be disaggregated into different components for different planning purposes (e.g., bundled load at ISO). |
| SDG&E | No. We attempt to use a consistent forecast for all planning purposes. Adjustments to the forecast are done as warranted by changed circumstances. |
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| **10. How is uncertainty incorporated in your forecast? Scenario analyses, confidence intervals** | |
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| LADWP | For sales, we compute historical accuracy for the budget year which is 0.3% with 1.6% deviation. We make all kinds of simplifying assumptions and say that deviation will grow with the square root of time.<br><br>I also state explicitly that I believe uncertainty is growing basically because the marginal load is now regulatory-driven rather than econ-demo-driven as it was historically. I cite known unknowns of the real impacts of US housing policy, AB 2021, AB 32, SB 375, Smart Grid, PHEV, Climate Change and Zero Net Energy requirements.<br><br>On the peak we publish the 1-in5, 1-in-10 and 1-in-40 cases using the historical simulation method described above. |
| PG&E | PG&E typically reports sales forecasts as “expected value” cases. Recently, we have been experimenting with simulation of the forecast distribution to produce a probability distribution for end-of-year budget assessment.<br>This is accomplished by simulating each class level forecast model based on its forecast error, including random effects of temperature deviating from the normal temperature represented in the forecast. The resulting simulation of the out months is added to the total year-to-date recorded sales to give an expected end-of-year total for that specific set of conditions. The process is repeated 50,000 times and the resulting distribution of possible end-of-year results is used to evaluate possible implications regarding the end-of-year budget. |

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| SCE | Both confidence intervals and high and low economic cases are usually developed. |
| SDG&E | SDG&E uses scenario analyses and confidence intervals to measure and analyze uncertainty in the forecast. |
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| **11. Any plans for significant forecasting methodology changes in the next few years?** | |
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| LADWP | We are always experimenting with new things. In forecasting you test things but do not use most of the work you do. I am probably more focused on improving data detail and quality right now and further automating the forecasting process. |
| PG&E | No. The advent of SmartMeter™ data will certainly alter the way in which usage is aggregated, and will allow for much deeper analysis of customer, regional, and market segment trends. But at the aggregate customer level, at which our forecast models are currently built, we would not anticipate any changes in the way our forecast is generated. |
| SCE | Possibly, as SCE always tries to improve its forecast process. |
| SDG&E | Yes, we are currently evaluating SAE models. |
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| **12. In what venues are the forecasts used? How do the forecasts affect procurement decisions?** | |
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| LADWP | Main venues are Wholesale Marketing, Financial Planning, IRP, Transmission, Distribution Planning and the EE group. |
| PG&E | Our forecasts are used in principally three venues -- the CPUC, the CEC, and FERC. At the CPUC, PG&E sales forecasts are used mainly in rate development and procurement issues. The key proceedings are the Annual Electric True-Up (AET), the General Rate Case (GRC Phase II), and the Energy Resource Recovery Account (ERRA). While the ERRA deals with a one-year ahead procurement decision, the Long Term Procurement Plan (LTPP) deals with a 10-year vision. At the CEC, longer term issues are the primary focus. These issues include state energy policy, resource development, and infrastructure siting. Resource Adequacy (RA) and the Integrated Energy Policy Report (IEPR) are the two main filings. At FERC, the need for transmission investment is the focus through the Transmission Owner (TO) proceeding.<br><br>The ERRA, LTPP, and IEPR are all forums for addressing procurement decisions. Short term need, resource mix, costs, |

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| | renewables, and energy efficiency goals are among the many policy issues dealt with in these proceedings. |
| SCE | GRC rate design and revenue requirement, LTPP, FERC transmission planning and transmission rate design, regional distribution planning, ERRA, IEPR, Resource Adequacy filing, RPS calculation. |
| SDG&E | The forecast is used in CPUC proceedings (procurement planning, transmission planning, resource adequacy and general rate cases) and FERC proceedings (transmission rates). |
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| **13. What kinds of policy considerations affect the forecast? Are different forecasts produced for different policy or other uses?** | |
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| LADWP | Policies listed under uncertainties should be included: US housing policy, AB 2021, AB 32, SB 375, Smart Grid, PHEV, and Zero Net Energy requirements. Port electrification is under AB 32. The City of LA has its own housing and energy policy. I consider the EE objectives under AB 2021 to be stretch goals given our current EE Potential Study so I consider the Huffman Bill and City EE plans to be achievable under the 10 percent objective.<br><br>The Load Forecast does not produce alternative scenarios but under the current IRP process a consultant produced alternative EE scenarios in the IRP study focusing on the likelihood of achievement of EE AB 2021 objectives. So planners are free to look at alternative scenarios even if not produced by the Load Forecast group. |
| PG&E | PG&E attempts to quantify all public policy goals and incorporate them into the demand forecast. For example, in PG&E's current electric sales forecast, PG&E has built in assumptions regarding energy efficiency (EE), distributed generation (DG), electric vehicles, direct access (DA) and community choice aggregation (CCA), and climate change. For the most part, PG&E produces one sales forecast per year, in order to maintain consistent assumptions across different proceedings and internal planning needs. In the past, the LTPP proceeding has required various scenarios to be developed, generally looking at alternative EE/DG "take" rates. |
| SCE | Policy considerations, both internal and external to the company, include expected GRC revenue requirement, 33% RPS, state and federal appliance and lighting efficiency standards, committed and uncommitted EE, DA migration (AB 695), CA Solar Initiative, TOU pricing, electric vehicle load, smart connect, electro technologies, AQMD and State Water Board policies impacting existing and new electric generation plants.<br><br>No. SCE management adopts a single forecast of retail sales and system peak demand. Different policy analyses would use the latest forecast available at the time any policy analysis is conducted. |

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| SDG&E | Currently, the forecast used is on a 2-year IEPR process. As mentioned in Q9, we attempt to use consistent forecasts for all planning purposes. |
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| 14. How often are forecasts produced/what is the cycle? How long does it take to prepare each forecast or to complete a cycle? | |
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| LADWP | Two forecasts are produced each year in October and April. The numbers do not take much time. The write up and multi-level review take longer. Often only one forecast is signed per year. We will use October unless the circumstances suggest the April is more accurate. Budgets are approved in May for the fiscal year beginning in July. Using the April forecast means some additional work last minute work. |
| PG&E | PG&E generally produces updates to its electric and gas forecasts on an annual basis. As mentioned above, this is done to ensure that consistent assumptions get built into the various proceedings over the course of the year, as well as for internal planning and budgeting. Forecasts are monitored over the course of the year, and error variances are tracked. If a material variance persists over a period of months, additional analysis will be done, and if necessary, a revision to a specific class or classes can be incorporated.<br><br>Work on a forecast will generally begin in November with the goal of an early January release. Data compilation, model development, and regression forecast output can generally be accomplished within 2-3 weeks. More time consuming, however, is the process of building policy assumptions into the forecast. This generally involves meeting with subject matter experts and building a consensus around how an assumption should be designed, what sources of data should be used, and how the outlook should be structured. |
| SCE | Forecasts are reviewed quarterly. An assessment is made each quarter whether to recommend an official change to the current forecast. The forecast process takes 2 to 3 months. |
| SDG&E | SDGE uses the same 2-year IEPR cycle. It takes approximately 6 months to prepare the forecast. |
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| **15. How are losses handled?** |
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| LADWP | Reported Losses at LADWP include (UFE) unaccounted for energy (theft and (difference between actual sales and cut flat sales)), and purpose of enterprise sales. Reported losses tend to be higher due control area function of operating the DC line from COB to Sylmar Converter station. Also LADWP transforms its energy to 34.5 KV and 4.8 kV which is lower than other utilities.<br><br>To calculate losses we take the annual loss factor which is based on a historical average and allocate the losses to months based also based on historical average. We also calculate loss factor in unusual way. (NEL-Sales)/NEL. More traditionally Sales would be in the denominator.<br><br>We have looked the impact of more local loads on losses but think it is more appropriately calculated in resource planning model. Right now we are using the Ventex (sic?) Planning and Risk software for resource planning. |
| PG&E | For transmission losses (TL) and Unaccounted For Energy (UFE), PG&E uses the 3% loss factor as implemented in Resource Adequacy Compliance (2.5% TL; 0.5% UFE). For distribution losses, PG&E employs an engineering function based on power flow studies that relate losses to the actual level of load. Percentage line losses for distribution can range from 5% to 10% (min to peak), but generally are around 6% or 7%. |
| SCE | |
| SDG&E | |
| SMUD | |