Department of Water and Power the City of Los Angeles

ANTONIO R. VILLARAIGOSA
Mayor

Commission
MARY D NICHOLS, President
H. DAVID NAHAI, Vice President
NICK PATSAOURAS
EDITH RAMIREZ
FORESCEE HOGAN-ROWLES
BARBARA E. MOSCHOS, Secretary

RONALD F. DEATON, General Manager

October 4, 2006

The Honorable City Council
Office of the City Clerk
Room 395, City Hall
Mail Stop 160

Attention: Councilmember Jan Perry
Chairperson, Energy and Environment Committee

Honorable Members:

Subject: Council File No. 06-2288 –2006 Heat Storm Power Outage

This is in response to the subject referenced motion and the request that the Los Angeles Department of Water and Power (LADWP) report to the Energy and Environment Committee with information relative to the power outages July 21-26, 2006.

From July 21-26, 2006 LADWP's power system experienced six record peak loads. On July 24, 2006 the LADWP reached a new peak load of 6165 Megawatts. Though the instantaneous peaks were approximately 8% to 9% above previous peaks; the residential peaks were approximately 30% above previous peaks.

Overall, during the period in question, the power system performed well. Over seventy-one percent of the outages were related to circuit failures, faults, broken wires, cars hitting poles, etc. Twenty-one percent were related to small residential and commercial transformers and 7.5% were related to an outage at Distribution Station No. 25. Summarily, the power outage affected 79,303 LADWP customers; this represents 5.7% of LADWP's total customer base.

To meet the growing demands on the power distribution system, LADWP will use new transformer load management tools to enhance the transformer replacement program in an effort to reduce the reoccurrence of transformer failures. Additionally, LADWP is implementing EPRI's Distribution Reliability Assessment recommendations. Lastly, though LADWP's current load forecasting methodology is consistent with industry standards, we are investigating alternative forecasting methodologies that may assist in strengthening our current forecasting models.

Enclosed for your information is the report presented to the Board of Water and Power Commissioners. If you have any questions or if further information is required, please call me at (213) 367-1338, or have your staff contact Ms. Winifred Yancy, Government Affairs Representative at (213) 367-0025.

Sincerely,

Ronald F. Deaton
General Manager

WY:gw
Enclosure

c/enc: Councilmember Eric Garcetti, Vice-Chair, Energy and Environment Committee
Councilmember Wendy Greuel, Member, Energy and Environment Committee
Councilmember Tom LaBonge, Member, Energy and Environment Committee
Councilmember Alex Padilla, Member, Energy and Environment Committee
Gerry F. Miller, Chief Legislative Analyst
Winifred J. Yancy

Heat Storm Outage Report

Los Angeles Department of Water & Power

July 21-26, 2006

September 15, 2006

Heat Storm Outage Report

July 21 – 26, 2006

This report provides information about the power outages, that occurred during the recent Heat Storm experienced during the period of July 12 through 26, 2006 in the City of Los Angeles.

Contents Page

Executive Summary – Key Findings and Observations

1. The Power System Experienced Six Record Peak Loads within a Period of 7 Days

The July 2006 Heat Storm was the second hottest in national history. This event broke 2300 records across the country. In addition to heat records, LADWP reached a new peak load of 6165 Megawatts (MW) on July 24, 2006. Although these instantaneous system peaks were approximately 8% to 9% above previous peaks; the residential (i.e., non-coincidental) peaks were approximately 30% above previous peaks.

2. LADWP Experienced a Significantly Lower Percentage of Customer Outages and Transformer Failures were In-Line with Other Major Utility Companies

There were 79,303 LADWP customers affected by power outages during the Heat Storm; this represents 5.7% of LADWP's total customer base. Southern California Edison and Pacific Gas and Electric experienced outages that affected 23% and 24% of their customers, respectively. Power was restored to 73.4% of the affected LADWP customers within six hours, and 99.3% of the affected LADWP customers within 72 hours. Following the Heat Storm, LADWP evaluated and upgraded approximately 800 transformers, including the replacement of 303 failed transformers.

3. Most of the Power System's Infrastructure Performed Well

The causes of the outages are as follows:

- 71.5% of the outages were related to seventy 4.8-kV primary circuit failures. Ten outages were caused by overload conditions, and the remaining sixty outages were caused by normal incidents such as underground faults, broken wires, cars hitting poles, etc..
- 21% of the outages were related to small residential and commercial transformers.
- 7.5% were related to an outage at Distribution Station (DS) 25, caused by an internal station fault that resulted in a short outage of five primary circuits.

The Distribution Stations and high voltage circuits, for the most part, performed well. As a result, there were minimal large-scale power outages associated with high voltage equipment failure. This can be attributed to the significant investments that LADWP has made during the past several years.

4. Steps Need to be Taken to Reduce the Frequency and Duration of Outages.

Some customers endured outages over a multi-day period. Distribution transformer replacement is a time consuming process. Historically, transformer upgrades were based primarily on load growth, or an observed overload condition. In the future, LADWP will utilize new transformer load management tools to provide a proactive approach to reduce

the reoccurrence of transformer failures. Renewing LADWP contracts to expedite the replacement of its aging cable, poles, and cross arms, coupled with the deployment of supplemental emergency field crews, as required, will further increase the reliability of the distribution system, thereby reducing the frequency and duration of power outages.

5. Third Party Review of LADWP's Infrastructure

LADWP conducted a workshop on September 11 and 12, 2006 to prioritize the implementation of appropriate recommendations from the EPRI "Distribution Reliability Assessment" study published in February 2006. These recommendations include the aforementioned issues, as well as the proposed creation of a new LADWP Reliability Planning Group.

6. LADWP's Load Forecasting Methodology

LADWP's forecasting methodology is consistent with industry standards and best practices. However, there are strengths and weaknesses to alternative forecasting methodologies. LADWP recently participated in a July 2006 Heat Storm Workshop at the California Energy Commission (CEC). The general conclusion was that the Load Forecasting function at the CEC or the state utility companies is not broken. Clearly, recent events mean that we must take new information into account and make adjustments to forecasting models. Two areas for exploration include: placing more emphasis on the potential duration of heat storms, and better integration of load research into the forecasts.

7. Energy Efficiency/Conservation and Demand Side Management are Key

LADWP expected to have sufficient energy supplies to meet the City's long-term needs. However, in order to meet extraordinary record increases in retail demand, including air conditioning load, management will present to the Board of Commissioners in the coming months, its plan to aggressively reduce retail demand through demand side management and energy efficiency programs. In addition, as a part of its expanded outreach efforts, a two-sided, 8 ½" x 11", two-color flyer was prepared and inserted in the *LA Daily News* on September 9, 2006, the Spanish language publication *Impacto,* on September 10, 2006, and topped the *LA Times* on September 15, 2006. The flyer features useful water conservation and energy efficiency information for LADWP customers. The flyer is posted on the LADWP Web site, has been emailed to the Neighborhood Councils, is available in English and in Spanish at all LADWP Customer Service Centers, and is being distributed at all community events at which an extended media outreach initiative is underway to promote energy conservation.

8. Communications with Customers During Outages Need Improvement

Based upon feedback from our customers during the Heat Storm, LADWP must improve its ability to develop and deliver a consistent and accurate message concerning what has

occurred in their area during an power outage, what is being done to remedy the situation, and to the extent feasible and available, provide a realistic, expected time of restoration.

Since July 2006, LADWP's Communication and Work Process Improvement Task Force has identified and incorporated key initiatives in a comprehensive action plan to improve communications with customers. The plan was submitted to the Board of Commissioners on August 6, 2006.

LADWP has also met with City's Emergency Preparedness Department, Department of Recreation and Parks, and Department of Aging to discuss a number of issues, including existing and potential staging locations (e.g., cooling centers, parks, libraries, senior centers), back-up water/power supplies, communications capabilities (e.g., telephone, internet access), activation procedures and notification processes.

Summary of Outage Information and Statistics

By Power System Staff

During the period of July 21 to July 26, 2006, approximately 79,301 LADWP customers were affected by heat related outages. Most of the outages were short, primarily 4.8 kV circuit failures, or in one case an internal problem at a Distribution Station. As expected, the most severe outages were in locations with the highest temperatures and in residential neighborhoods.

Key Points:

In general, LADWP's energy supply was adequate, and transmission and distribution systems performed well. LADWP did not experience any outages associated with its Receiving Stations, high voltage (34.5-kV) transmission lines, and 3,200 Industrial Stations.

- There were, however, several 4.8 kV primary cable failures and six failed commercial transformers.

- 79,301 customers (5.7%) experienced outages *(including circuit outages, secondary outages, services and miscellaneous trouble calls)*. This compares favorably to neighboring utilities. 73.4% of customers were restored in less than 6 hours.

- Ten Distribution Stations (DS) exceeded their operation ratings without outages.

- One DS experienced outage due to an internal cable failure. A failed 4.8 kV cable caused the outage at DS-25; this required de-energizing five primary circuits while repairs were made.

- 16,777 (1.2% of LADWP customers) of the 79,301 customers that experienced an outage had transformer related outages. These residential or small commercial customers were most severely impacted because of the long transformer restoration times required to re-establish service.

Summary of California Energy System:

The California Energy commission hosted a meeting on August 2, 2006 to summarize the findings of the condition of the California energy system. The assessment of the Heat Storm (lessons learned) is identified below.

Pros / Activities to continue:

- Good communications/coordination among utility operators.
- All transmission and generation facilities were available.
- Low forced outage rates of equipment.
- All import paths into California were available.

- High Hydro availability.

Cons / Areas for improvement:

- Some utilities were one critical contingency away from either non-firm or firm load shedding.
- Need for increase in demand response programs.
- Improve appliance/electronic equipment efficiency standards.
- Expedite the transmission / generation processes.
- Inventory pooling of critical equipment (e.g. transformers).

State Investor Owned Utilities also summarized their service restoration efforts as follows:

July 2006 Heat Wave – Basic IOU Facts

Record Temperatures Led To Unprecedented Peak Loads

Utility	Highest Peak Day	IOU Peak Load (MW)	Last year's Peak (MW)	% Above Last year	Frequency of These Temperatures Occurring
PG&E	Tuesday 7/25 (7/24 would be the peak without interruptibles)	Confidential	Confidential	13%	Highest in 34 years
SCE	Tuesday 7/25	Confidential	Confidential	3.6%	1 in 10 years
SDG&E	Saturday 7/22	Confidential	Confidential	11%	1 in 25 years
Total ISO System Load	Monday 7/24	50,270	45,431	10.6%	

Outages Due To Excessive Heating of the Equipment
Crews Worked Hard To Restore Power As Soon As Possible

Utility	# of Events Affecting Service to Customers	Customers Affected	Duration
PG&E	6,600 events at substation/transformer level	1.27 million	90% of customers restored in less than 6 hours 0.5% lasted 48-72 hours
SCE	171 at substation/transformer level	1.1 million	Between 30 seconds and 72 hours; restoration prioritized based on number of customers affected
SDG&E	• 7/21 (SBC Communication related, not heat) • 80-90 at substation/transformer level	45,000 40, 000	50 minutes 98% within 12 hours, and all customers restored by evening of 7/23

Assessment of the Power Distribution System (July 20 – 24, 2006)

During the Heat Storm, Los Angeles experienced multiple continuous days of record hot weather, and LADWP's system reached its highest peak system electric demand with much of the LADWP distribution system loaded to an abnormally high level. This preliminary study summarizes the performance of the distribution system from the receiving stations (RS) down through the 4.8-kV circuits.

Twenty receiving stations, five hundred 34.5-kV circuits, 120 permanent distribution stations, and 1600, 4.8-kV circuits distribute electric power in Los Angeles. The Distribution Planning Group (DP) is responsible for planning all load-related additions and changes to these listed elements of the distribution system. This includes annually producing load forecasts for all of the above and developing and issuing specific plans for all load-related additions and changes to the system.

Low Load Diversity – The extremely hot weather occurred in all areas of the City at the same time. While the individual station peak loads averaged only slightly higher than their 1 in 10 year forecasts, the total simultaneous system peak load was considerably higher than the total 1 in 10 year system load forecast.

Receiving Stations (RS) – Peak loads on 12 of the 20 receiving stations were slightly higher than their 1 in 10 year forecasts with the other 8 receiving stations being at or slightly below their 1 in 10 year forecasts. The total summed peak load of all receiving stations was about 1 percent higher than the total of all individual 1 in 10 year receiving station load forecasts.

Preliminary data indicates that RS-J had a peak demand of about 529 MW, about 2 percent higher than forecast. This RS-J peak load, the forecast load growth for the area, and the RS-J current 600MW firm capacity all reinforce the need for planned new RS-V in the West Valley to be in service by 2011 as planned. There are already plans to upgrade equipment at RS-A, -C, -D, and -K to allow full utilization of recently installed larger transformers. Most receiving stations that exceeded forecast loads have sufficient capacity and no immediate additional capacity is needed. There were no hot-weather related receiving station failures.

Distribution Stations (DS) – Peak loads on about 90 of 120 permanent distribution stations were at or slightly below their 1 in 10 year forecasts and 30 distribution stations had peak loads above their 1 in 10 year forecasts. Of the 30 distribution stations that exceeded forecasts, 10 had recorded loads indicating they also exceeded their rated capacities. DS-15 and DS-61 will be relieved by new DS-87. DS-20 and DS-76 exceeded their rated capacities, and they are to be relieved by planned new DS-145. DS-145 is scheduled to be in service in 2008.

High loads on DS-29 in Pacific Palisades will be relieved by an already-issued load transfer plan, and later by new DS-104. High loads on DS-77 and other West Valley

stations in that area will be relieved by load transfers already planned, and later by new DS-97.

Load relief plans have also been produced and issued for almost all of the other distribution stations that had recorded loads above rated capacity. Load relief plans were also issued for other distribution stations that exceeded their forecasts. The rest of the distribution stations that exceeded forecast loads have sufficient capacity and no immediate additions are needed.

DS-25 had a faulted cable inside the station. The bank was deenergized with a short duration loss of service to customers.

The recent high peak DS loads appear to support and further justify the need to complete new DS-87 (2006), -145 (2008), –97 (2012), and -104 (2013) as planned or sooner. Further assessment may result in the need to reschedule already planned load relief and capacity increases earlier and entirely new station relief plans may also be initiated.

34.5-kV Circuits – Load on most of the 500, 34.5-kV circuits was near expected peaks. Several circuits exceeded ratings and plans are issued or in progress to add capacity or relieve loads. There were no 34.5-kV circuit failures directly attributed to the recent hot weather. Preliminary review indicates that some later planned 34.5-kV circuit additions may need to be rescheduled earlier.

4.8-kV Circuits – Peak load data on the 1600 feeders has not yet been fully assessed but preliminary review of load reads indicates that the number of highly loaded circuits is considerably higher than in recent years. Over the extreme hot weather period, the number of circuit relays was not excessive, with few or no 4.8-kV circuit relays of normally configured circuits being directly due to overload. Several abnormally configured circuits had outages due to overloads. In the next three months, the Distribution Planning Group (DP) will evaluate all feeder loads and update all forecasts. As required, DP may then increase its development and issue of plans for feeder relief accomplished by load transfers and new feeders.

Overall, there were 61, 4.8-kV feeder and primary outages caused by 16 underground faults, 14 overhead equipment failures, 9 overloads, 8 station problems, 6 tree events, 4 outages caused by car accidents, and 4 others miscellaneous events.

Customer Transformers

Industrial Stations: Industrial Stations (IS) contain transformers that serve customers directly from the 34.5-kV system. Of the 3200 Industrial Stations, there were no transformer failures. It is important to note that all the transformers in the industrial stations were evaluated for loading about 6 weeks before the Heat Storm.

Commercial 4.8-kV Transformers: Six 4.8-kV padmount commercial transformers failed during the Heat Storm.

Residential and Small Commercial Transformers: Failure of overhead pole mounted transformers and underground transformers had the largest customer impact. There were approximately 800 incidents that affected residential transformers. These include blown fuses, tripped breakers, broken jumpers, etc.. Many of these could be put back into service; however, since the load did not go down, they would often trip off again. Of the 800 incidents, 302 of the transformers failed and required immediate replacement.

Summary of Transformer Outages:

LADWP had a significantly lower percentage of customer outages and its transformer failures were in-line with other major electric utilities in the State.

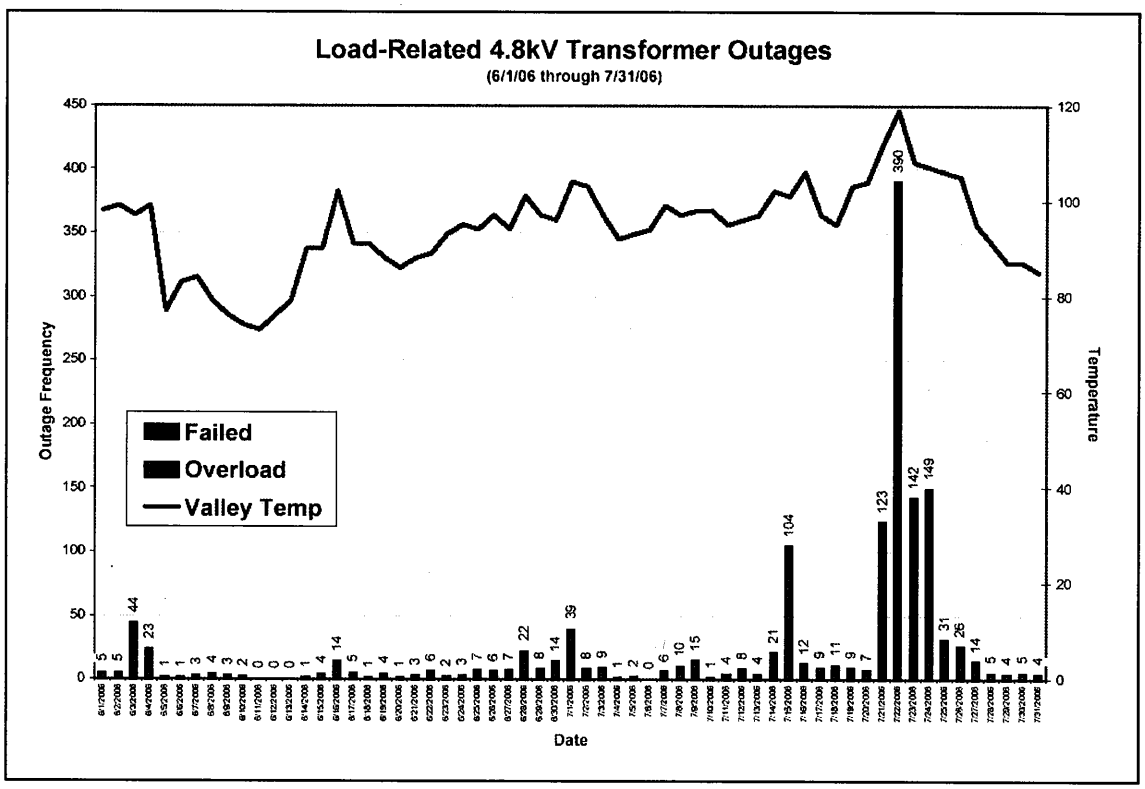
Comparison of Neighboring Utilities

	No of Customers Outages	Total No. of Customers
LADWP	79,303 (5.7%)	1,400,000
SCE	1,100,000 (23%)	4,700,000
PG&E	1,200,000 (24%)	5,000,000

Comparison of Transformer Failures

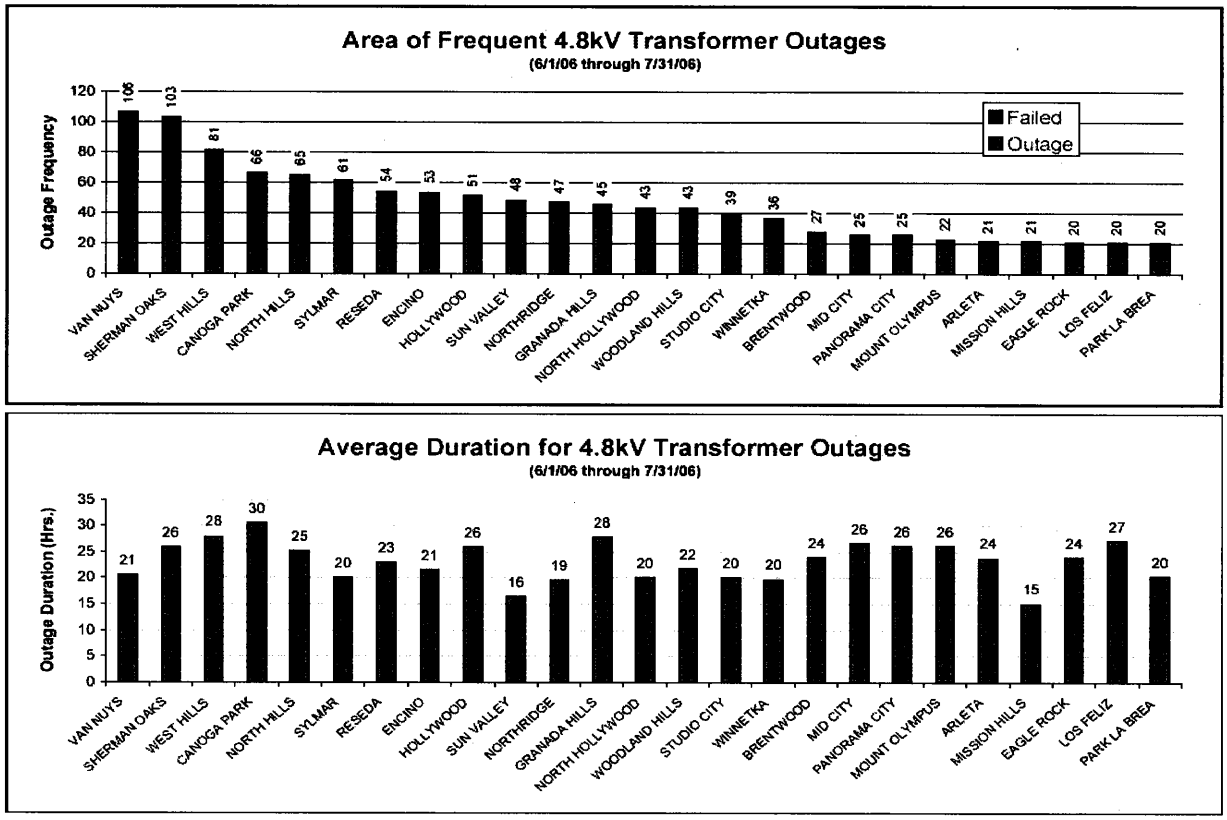
	Total No. of Transformer Failures	Total No. of Transformers
LADWP	303 (0.23%)	126,000
SCE	1375 (0.20%)	700,000
PG&E	1150 (0.12%)	970,000

Graph 1 shows the temperatures building for approximately 20 days. The weekend of July 22nd and 23rd recorded residential usage up 30% over our previous peak (being a weekend) even though the system peak overall was 8% to 9% greater than the prior peak. Transformer failures increased as the temperature increased, failures peaked when the temperature peaked.



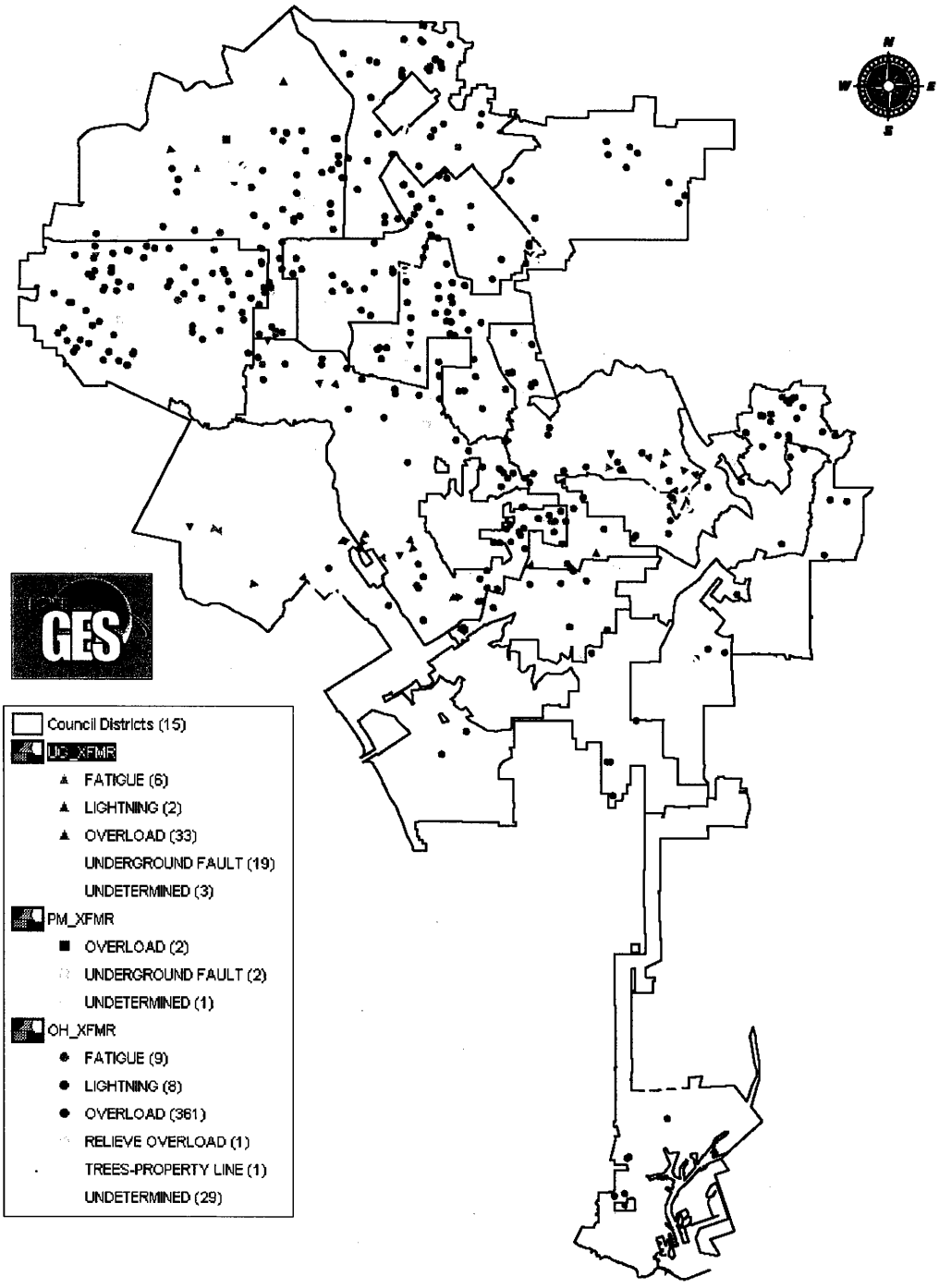
Graph 1: Transformer Outages Per Day 6/1/06 – 7/31/06)

Graph 2 shows that the majority of transformer outages were in the hottest locations of the City. The durations were long because changing transformers is labor intensive (typically 5 hours each).



Graph 2: Summary of Transformer Outage Locations and Average Durations

Failed Transformers
June1,2006 through July 31, 2006



Graph 3: Locations and Causes of Transformer Outages

Causes of Transformer Failure:

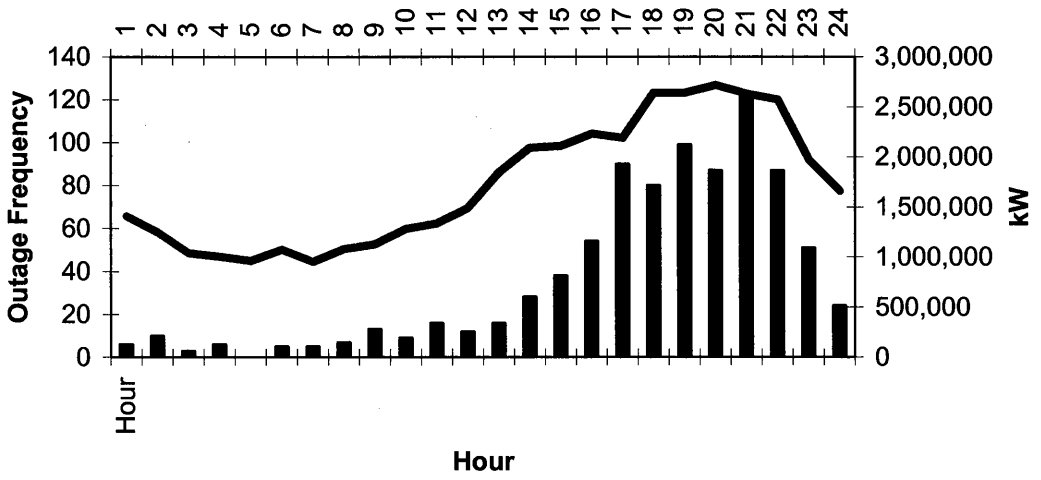
Many factors can shorten the life of a transformer including corrosion, moisture, physical damage, electrical surges, ambient temperature, loading, and age. Heat was the primary cause of the outages due to both the prolonged ambient temperature and transformer loading beyond the ratings. This caused accelerated insulation breakdown and ultimate failure.

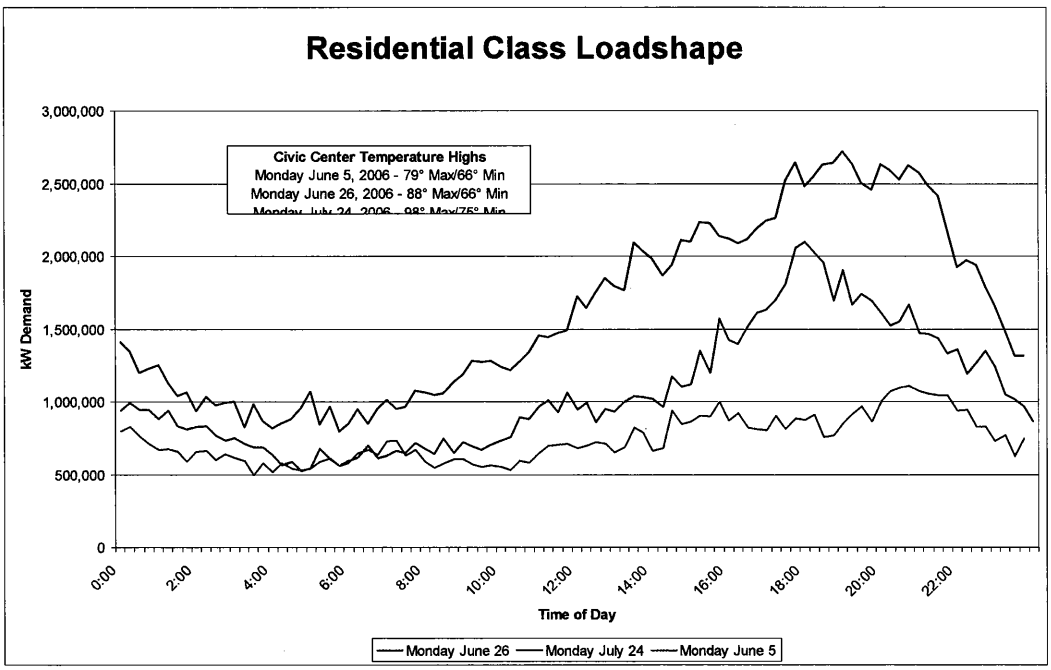
The July 2006 Heat Storm resulted in several all time system peaks on the LADWP distribution system. They include:

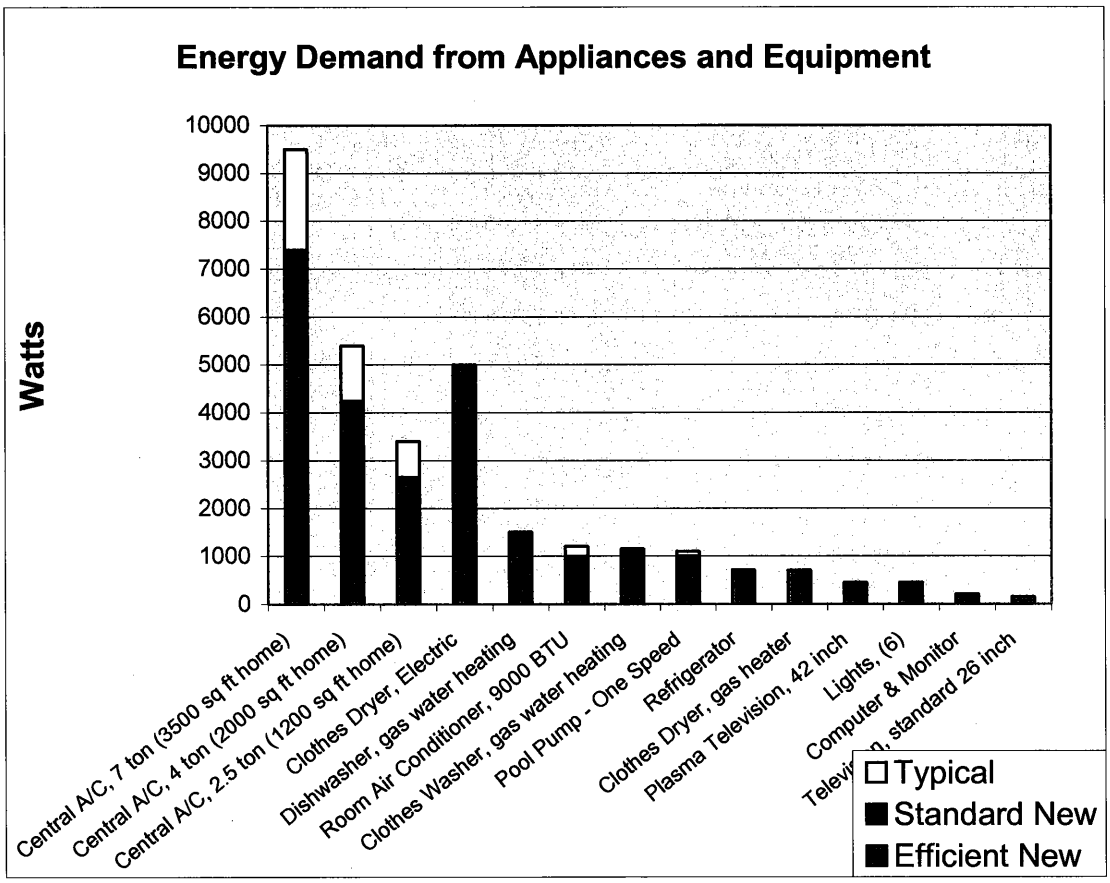
- July 21 5868 MW 4th highest on record
- July 22 5765 MW 5th highest on record and highest Saturday ever
- July 23 5224 Highest Sunday on record
- July 24 6165 All time peak
- July 25 6007 3rd highest on record
- July 26 6064 2nd highest on record
- July 27 5748 6th highest on record

Although these instantaneous system peaks were approximately 8% to 9% above previous peaks, the residential (i.e., non-coincidental) peaks were approximately 30% above previous peaks. This is illustrated by Graph 1, which shows the transformer outages peaking when the temperature peaked. Additionally, the following Graph 4, 5, and 6 demonstrate that the outages reported on July 22nd were proportionate to the increased energy demand loading primarily due to a 30% increase in residential peak loads above previous peaks.

Residential Peak Day Load vs. Outage Frequency

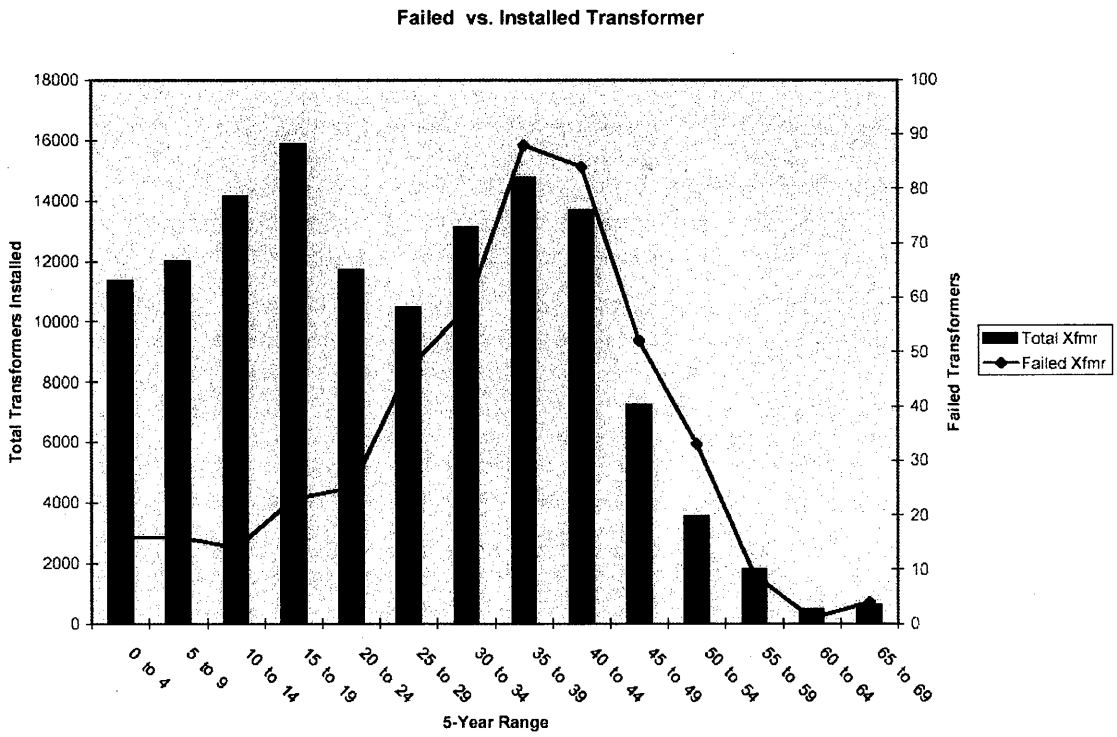






Graph 4, 5, and 6: Correlation of Residential Load vs. Outage Frequency for July 22, 2006, the Residential Class Load Shape, and Energy Demand from Appliances and Equipment.

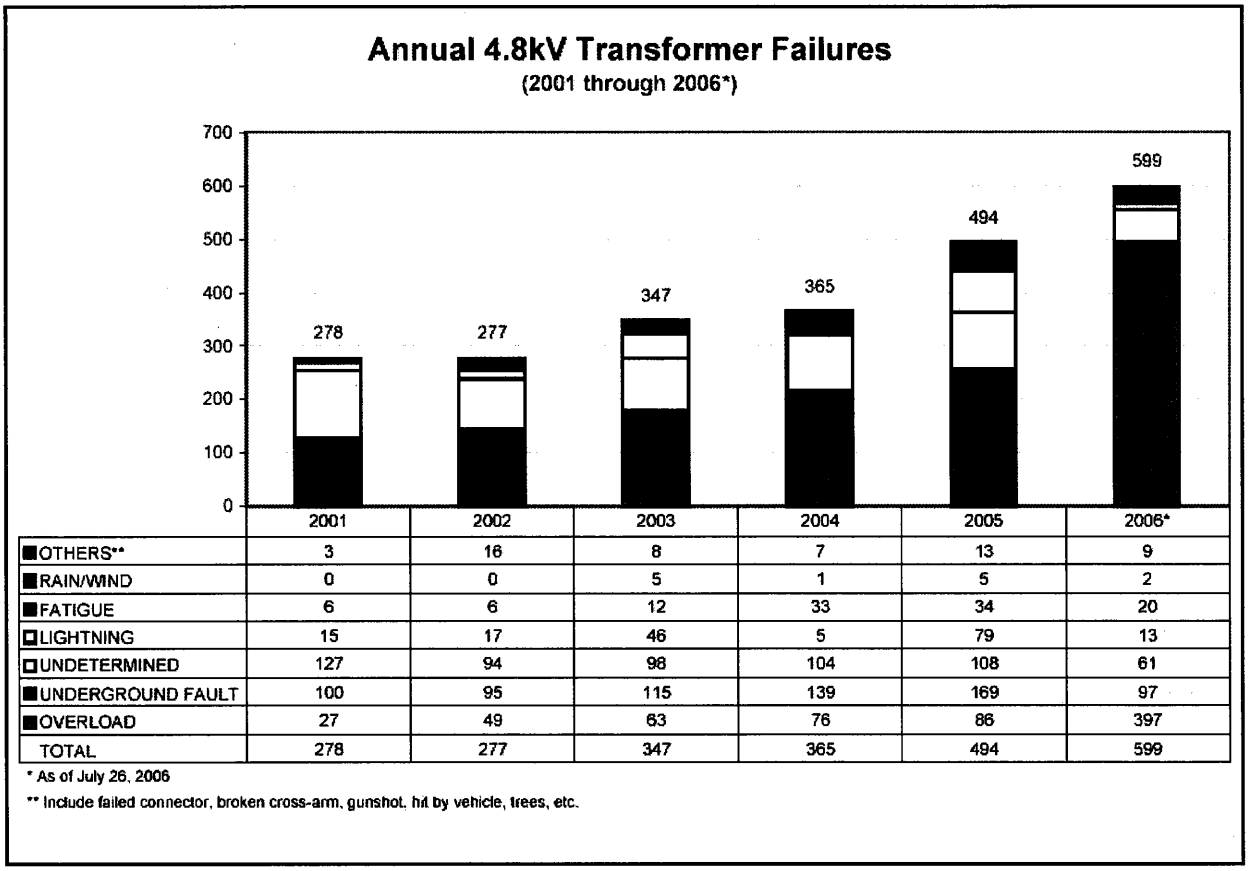
It was shown above that ambient temperature and transformer loadings were the primary factors for failure. Graph 7 below shows that the average age of the failed transformers during the Heat Storm was 38 years old (blue line). The average age of LADWP transformers is 27 (red bars). This would indicate that with overloads and heat being the primary factors for the transformer failures, these transformers were located in neighborhoods that have had load increase over the years through upgrades, home offices, and the addition of air conditioners.



Graph 7: Age Distribution of Heat Storm Failed Transformers

An analysis of the causes of transformer failure was made for the past 5-½ year period. Graph 8 summarizes the results indicating categories of transformer failure. Three factors stand out:

- 2005 had high incidents of underground transformer faults due to the record rainstorms.
- 2006 had an abundance of overloads due to the record temperatures.
- These trends show increased failure over time in most categories. Long-term plans will provide a methodology to mitigate these increased failure rates.



	2001	2002	2003	2004	2005	2006*
OTHERS**	3	16	8	7	13	9
RAIN/WIND	0	0	5	1	5	2
FATIGUE	6	6	12	33	34	20
LIGHTNING	15	17	46	5	79	13
UNDETERMINED	127	94	98	104	108	61
UNDERGROUND FAULT	100	95	115	139	169	97
OVERLOAD	27	49	63	76	86	397
TOTAL	278	277	347	365	494	599

* As of July 26, 2006

** Include failed connector, broken cross-arm, gunshot, hit by vehicle, trees, etc.

Graph 8: 5 ½ Year Summary of Transformer Failures

Response by LADWP Crews

- In total, 85 crews were called up (including Owens Valley). The crews went on 16-hour shifts before going to a staggered 12-hour shift on July 25, 2006

    - Crews from the Construction Districts were called to report to Electric Trouble starting on Friday, July 21, 2006

    - Crew Make-Up included (Most are 3-5 man crews):

        - 40 Primary/34.5-kV crews
        - 10 Electric Service Workers
        - 47 Line/Splicing/Underground crews
        - 17 Senior Electric Distribution Mechanics/Detach crews
        - 3 Owens Valley Line Crews
        - 19 Transmission crews
        - 12 Linemen crews
        - A gas crew

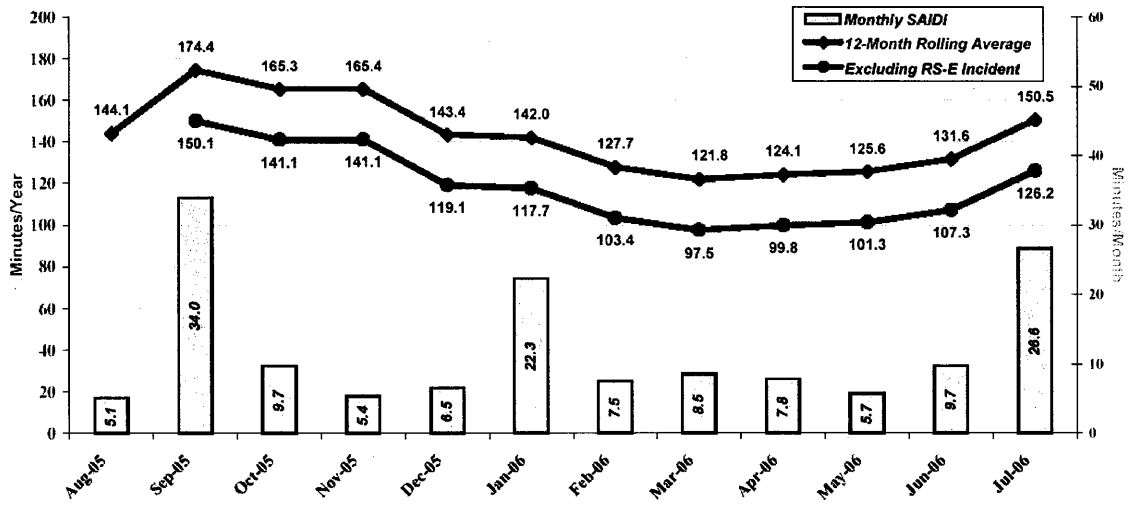
- Service restoration was accomplished within with the following timetable:

6 hours	73.4%
12 hours	83.5%
24 hours	89.5%
48 hours	96.4%
72 hours	99.3%

Effect On Overall Reliability for the Year

The reliability indices have worsened in July due to overload-related outages caused by the Heat Storm. As a result of overwhelming numbers of 4.8kV transformer failures and overloads, customers experienced long outage durations, causing the System Average Interruption Duration Index (SAIDI) to increase by 14.3% (i.e., from 131.6 minutes in June to 150.5 minutes in July). SAIDI is the average duration in minutes that a customer is out over past 12-month period.

Power Distribution Service Reliability Matrix
System Average Interruption Duration Index (SAIDI)
August 2005 – July 2006



SAIDI is the average duration of sustained interruptions per year for each customer served during the 12-month period ending with the indicated month. Sustained interruptions are 5 minutes or more in duration. 8/24/06 jh

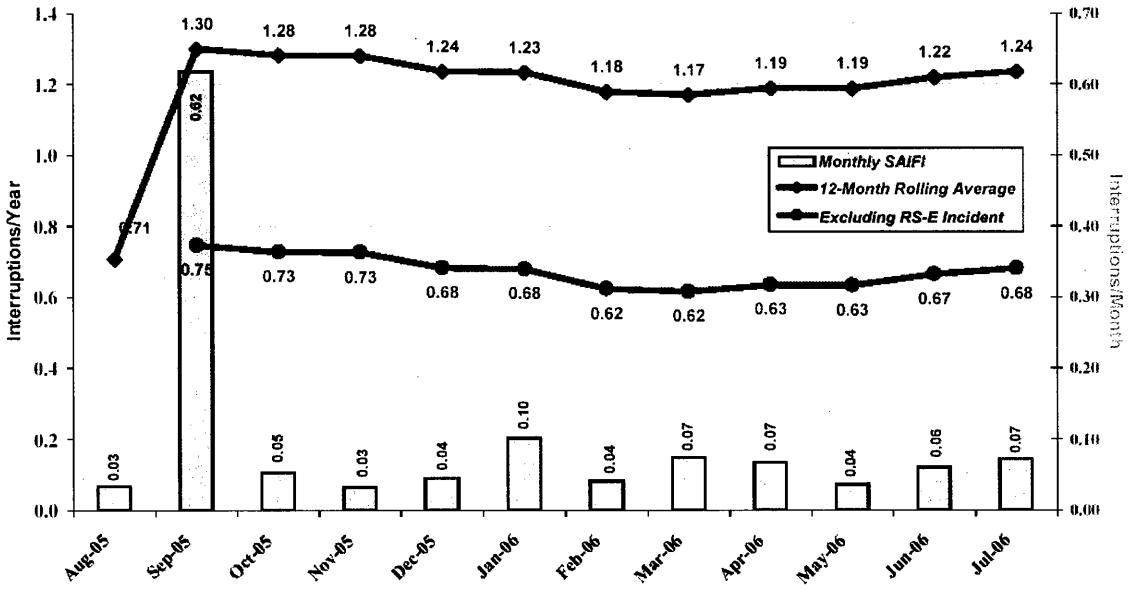
The System Average Interruption Frequency Index (SAIFI) did not vary significantly because each transformer outage affected roughly 10 to 20 customers. A large SAIFI peak occurred last year on September 12, 2005 when a station outage affected most of the City.

The outages during the period from July 21st through July 26th accounted for 43% of the SAIFI and 70% of the SAIDI.

LADWP Indices for July 2006:	SAIFI: 1.24 (0.68*) SAIDI: 150.5 (126.2*)
American Public Power Assoc. Avg.:	SAIFI: 3.25 SAIDI: 64.6

* Actual indices exclude the September 12, 2005 power outage occurrence.

Power Distribution Service Reliability Matrix
System Average Interruption Frequency Index (SAIFI)
August 2005 – July 2006



SAIFI is the average number of sustained interruptions per year for each customer served during the 12-month period ending with the indicated month. Sustained interruptions are 5 minutes or more in duration. 08/24/06 jh

Preparation For The Next Heat Storm - Immediate Actions

LADWP put crews on extended shifts through Labor Day to do the following:

- LADWP completed a transformer evaluation survey. All transformers that had operation issues during the Heat Storm were evaluated. Crews upgraded these transformers as appropriate in preparation of future Heat Storms. These upgrades are now complete. To date this summer, over 1300 existing transformers have been issued equipment service orders for transformer upgrades.

- In an effort to restore power quickly, some temporary transformers and cables were installed to support neighboring circuits. Permanent repairs and circuit restoration to normal are ongoing.

- An order for 1000 additional transformers was placed with LADWP vendors. The vendors offered to accelerate delivery to 30 days instead of the normal 6 months delivery time. Many utilities are currently requesting accelerated deliveries due to the Heat Storm and upcoming hurricane season.

Plan Going Forward for Infrastructure Work - Long Term Plans

Although the failure rates were in line with the rest in the industry, and the overall number of customers affected was significantly lower than our neighboring utilities, there is room to improve. Especially troublesome was the labor-intensive transformer replacements. Long-term strategies to mitigate transformer failure focus first on prevention, and secondly on the resources required to handle future incidents. These measures include:

Prevention:

- The majority of the cables and Distribution Stations that overloaded had pending jobs designed to prevent overloads from occurring. A priority will be placed on completing this work based on the available resources.

- LADWP will be potentially hampered in an emergency due to temporary or abnormal conditions on our system that resulted from previous outages. These temporary or abnormal conditions must be corrected in a timely manner.

- Investigate and implement various methods to monitor loading on small residential transformers. Loads in some neighborhoods have been creeping up due to home additions, added air conditioners, modern electronics, and home offices. Their load profiles are shifting based on these new additions. By using adjusted load profiles and other statistical analysis tools, an estimated load will be determined and assigned to every transformer on the LADWP system. The modeling tool takes into account consumption data of customers, changes in loading on circuits, and other factors such as air conditioner permits, and county

records (square footage). The modeling tool will generate an exception report to identify transformers that may require additional investigation.

- Investigate and implement a Reliability Planning Group in alignment with the February 2006 EPRI recommendations to continually monitor power distribution component performance and develop specific reliability instructions to design and construct new installations.

- Review transformer sizing standard for new loads.

- Prescriptive Transformer Change outs: An End-of-Life study will be performed to determine the remaining useful life of transformers. Although loading was more of an issue than age in this instance, specific recommendations will be forthcoming regarding changing transformers of certain vintage while performing routine system work. This is already in place for cable replacement work.

- Equipment Specifications Review: A review of the LADWP transformer purchase specifications was performed on a preliminary basis with utilities that operate in desert environments. Other utilities generally claim shorter transformer service life than LADWP due to hotter temperatures, which can accelerate the aging of the insulation of the transformers.

- Transformer Inventory: Before the Heat Storm, LADWP had an 8-month supply of the most commonly used transformers in inventory. One transformer size (50 kVA) was depleted briefly; however, there was sufficient inventory of other sizes, so crews always had sufficient stock. Future inventory will be adjusted so that the main store will carry a 6-9 month supply of the most commonly used transformers. We will have over a 12-month supply system wide.

- Equipment Enhancements: Although it would not have helped the 126,000 transformers in service, a review of transformer features is underway to investigate the feasibility of specifying lower temperature transformers that would have more overload capabilities. LADWP is also investigating the feasibility of using overload indicators on overhead transformers. This was done for a short time in the 1960's but discontinued for economic reasons. This change, if feasible, would provide a means to tell if a transformer was overloaded by inspection, identifying units to be more closely monitored, with the result of longer transformer life, and improved overload capability.

- Continue with transformer inspection programs and infrared programs. Test transformers if required as they are identified by the transformer-modeling tool.

- Proposed modifications to field reporting of failed equipment will be considered to provide a less labor-intensive method to evaluate field conditions.

Resources

- Changing transformers is labor intensive (typically 5 crew hours each). Labor was an issue with the number of concurrent problems. The following is under consideration:
    - Create a contract for emergency crews in the event of another emergency.
    - Re-instate the underground cable contract and overhead pole contract. Both have provisions for adding emergency crews should they be required.

- Develop and implement strategies to recruit and train additional linemen to fill labor vacancies in the Construction Lineman series.

EPRI Recommendations

The Electric Power Research Institute (EPRI) provided in February 2006, recommendations regarding distribution infrastructure improvements. A two-day workshop was done September 11 –12, 2006 with Power System Managers to discuss implementation of the EPRI reliability recommendations.

Recommendations include:

- Accelerate Underground Cable Replacement: In addition to the regular 40 miles per year, starting next year, the replacement cycle is scheduled to be 56 miles per year for the next five years.

- Pole and Crossarm Replacement: In addition to the regular 1200 poles per year, starting next year, the replacement cycle is scheduled to be 2000 poles per year.

- Reliability Planning Group: EPRI recommends implementing a group to continually monitor distribution components and develop plans to design and construct new installations to improve reliability.

- Note that the transmission and bulk power system were reviewed last year following a Receiving Station incident. Recommendations were acted on from that study.

Reliability Infrastructure Funding

From Budget Office

Distribution Reliability/Infrastructure Issues

The Distribution Stations and high voltage circuits have for the most part performed well. As a result of this there have been minimal large-scale power disruptions from failures of high voltage equipment. This has been a result of the significant investments that LADWP has made over the last number of years. Major elements include:

- Distribution Reliability Improvements ($410M, 5-year): Based on engineering evaluations as well as both potential and actual failures, LADWP has upgraded and/or replaced power distribution equipment (at the 34.5 and 4.8 kV level) such as: overhead circuits, underground circuits, circuit splices, disconnects, capacitors, transformers ($7 Million on transformers, $4 Million to pole top and underground transformers) and other related electrical equipment to distribute power to our customers. Roughly 2000 transformers of various types were purchased last year.

- Replacement of Underground Cable ($50M, 5-year): This program replaces older deteriorating cable that was determined by an engineering study to be vulnerable. These cables operate at 34.5 kV or 4.8 kV. This budget was increased by $21 Million in Fiscal Year 06-07.

- New and Upgraded Facilities for Customers ($174M, 5-year): This includes new service to customer and/or upgrading services to commercial and residential customers. This includes: overhead/underground customer stations, transformers, conduits, line extensions, poles, disconnects and etc. $174M-5yr.

- Automation and Information Systems ($97M, 5-year): Over the last 5-years LADWP has spent nearly $100 Million on its System Control and Automated Dispatch (SCADA), automated dispatch, and other Automation/Information systems.
    - When fully implemented, the SCADA system will allow LADWP dispatchers to pinpoint outages down to the circuits out of the Distribution Stations. LADWP is evaluating moving the monitoring and control function past the Distribution Station.
    - Additionally, the Automated Dispatch System will more efficiently dispatch crews to outages, allowing for faster resolution of outages.

- Additional Distribution Stations ($60M, 5-year): LADWP has recently added 2 additional Distribution Stations, with a third station currently being designed, to support additional electrical loads within the City.

- Additional Capacity to Existing Distribution Stations ($24M, 5-year): LADWP has upgraded a variety of equipment within existing Distribution Stations to increase their load carrying capacity. These upgrades include: transformer banks, voltage regulators, circuit breakers, disconnects and etc.

- Additional Capacity to Distribution Circuits ($35M, 5-year): This includes upgrading the capacity of the overhead and underground circuits as well as adding new circuits that distribute the power to various customers throughout the City.

- Opportunities for Further Improvement of Distribution Reliability: As a result of the September 12, 2005 power outage, LADWP contracted with EPRI to evaluate the Power System Reliability. As a result of this ongoing study, the following recommendations have been made:

    - **Cable Replacement Program**: As a result of an expired contract for Cable Replacement services LADWP needs to replace the contract to expedite the replacements of temporary circuits and abnormal circuits.

    - **Pole and Crossarm Replacement**: The contract for replacing this equipment has expired and not been renewed. LADWP needs to establish a new contract to replace 4000 Poles that have been identified as needing replacement.

    - **Reliability Planning Group**: EPRI recommends creation of a Reliability Planning Group that will specifically evaluate all of the customer/system data and make recommendations to improve reliability.

- Automation Systems: There are a number of automation systems that can be implemented that could be used to specifically identify the problems that have been encountered during this recent Heat Wave:

    - **Automatic Meter Reading (AMR):** Automatic Meter Readers (AMR) together with an Outage Management System (OMS) can pinpoint outages even at the localized level very quickly. When power is lost to the AMR meter, a signal can be sent to a central OMS that will identify the circuit quickly, leading to a more efficient resolution of the problem.

    - **Additional Metering**:

        - AMR meters equipped with demand measuring capability can be analyzed and compared to the connected transformer capacity.
        - Additional metering could be installed in the field to measure loads at lower voltage locations.

    - **Customer Information System**: A proactive step would also be to obtain the existing energy consumption records for customers, use some assumptions on consumption versus demand, and then compare these calculated customer demands against the transformer demands in our current database.

Plans to Improve Crisis Communications with Customers

From: LADWP Communication and Work Process Improvement Committee

Communicating a Consistent and Accurate Message

It has become readily apparent based on numerous communications with customers during the Heat Storm, that clearly what is most needed and wanted is a consistent and accurate message concerning what has occurred in their area, what is being done to remedy the situation, and specifically in outage situations, and to the extent available, provide a realistic, expected time of restoration.

LADWP has formed a task force to oversee the development and implementation of the communication and work process improvement initiatives identified below.

Actions That Can Be Taken Immediately:

- **Internal and External Communications**

  - Mailed letters to approximately 76,643 LADWP customers affected by the recent power outages explaining the facts surrounding the widespread outages and informing them of steps LADWP is undertaking to improve its response to similar situations in the future.

  - Implemented an Electric Trouble Section Interactive Voice Response (IVR) system; a new component of the Outage Management System (OMS). The IVR system automatically calls customers who have requested call back service during their initial trouble call to the Customer Call Center, and issues outage and restoration confirmation notifications to customers on life support. This IVR system has a limited capacity of making 360, two-minute long telephone calls per hour. LADWP is exploring whether or not to expand the IVR hardware infrastructure to increase calling capacity, or incorporate the current system into a more comprehensive IVR system that includes additional self-service options for customers.

  - Establish an automated e-mail and text messaging system to provide power outage notifications to the Mayor's Office, City Council Offices, LADWP Board of Commissioners, LADWP Senior Managers, Department of Transportation, Fire Department, Police Department, and other emergency response agencies in the event of a level two (Storm) or level three (Disaster) power outage.

  - Expand reporting capability of the Outage Management System to provide intranet access and/or password protected internet access to reports containing the following information:

a. The total number of people affected by an outage sorted by Council District and by type of outage.
b. The total number of people affected by the outage sorted by affected transformers, electric circuits, and areas (switch level or higher).

Data reports will be generated based upon user selection of designated date interval and/or time interval.

- In conjunction with the Public Affairs, Customer Services, and Power Distribution Divisions, prepare "scripts" for public contact employees to ensure that an accurate and consistent message is given to our customers. For example: Imprint messages such as "What to do When the Power is Out" and "Why it is Important to Update Your Telephone Number With LADWP" on the customer utility bills, and communicate LADWP's policy of restoring service in the order that outages are reported.

- **Work Procedure Modification and Resource Management**

  - Evaluate the feasibility of midstream reporting of the cause of an outage and crew dispatch status for each outage job and input into the OMS.

  - Evaluate the feasibility of updating estimated time of arrivals and estimated time of restoration (or provide average restoration time required based on historical data) for each outage job and input into the OMS on a real time basis (i.e., not on a historical reporting basis as jobs are closed).

  - Designate customer service representatives (CSRs) to be stationed at the electric trouble dispatch office throughout level two or level three power outages to act as liaisons, and communicate timely updates to other public contact employees; thereby leaving dispatchers free to perform their duties.

  - Expand current call out lists for CSR staff to include all individuals in this classification, regardless of their current assignment.

- **External Assistance**

  - LADWP staff will explore working with the Neighborhood Councils to obtain their assistance in communicating accurate and timely information to their stakeholders and neighborhoods.

  - LADWP staff will meet with staff of the City's "311" organization to discuss the feasibility of using the 311 system to communicate timely outage and service restoration updates to the public.

Actions That Can Be Taken in the Future:

- **System Integration and Automation:**

  - Enhance and streamline interfaces between the Customer Information System, Outage Management System, and Electric Trouble Management System.

  - Fast track the negotiations, approval and implementation process for the LADWP Emergency Notification System; in addition to emergency notification functionality, this system has the ability to handle overflow calls in a crisis situation when existing resources have been exhausted.

  - Fast track the ongoing Request for Proposal process to upgrade existing telecommunication and management systems within the Customer Contact Center.

  - Fast track the installation of Voice Over Internet Protocol (VOIP) technology in the 24 Customer Service Centers to allow CSR staff in branch offices to assist with incoming customer calls.

  - Continue Geospatial Electric System Modeling of 34.5 kV and Transmission Systems to support Outage Management System (pending contract approval with Intergraph).

  - Complete final implementation of graphics and switching products at Electric Trouble Section (pending contract approval with Intergraph).

  - Enhance interfaces between Outage Management System to System Controls and Automated Dispatch Systems.

  - Allow customers registered with LADWP internet website access to address specific outage information via the Internet (there are currently 300,000 LADWP customers registered with the LADWP internet website)

  - Examine options to enhance the outage management system for the Water System.

  - Work with the City Attorney to create "safe harbor" statements relative to the dissemination of outage information

- **Disaster Recovery**

  - Establish a remote backup customer call center.

  - Ensure adequate emergency backup power supply to the LADWP enterprise information systems and call centers.

Conservation Messages and Media Calls During Outages (July 21-28)

From: LADWP Public Affairs Division

Media Inquiries

Public Affairs Division staff responded to nearly 500 inquiries from local and national print and electronic media during the period of July 21-28. Staff was available around-the-clock to provide media with outage updates, to research questions, provide conservation messaging, give interviews and coordinate interviews with LADWP management.

Press Releases

In addition, staff remained in continuous contact with the Mayor's office to ensure consistent messaging and organized three press conferences (July 23, 24, and 25) with the Mayor's office and another on July 26th at which LADWP General Manager Ron Deaton provided the public with an outage status report, and encouraged Angelinos and City Departments to increase its conservation efforts (i.e. turn off unnecessary appliances, and shift discretionary electric use to off peak times).

The City Council also adopted a motion on July 25the instructing all City Departments "to immediately initiate power consumption reduction measures to alleviate the record setting electrical demand currently being experienced in Los Angeles."

News releases were issued regularly from July 21st to July 28th in an effort to provide the public with updates and to encourage continued conservation.

- *"LADWP Experiences New Peak Energy Demand But Urges Conservation During Heat Wave"*- 7/21
- *"LADWP Experiences Historic Demand on its Electrical System Causing Sporadic Outages—Mayor and City Urge All Residents To Conserve During Heat Storm"*- 7/23
- *"LADWP Urges Energy Conservation As Unprecedented Heat Wave Continues"*- 7/24
- *"City Continues To Experience Historic Demand On Electric System Causing Sporadic Outages"*- 7/26
- *"LADWP Crews Tackle System Repairs"*- 7/28

Additionally, energy conservation messages were highlighted in the LADWP customer newsletter, *LADWP Connections*, summer issue, which began insertion in all customer bills beginning on July 27th and was posted on the LADWP Web site. The feature article for this issue of LADWP Connections emphasizes the importance of reducing energy (and water) use.

Requests for Commercial Customer Reductions

On Monday, July 24, 2006, the Commercial Services Group contacted the largest LADWP commercial and industrial customers to request that they conserve energy to help mitigate the increasing electrical demands being placed on the LADWP distribution system. Contact was made by phone and through e-mail correspondence to the energy managers at these companies. Most customers were very receptive and supportive in general to LADWP request. Many companies were already instituting corporate-wide energy reduction strategies to help with the energy crisis facing the State.

Conservation Messaging Employed in Anticipation of and During Increased Temperatures

The Los Angeles Department of Water and Power Public Affairs Division actively promotes energy efficiency on a year-round basis, with emphasis placed on conservation and its benefits during the summer months.

Literature promoting the environmental benefits and cost savings associated with energy conservation is available on the LADWP Web site (www.ladwp.com) and is regularly distributed at community events via the LADWP community relations exhibit program. In addition, news releases and media advisories encouraging conservation and offering "tips" for energy savings are issued regularly during the spring and summer.

Press Release and Media Communication
News releases encouraging customers to conserve energy in anticipation of the hotter summer months were issued beginning in March (*"The LADWP Offers Tips on Saving Water and Energy During Daylight Saving Time"* – March 29, 2006) and then increased in frequency in the month of June (*"The LADWP Offers Tips on Saving Water and Energy As We Head into the Summer Season"* – June 2, 2006; *"The LADWP Offers Tips on Saving Water and Energy and Asks Customers to Conserve As the Summer Season Heats Up"* – June 22, 2006; *"LADWP Assures Customers of Sufficient Energy But Urges Conservation During Heat Wave"* – June 28, 2006).

As the heat wave progressed into July, further news releases stressing conservation were issued and posted on the LADWP Web site (*"LADWP Encourages Energy Conservation As Temperatures Remain High"* – July 7, 2006; *"LADWP Offers Tips on Saving Water and Encourages Conservation During the Hot Weekend"*- July 14, 2006).

Water Conservation & Energy Efficiency Newspaper Insert/Community Flyer
A two-sided, 8 ½" x 11", two-color flyer was prepared and inserted in the *LA Daily News* on September 9, 2006, the Spanish language publication *Impacto,* on September 10, 2006 and topped the *LA Times* on September 15, 2006. The flyer features useful water conservation and energy efficiency information (energy one side, water on the other) for LADWP customers. The flyer is posted on the LADWP Web site, has been emailed to the Neighborhood Councils, is available in English and in Spanish at all LADWP Customer Service Centers, and is being distributed at all community events at which LADWP has a booth/exhibit and has been delivered City Council field offices. It also

will be distributed by the four community based organizations providing ultra low-flush toilet replacement services to the residents of Los Angeles. Enlarged versions of the flyer have been converted into posters for LADWP facility and community placement.

Community Events
Energy Conservation materials are distributed at each community exhibit, Speakers Bureau presentation, Informational Field Trip and facility tour. Since January, our conservation messaging has reached nearly 62,000 residents through these programs.

Compact Fluorescent Bulb Distribution
Since the beginning of the calendar year, more than 85,000 Compact Fluorescent Lights have been distributed to City residents through community groups, events and to low-income customers and seniors. This represents an energy saving of approximately 6.5 million kilowatt-hours.

LADWP Web Site
The LADWP Web site contains an on-going message on energy and water conservation. The messaging includes energy saving tips and efficiency programs.

Telephone Messages
A trees and a conservation message ran on the LADWP Customer Service telephone line encouraging conservation.

Green LA Telephone Line
The 1-800-GreenLA telephone line offers specific information on energy savings programs offered by the LADWP.

Fan Distribution
The LADWP supported the purchase of 750 fans for the Department of Aging (DOA), for the DOA to distribute through its outlets.

Future Activities
Public Affairs Division staff proposes a multi-pronged strategic communication campaign to encourage energy conservation and awareness. Staff is working to develop a theme for the messaging, such as "Save Power, Save Money," that would be tied into our media activities, outreach materials and publications.

Review of July 24, 2006 Peak Event

The system reached an all-time peak of 6102 MW on July 24, 2006 during the hour ending 17:00. Due to regulatory reporting requirements, the Load Forecasting section forecasts Net Energy For Load (NEL) which is the hourly average integrated load as opposed to the Net Power For Load (NPL) which is the highest instantaneous peak load.

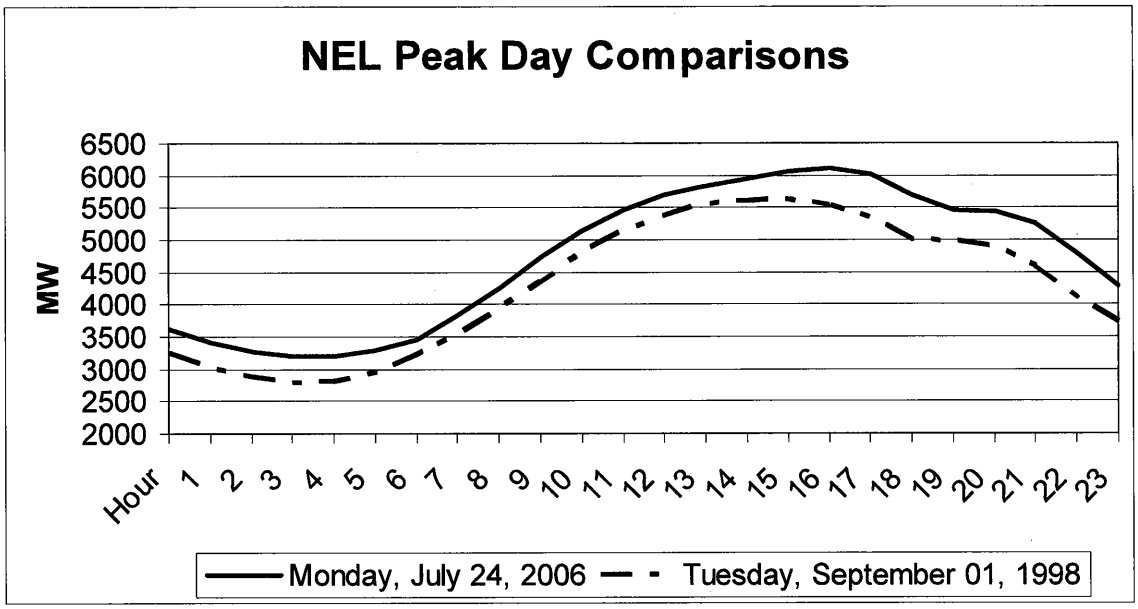
The 6102 MW peak exceeded all forecasting expectations. Based on the October 2005 peak demand forecasting model, the System had only a 0.6 percent probability of reaching 6102 MW in 2006.

Following industry practice, five alternative forecast scenarios are published each year. The five scenarios are used by different groups in the power planning process. The following is a table of the scenarios for the calendar year 2006 from the October 2005 Forecast with the variances computed against the actual.

MW	Actual	Forecast	Difference	Percent
Base Case	6102	5539	563	10.1
1-in-5 Years	6102	5813	289	5.0
1-in-10 Years	6102	5889	213	3.6
1-in-40 Years Hot	6102	5955	147	2.4
1-in-40 Years Cool	6102	4621	1481	32.0

The 6102 MW peak was the result of both the duration and the intensity of the Heat Storm. The July 2006 Heat Storm ranked longest in duration and second highest in intensity of all heat storms that have occurred since 1966.

The pattern of the peak day load was also unusual and had not been previously observed. Typically the System peaks at the hour ending 1600 rather than 1700. From the hour ending 1500 to 1700, demand rose from 5949 MW to 6102 MW or 153 MW where typically demand will rise only 25 to 50 MW after 1500 hours. The following chart plots the load curve of July 24, 2006 against the previous hottest peak day, September 1, 1998.



Review of Peak Demand Methodology

Summary

LADWP forecasting methodologies meet industry standards and are in-line with best practices. However, there are strengths and weaknesses to different forecasting methodologies.

Methodologies

Econometric models and end use models are the two primary methodologies used in Load Forecasting. LADWP uses econometric models in its forecasts.

Econometric models use economic and demographic data to drive growth in electricity consumption. Econometric modeling is a top down approach. Relative to end use models, econometric models require fewer equations and less staff to maintain. A 2005 EPRI Benchmark study showed that 100% of the utilities surveyed used econometric models. Most electric utilities as well as LADWP converted to econometric models during the industry downsizing in the late 1990s.

End use models are giant counting machines. They break electric consumption into separate end uses. The electricity consumption for each end use is separately forecast. The model is a summation of hundreds of econometric equations. They require high staffing levels to maintain all the separate end use equations. The strength of end use modeling over econometric modeling is that it is better able to capture technological change. However, despite their complexity the end use models do not necessarily lead to better forecasts. End use models are still being run by government agencies such as the Energy Information Agency and the California Energy Commission.

Audits and Best Practices

The Load Forecasting process has been audited twice in the past five years by both PricewaterhouseCoopers and Barrington Wellesley. Much of the recent change in the Load Forecasting section has been at the directive of these audits. The Load Forecast Section also recently participated in an EPRI Best Practices survey that was published in March 2006. These reports can be made available upon request.

Changes and Improvements

LADWP recently participated in a July 2006 Heat Storm Workshop at the California Energy Commission (CEC). The general conclusion was that the Load Forecasting function at the CEC or the state utilities was not broken. Clearly recent events mean that we must take new information into account and try to make adjustments to the forecasting models. Two areas for exploration are putting more emphasis on the duration of heat storms and better integration of load research into the forecasts.

However, there are no simple answers. The modeling techniques experimented with since the Heat Storm has not significantly improved the accuracy of the forecasts. Given the data available in October 2005, is there a model that would have forecast this year's system response to the Heat Storm? Given that the peak rose out of a previously unobserved pattern, based upon our experience, there was no forecasting methodology available that would have been able to forecast a peak of 6102 MW for 2006 with a probability of greater than 2.5%. The 2.5% probability is associated with the 1-in-40 year peak event that is the highest forecast that LADWP publishes in accordance with electricity utility standards.

Coordination with City's Emergency Operations Center

From LADWP's Office of Emergency Management

The City's Emergency Preparedness Department (EPD) assumes the lead on behalf of the City of Los Angeles in addressing the City's emergency response capability to events like the recent Heat Wave.

LADWP has met with EPD to discuss existing and potential staging locations (including cooling centers, parks, libraries, senior centers, etc.), addressing back-up water/power supplies for these staging areas, communications capability (telephone, Internet access), activation procedures, notification process, etc. LADWP has also contacted the City Department of Recreation of Parks (DRP), which is responsible for identifying staging locations, and is working with DRP to address needs for back-up water/power, etc. LADWP has also contacted the City Department of Aging regarding voluntary, community-based cooling centers to identify how LADWP can assist to ensure adequate back-up power during a future event.

Discussions include both Citywide and isolated events where a City-level activation is not required. Status reports will be developed on:

- Preparing facilities (e.g. backup facilities)
- Recommendations regarding staging centers during emergencies
- Cooling centers / stations for customers

Regarding work on coordinating emergency operations communications, telephone notifications procedures are in place for communications between the LADWP and LAFD, LAPD, LADOT, and the City's Emergency Operations Organization (EOO).

During the recent Heat Wave, the City's Emergency Operations Center (EOC) was activated and per existing procedures, LADWP was contacted via the 311 operators.

The EOC was activated by the LAFD, who also requested that the LADWP serve as co-lead in the EOC during the approximate 2-1/2 day EOC activation. This request was relayed by the EPD to the LADWP's Disaster Planning Coordinator, per existing protocol. A Power System management representative was contacted and reported as directed by LAFD; the Power EOC representative was also contacted and subsequently reported to the EOC. Overall, the EOC procedures were effective and the EOO departments worked well together during the EOC activation.

Internal After-Action meetings were held between staff from the LADWP Office of Emergency Management (OEM), Information Technology Services (ITS), and other Water and Power representatives on August 2, 2006 and August 7, 2006 to discuss "lessons learned" and changes to improve coordination and communications between the LADWP representatives at the EOC and LADWP operating organizations.

LADWP management representatives from OEM, ITS, and other Power and Water System staff who attended that After-Action meetings identified the issues of concern and associated action items outlined below, and will be providing status reports regarding implementation and/or completion of each action item:

- Provide additional training to LADWP management representatives of the EOC who might be requested to co-lead the activation

- Update "desk" information at the Utilities Division Station in the EOC

- Provide a link between the LADWP network and the City ITA network to allow the EOC Power representative access to the LADWP intranet web, ETS, and ECC sites (completed).

- Determine if the Water System requires similar access to the intranet site for access to its intranet Water Trouble Board and LAWSDAC web sites *(subsequently determined that access was not required)*

- Develop procedures to ensure links to the intranet sites are available including requiring regular, scheduled testing/polling procedures by LADWP ITS and notification to ITS of of any infrastructure changes

- Develop internal procedures to respond to requests from LAFD, LAPD, etc. for specific customer information (e.g. during the recent activation, LAFD requested the LADWP to provide a list of names/addresses/telephone numbers of customers in areas subjected to extended outages).

In addition, per the City's Emergency Operations Master Plan and Procedures Manual (Master Plan), LADWP submitted an After-Action report to EPD - this is a requirement per the Master Plan following any activation of the City EOC. LADWP included in its report that it is reviewing internal processes for information sharing with EOC responders. Areas of focus cited in the report included secure access to databases, links to informational sites, approval protocols, and release of information to outside agencies.

In conclusion, as summarized in this report, there are many efforts being taken by LADWP to ensure that any future crisis or emergency events will be managed effectively and responsively.