Power Reliability Program Summary

Los Angeles Dept. of Water and Power

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Power Reliability Program Summary

Executive Summary:

The Power Reliability Program is an initiative by the Department to address concerns related to the upward trend in outages. It is a combination of mitigation to specific circuit and station outages, proactive capital and maintenance programs, and replacement of infrastructure in alignment with the life cycle of the equipment. The following is a graphical summary of the major initiatives of the PRP.

KEY PERFORMANCE METRICS
POWER RELIABILITY PROGRAM (PRP)
TARGET SUMMARY

Power Reliability Program Performance Metric Target Summary			
	Performance Metric	- -	**FISCAL YEAR TO REACH TARGET**
1	PROJECTED NEW HIRES FROM TRAINING PROGRAM		
	ELECTRIC DISTRIBUTION MECHANIC	98	FY 11/12
	ELECTRIC MECHANIC	50	FY 13/14
	STEAM PLANT ASSISTANT	31	FY 11/12
	ELECTRIC STATION OPERATORS	48	FY 11/12
		227	
2	POLE REPLACEMENT TARGET (per Year)	5,000	
	REPLACEMENT CYCLE (IN YEARS)	60	FY 11/12
3	DISTRIBUTION TRANSFORMER REPLACEMENT (NO. PER YEAR)	2,400	
	IMPLEMENT TRANSFORMER MANAGEMENT PROGRAM	-	FY 08/09
4	CABLE REPLACEMENT (IN MILES)	60	
	REPLACEMENT CYCLE (IN YEARS)	75	FY 10/11
5	TEMPORARY CIRCUITS (NO. OF CIRCUITS PER MONTH)	60	
	RESTORATION CYCLE (IN DAYS)	90	FY 14/15
6	UNDERGROUNDING PROGRAM (CIRCUIT MILES PER YEAR)	8	
	IMPLEMENT UNDERGROUNDING PROGRAM	-	FY 013/14

Overview:

Reliable service delivery has always been a key success factor and core mission objective of the Los Angeles Department of Water and Power (LADWP). Historically, LADWP's Power System reliability has benchmarked in the top quartile of the electric utility industry. In the past few years, an increasing outage rate, including several high profile outages have resulted in service reliability concerns. This trend appears to be the result of an aging infrastructure and a significant amount of deferred maintenance and deferred reliability enhancing capital work. Several years of limited funding and reduced staffing levels are underlying contributors to the deferred infrastructure replacement cycle, maintenance, and capital improvements. Opportunities to improve reliability include all functional areas of the Power System, but particularly in distribution and transmission. Many of these enhancements will require additional capital and staffing investments.

Power System staff and independent industry expert consultants have reviewed several operational and reliability problem areas, and have developed recommendations encapsulated in an initiative called the Power Reliability Program (PRP). The PRP is recognition that an infrastructure based industry, such as an electric utility, requires substantial re-investments in the infrastructure to have a viable and reliable system. The PRP is a recognition that these investments need to be stepped up on a permanent ongoing basis to support reliability on a long term basis. This document presents the reliability issues that will be addressed in that plan and the components of the plan.

System Description:

The Department's distribution system is comprised of the following major assets:

Substations:

- 20 Receiving Stations (RS): Typical 600 MVA Transformation to 34.5 kV
- 123 Distributing Stations (DS) & 26 Pole-Top DS: 34.5- to 4.8-kV Transformation
- 3,500 Industrial Stations (34.5-kV Customer Stations)

Distribution Lines

- 530 - 34.5-kV Circuits
- 1,630 - 4.8-kV Circuits
- 126,000 Transformers

Three –Year Reliability Performance:

The following two graphs show the types of outages from 2004 to 2006. The four basic types of outages are 4.8-kV Circuit Outages, Station Trouble, 34.5-kV Circuit and Outages, Localized Outages (Service and Transformers).

The two reliability indices referenced are SAIFI and SAIDI. These are standard reliability measurements used by the utility industry. SAIFI is the average frequency of outages a customer would expect to see in a year. SAIDI is the average duration of outages a customer would expect to see in a year in minutes.

Fig 1. SAIFI 3- Year

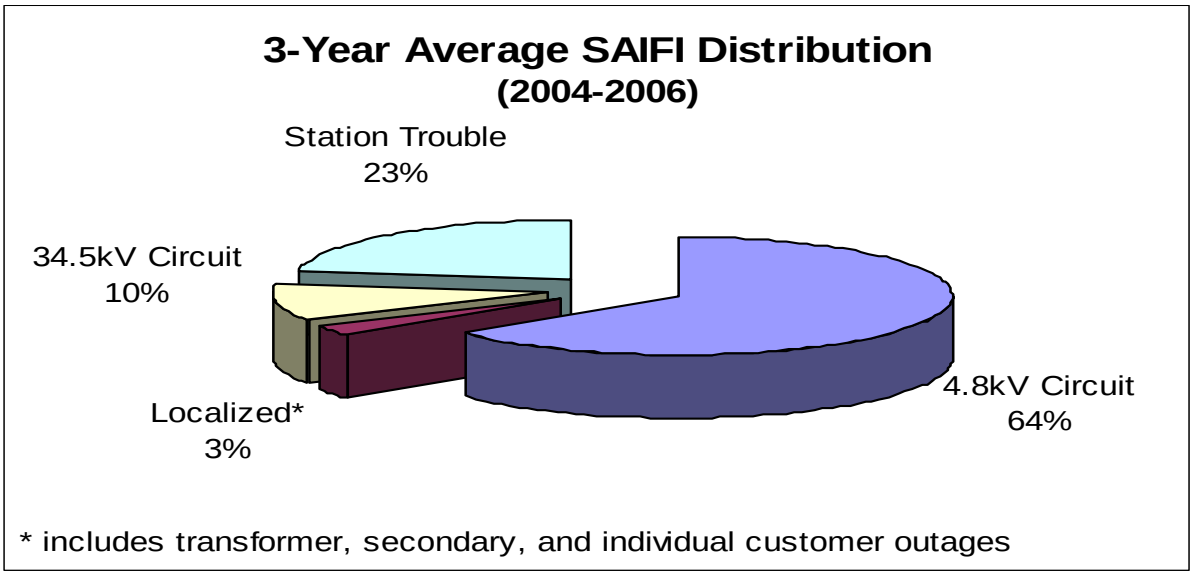
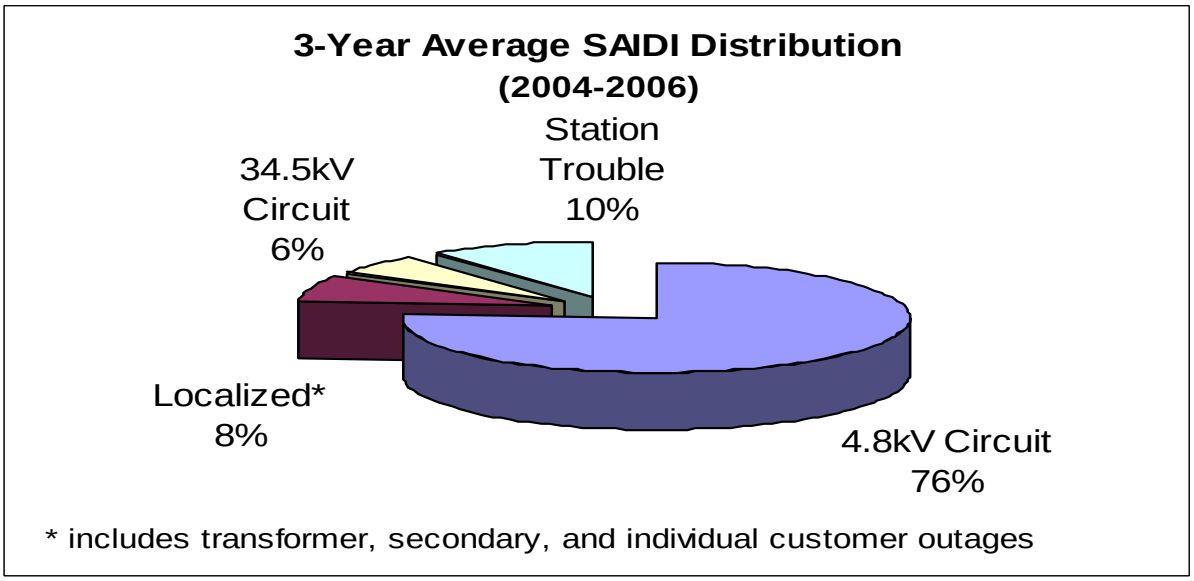


Fig 2. SAIDI 3 – Year



Overall Reliability Assessment:

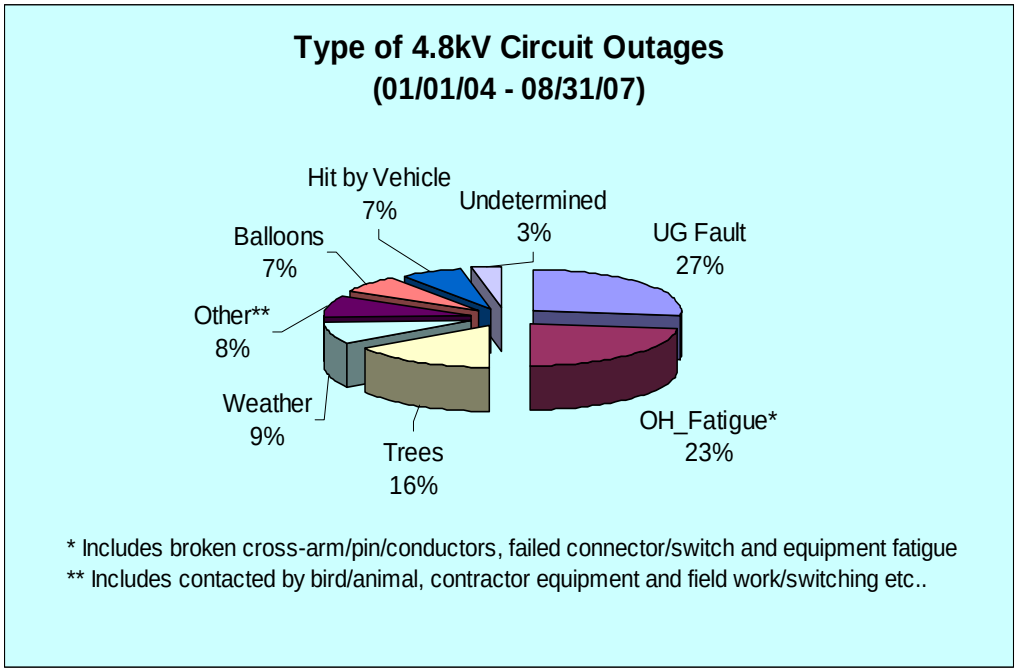
From the graphs above, the following assessment is made:

- 4.8kV circuit interruptions account for 64% of SAIFI and 76% of SAIDI.
- Receiving and Distributing Station outages caused by substation transformer and equipment failures, switching operations, and protection mis-operations account for 23% of SAIFI and 10% of SAIDI.
- 4.8kV transformer outages account for 3% of SAIFI and 8% of SAIDI.
- 34.5kV circuits account for 10% of SAIFI and 6% of SAIDI.
- Focus on 4.8kV circuit and substation reliability for optimum system improvement.

4.8-kV Circuit Outages:

Figure 3 shows the types of outages related to 4.8-kV Circuit Outages. From the diagram, it is observed that UG Fault, OH Fatigue, and Trees account for 66% of 4.8-kV Circuit Outages.

Fig. 3: Types of 4.8-kV Circuit Outages



PRP Program Description Major Components:

Major Components of the PRP may be summarized in three categories:

- Mitigation of problem circuits and stations based on the types of outages specific to the facility.
- Proactive maintenance and capital improvements that take into account system load growth and the inspections and routine maintenance that must take place to identify problems before they occur.
- Replacement cycles for facilities that are in alignment with the equipment's life cycle.

Mitigation Work:

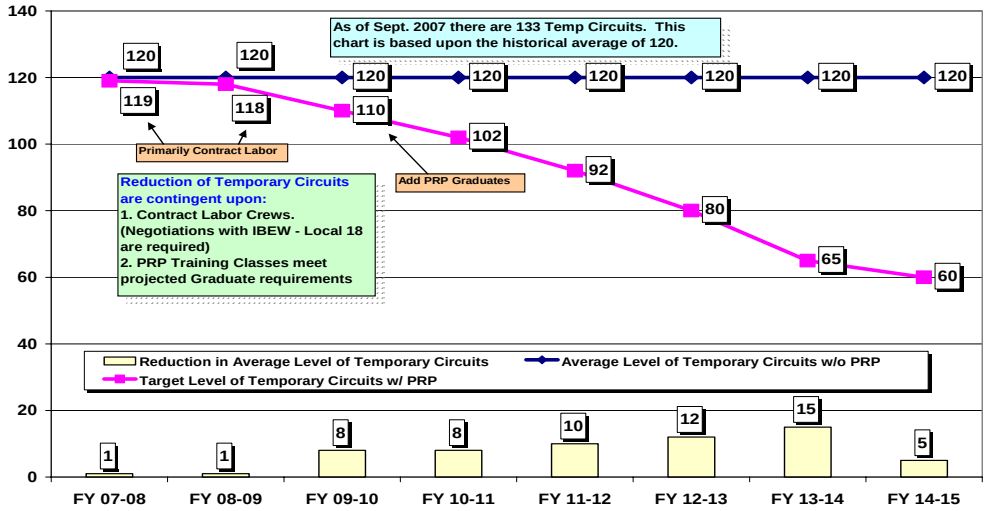
Addressing problems specific to problem circuits and stations is key to providing tangible improvements in reliability. Specific initiatives for circuit mitigation include:

Temporary Circuits:

When a circuit failure occurs, adjacent circuits often can provide support to the neighboring circuit to effect quick repairs. This condition would cause what is termed a "temporary circuit". A temporary circuit is a circuit that is not in it's normal configuration. If a permanent repair is not made in a timely fashion, this can lead to overloads, additional failures, and wider outages.

DWP has a backlog of temporary circuits. The following graph is the programs plan to reduce the temporary circuit backlog.

Temporary Circuits Reduction Target
From 120 Circuits to 60 Circuits



Worst Performing Circuits and Stations:

Addressing the specific issues found on the worst performing distribution circuits can make a dramatic improvement to overall system reliability performance. The PRP will ramp up over three years correcting the outage causes of the 20 worst performing circuits every year.

A recent study found that if the issues of the top 20 "worst performing circuits" were corrected, this would result in reducing the system outage frequency index (SAIFI) by 8.5% and system outage duration index (SAIDI) by 10.4% over a 5 year period. This is conservatively assuming that the corrections resulted in reducing the previous outages on those circuits to only half of what they were previously.

The same issues that affect circuits also affect major substations such as the large bulk power Receiving Stations and the neighborhood Distributing Stations. The PRP provides resources to address the worst performing stations, or address stations that do not have capacity to deliver power should a major component fail.

Proactive Maintenance and Capital Improvement:

Circuit Load Growth:

Properly addressing system load growth is fundamental to providing a reliable infrastructure. Properly sized circuits not only deliver peak loads in summer, but also have sufficient capacity for support for adjacent circuits as well as not overloading which degrades the circuits over time. DWP has a backlog of circuit load growth jobs. The PRP provides added resources to address the backlog over time and provide the reinforcement necessary in a timely fashion.

Substation Maintenance:

Substation maintenance has been 90% reactive due to resources. Proactive maintenance is preferable because it catches problems before the become failures. This includes things such as various types of physical and electrical testing, breaker cycling, cleaning and lubrication, etc. The PRP goal is to move from a 10% to 60% proactive maintenance mode over a 6 year period. This is accomplished by the addition of 50 electrical mechanics.

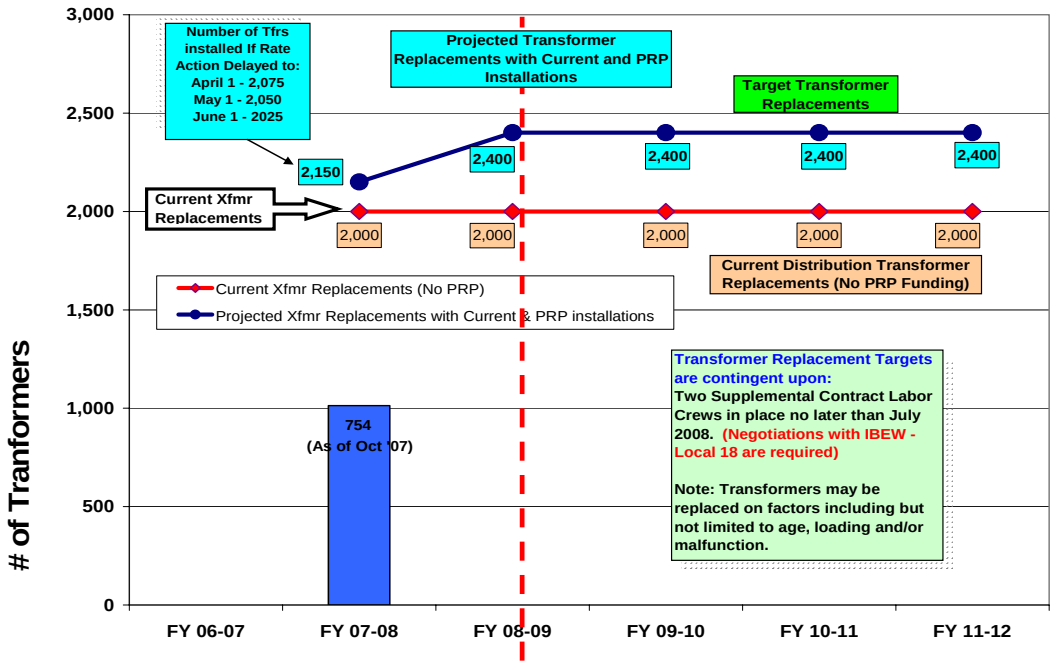
Distribution Transformers:

As witnessed in the last two summer major heat waves, there is a recognition that residential loading has increased with residential remodeling, addition of air conditioning and modern electronics. The distribution transformers have not kept pace with the changes over time. The PRP identifies on a priority basis, transformers that are overloaded require upgrading and replacement.

Tree Trimming:

The Department has, for a number of years, had a very aggressive tree trimming program to prevent outages. Tree trimming is a vital component to preventing circuit outages. Additional resources were not added to the program because of the excellent results the Department has seen from the program as well as having reached the point of diminishing returns with regards to preventing outages.

Distribution Transformer Replacements
From 2000 To 2400 Yearly



Equipment Replacement Cycles:

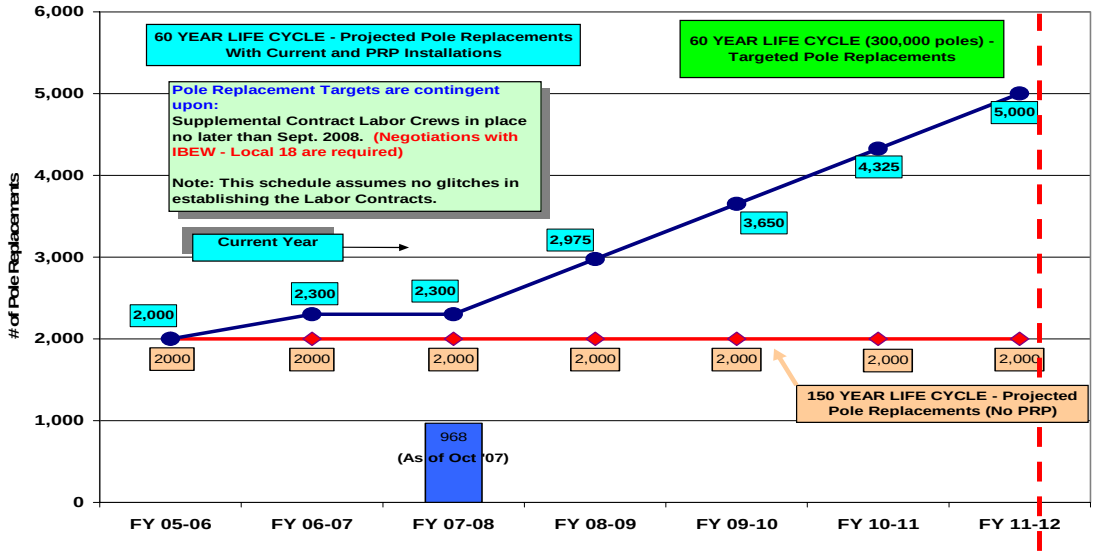
The PRP has provisions for distribution circuit replacements related to overhead and underground infrastructure. Additionally substations will require replacements for their transformers, breakers, and related equipment.

Overhead Circuit Replacement (Poles and Hardware)

"Pole Replacement" is more than the name denotes. Currently 48% of our pole inventory is 50 years or older. Besides merely replacing the pole, we are replacing the associated structures (cross arms, racks, and brackets) that support the wires and equipment. In doing so, a pole is usually replaced with a taller pole that can accommodate technical advances in support. For example, a wooden cross arm is good for about 20 years, whereas a fiberglass cross arm, almost exclusively used now is good for 75-80 years. In replacing the pole, more space is gained which relates to better construction and more spacing horizontally or vertically for the higher voltage conductors. This will eventually result in less outage on the overhead system.

Each time a pole is replaced, the line conductors are re-sagged to appropriate tensions. If numerous poles are replaced in-line, re-conductor in of the line should be considered with larger wire (minimum 3/0 Aluminum Core-Steel Reinforced) being used to further reduce outages. Pole replacement is also done in conjunction with scheduled equipment replacement (i.e. Distribution transformers or New Business) therefore saving time and money. Since 4.8-kV circuits account for nearly 64% of system outages, and overhead outages are over 65% of that, taking proactive step as to reduce 1/3 of our system outages is money well spent.

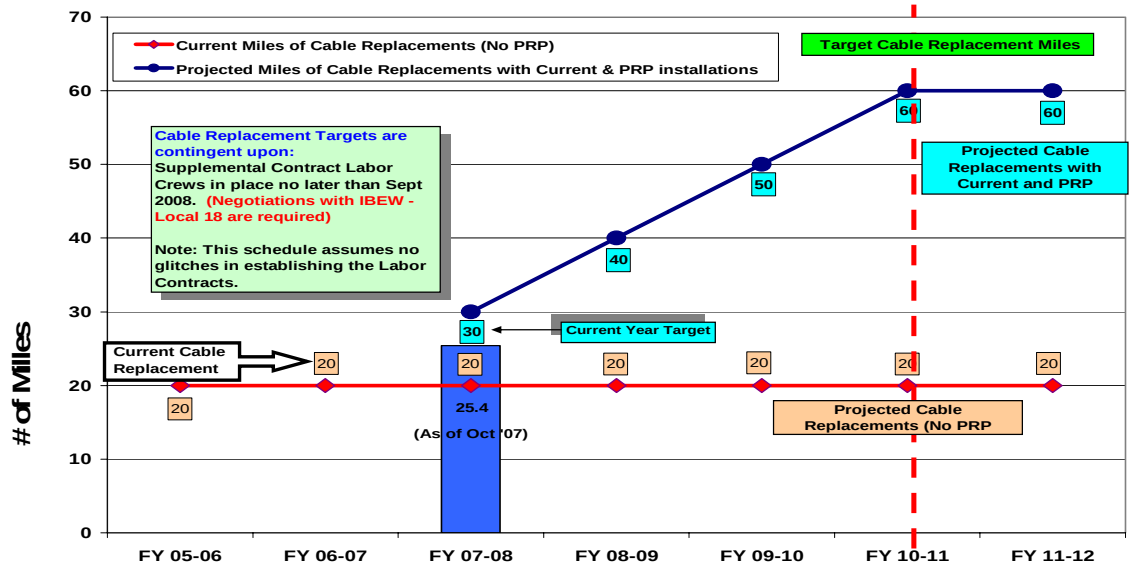
Overhead Circuit Replacement Target
From 150 Year Life Cycle to 60 Year Life Cycle



Underground Circuit Replacement (Cables and Splices)

"Cable Replacement" also has more benefits than it's name implies. Most underground outages are not strictly due to cable between substructures. In replacing spans of cable, we are renewing the life span of the cable as well as the associated cabling within a substructure. This includes circuit splices as well as terminations to equipment. New cable installations jobs should also reference any equipment replacement as efficiency of time and money in the splicing operation. Since 4.8-kV circuits account for nearly 64 percent of the system outages, and underground outages are nearly 35% of that, taking proactive steps for system renewal is worth it.

Underground Circuit Replacement Target
From 75 Year Life Cycle to 60 Year Life Cycle



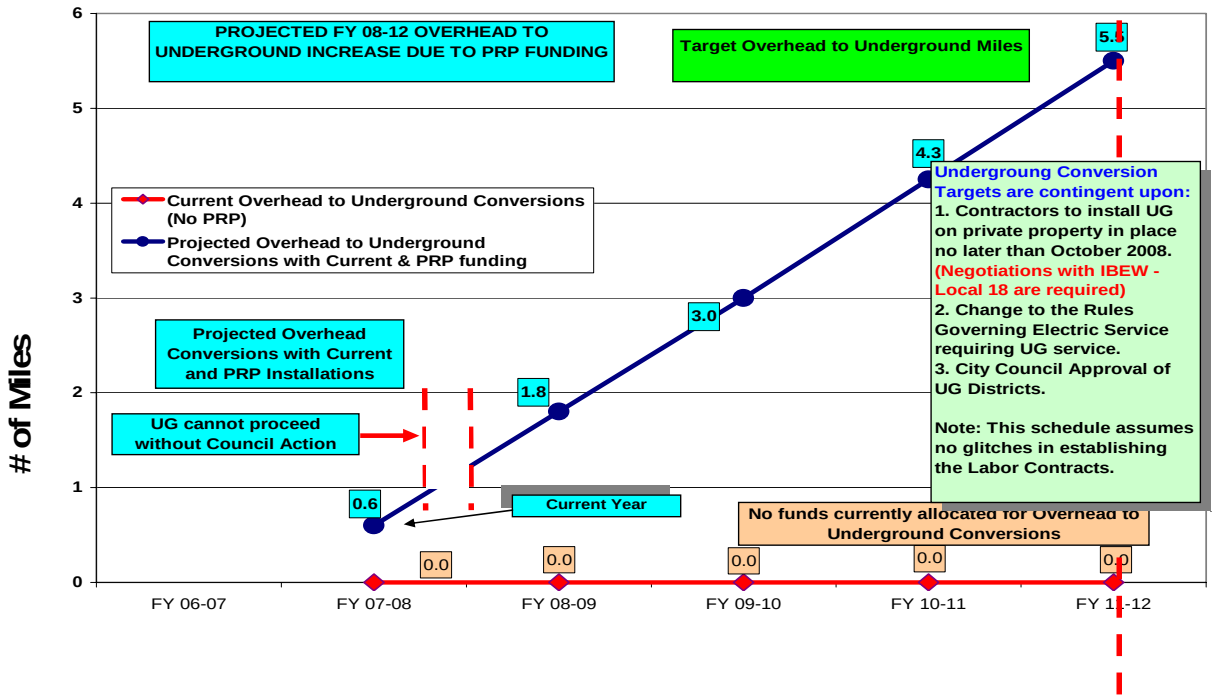
Substation Replacements:

The PRP will upgrade and replace substation transformers at a pace to achieve a 45 year replacement cycle. Additionally, circuit breakers and associated hardware will also be replaced on a condition basis.

Overhead to Underground Conversion:

Conversion of distribution circuits from overhead to underground not only are aesthetically pleasing, it also can be done for reliability purposes. The DWP currently only performs customer initiated conversion work. The PRP gradually increases DWP initiated conversion work to 8 miles per year as shown in the graph below.

Undergrounding Target
From Less Than One Mile per Year to Eight Miles per Year over 6 Years



Alternate Primary Voltage Evaluation:

The Department has investigated the possibly converting its 4.8-kV primary voltage from 4.8-kV to possibly another voltage like 12-kV. The study found that it is not cost effective and would reduce the reliability of the distribution system without the deployment of significant field distribution automation.

One factor that makes DWP unique is that it uses 34.5-kV as a distribution voltage. This has the benefit of slowing the growth of the 4.8-kV system and distributing stations to the extent that additional load can be served directly from that system. Today, approximately 40% of the customer load is served directly from the 34.5-kV system.

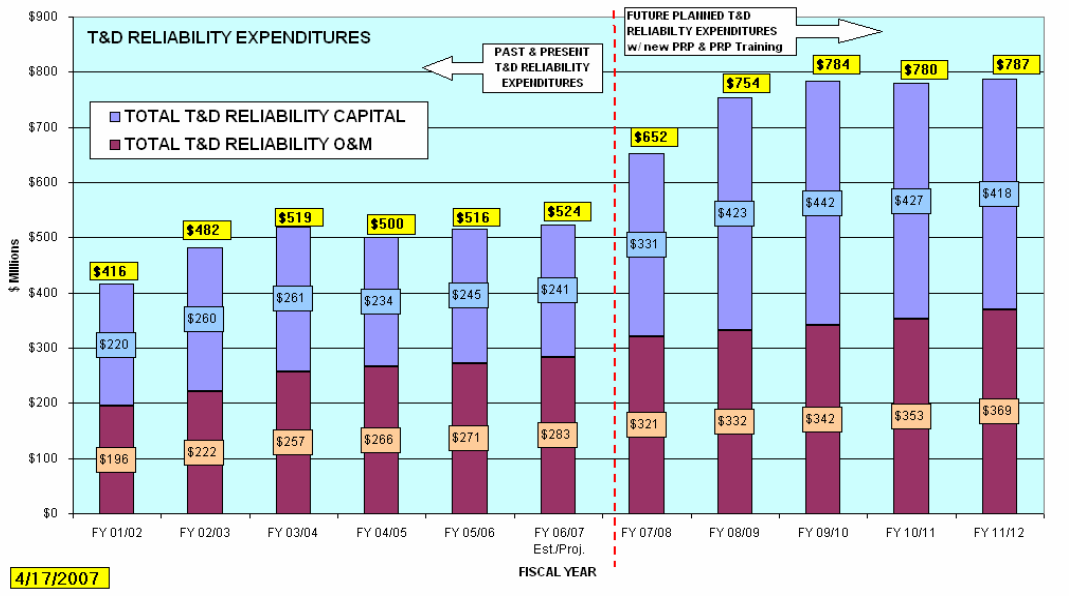
Budget Comparison to Outages

Comparing the Types of Outages to the Expenditures for Distribution Reliability and System Growth shows the following:

Comparison between Outage Contribution and Budget Expenditures.				(Table 1)
Type of Outage	**Contribution to Outages (SAIFI)**	**% Distribution Budget for Reliability & Growth, Current**	**% Distribution Budget for Reliability & Growth w/PRP**	**Long-Term Reliability Improvement (Estimate) (SAIDI/SAIFI)**
4.8-kV Circuits	64%	51%	48%	8.5%SAIFI 10.4%SAIDI (over 5 Yrs)
Substation Trouble	23%	18%	18%	-
34.5-kV Circuits	10%	31%	32%	-
Local Outages	3%	-	2%	-

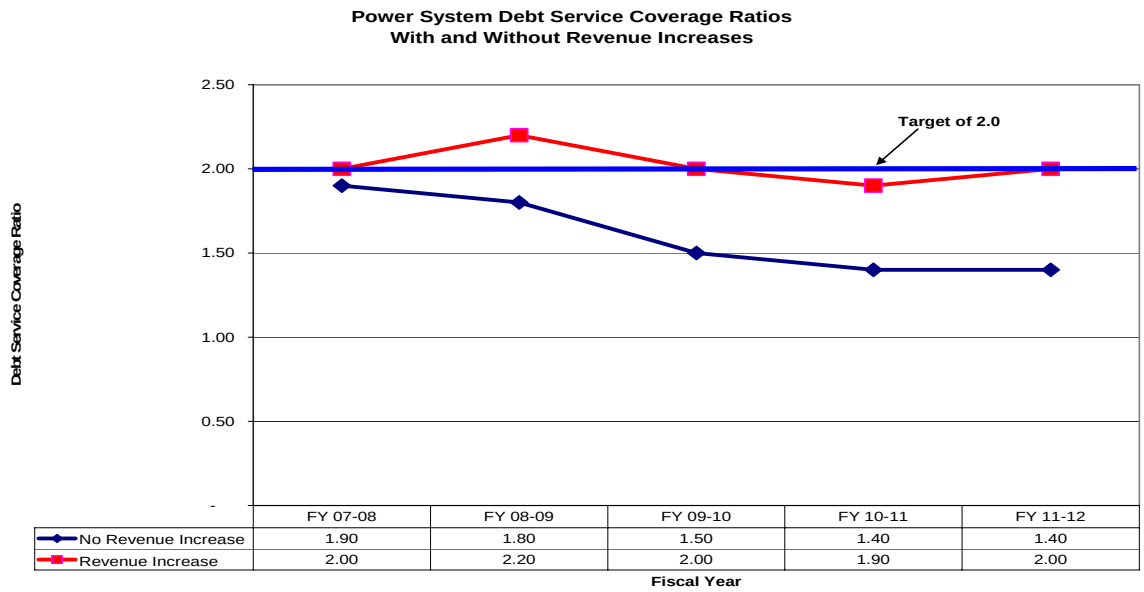
The graph below shows the expenditures of the power system for both Capital work and Operation and Maintenance to increase from typically $500M to approximately $780M. This represents an incremental power system investment of almost $1Billion dollars over the next 5 years.

JUSTIFICATION FOR INCREASING REVENUE
POWER RELIABILITY PROGRAM (PRP)
HISTORICAL & FUTURE EXPENDITURES



One of the Power System's critical financial planning criteria is to maintain "AA" bond ratings for the debt financing of its capital budget. To maintain this rating, the Department sets a minimum planned debt service coverage ratio of 2.0 or greater. This debt service coverage ratio is utilized to ensure that the Department's bonds are financed at the some of the lowest market interest rates due to its financial security. This is especially critical when the Power System will be issuing approximately $4.4 Billion in debt over the next 5 years to support a capital program of $5.7 Billion. If the debt service coverage ratio and the resulting bond ratings were to materially deteriorate, the Power System will pay higher interest costs for these bond issues. The resulting additional interest costs would then reduce the funding available for the planned (including reliability) infrastructure improvements.

POWER SYSTEM DEBT SERVICE COVERAGE
WITH AND WITHOUT REVENUE INCREASES



Summary Conclusion:

The PRP is a comprehensive program that addresses a multitude of aspects related to proactive maintenance, timely replacements, and corrective action. It is recognition that the Department's field infrastructure is substantial and requires investments to make it the reliable system that customers have experienced in the past and expect for the future.

The initiatives described above are broad in that they address both equipment condition as well as system issues. Initiative such as overhead and underground replacements have both a direct impact on existing problems (such as worst performing circuits), but they also have a proactive element to prevent future outages such as pole and cross arm replacement.

Some of the initiatives, such as Substation transformer and equipment replacement and transmission maintenance are backbone systems that usually are transparent to the customer; however, when one of the systems fail, they can affect many

customers at a time. An example is the September 12, 2005 substation problem at Receiving Station E that caused an outage to 2/3s of the City.

The PRP initiatives represent a balance between the scope of infrastructure work that needs to be addressed, the financial and manpower resources for both internal and external labor forces. It also sets the benchmark with regards to realistic maintenance and replacement cycles for various types of equipment. In addition, there is an alignment with the causes of outages, the planned expenditures, and the anticipated improvements in reliability.