Metropolitan St. Louis Sewer District

Review of Electric Utilities

February, 2015

The St. Louis Metropolitan Sewer District

Review of Electric Utilities

Febuary, 2015

Table of Contents

INTRODUCTION

To continue the efforts and commitment of the District (MSD) to achieve proper organizational governance, an engagement to perform a utility review of electricity costs and usage was included in the District Internal Audit (IA) Plan for Fiscal 2015.

The District incurred approximately $22.45 million in electricity costs during the two-year period of July 2012 through June 2014. Of these costs, the Bissell and Lemay treatment and pumping facilities, combined, accounted for approximately 66% of the dollars. The chart below depicts, per District records, the electricity costs incurred for the aforementioned locations over the two-year period.

LOCATION	ELECTRICITY COSTS (July 2012 – June 2014)	PERCENTAGE OF DISTRICT TOTAL
Lemay Treatment Plant	$3,611,337	16.08%
Lemay Pump Station	$3,480,748	15.50%
Bissell Treatment Plant/Pump Station	$7,659,185	34.12%
TOTAL	$14,751,270	65.70%

Electricity usage and usage patterns vary significantly from year-to-year and facility to facility with the most critical influence being rainfall and river levels. Disregarding the rainfall effect, electricity use can be expected to increase in the summer due to the loss of efficiency of blowers in the hotter months and the disinfection process the treated water is required to undergo during the summer months (April – October).

Management has made efforts to control costs through the use of system monitoring procedures, capacitor banks and through the installation of high efficiency lighting at the Bissell and Lemay sites. Based on data provided by Management and a review of the most recent WERF (Water Environment Research Foundation) report for Utility Benchmarking for Wastewater, IA noted that the District operated its' treatment sites last year using approximately 1,502 kwh per million gallons of water treated, which is well below the industry average of 2,037 kwh per million gallons of water treated.

Exhibits 1 and 2 (**see Appendix**) illustrate the comparative pattern of gallons of treated water to kWh usage for the Lemay and Bissell treatment plant sites.

SCOPE, OBJECTIVES, AND METHODOLOGY

Scope and Objectives

Scope: The scope of this engagement consisted of a two-year review of electricity utility costs at the Bissell and Lemay Treatment Plants and Pumping Stations. The period of the review was July 2012 through June 2014.

Objectives: The overall objectives of this engagement were to:

- Ensure rate structures are appropriate and are properly and accurately applied.
- Identify any billing errors caused by items such as misapplication of meter multipliers, errors in calculating taxes, and meter malfunctions or errors.
- Verify or assess the existence, condition, and assigned physical service area of each meter within the scope.
- Identify any anomalies in usage patterns and/or costs and determine the underlying cause.
- Identify opportunities for cost reduction or increased efficiency in areas such as monthly usage, demand charges and power factors.
- Verify the accuracy of the coding of costs (accuracy of cost centers).

Methodology

To accomplish the above objectives, Internal Audit (IA):

- Reviewed and analyzed two years (scope period) of utility bills for each facility.
- In an effort to obtain an accurate understanding of the appropriate computation methodology, reviewed rate, tariff and rider agreements and schedules.
- Reviewed the invoices and all related charges for accuracy and propriety through the use of spreadsheet recalculations and analysis.
- Calculated and reviewed power factor ratios.
- Met and maintained communications with the District's Ameren Account Executive.
- Conducted interviews and discussions with District operational and on-site facility personnel.
- Physically reviewed and inspected the meters, taking into consideration the environment, history, and physical service areas of each meter.
- Developed and performed analytics for various indicators related to the usage and costs related to the use of electricity at the sites included in the scope.

OVERALL CONCLUSION AND RESULTS

In the opinion of Internal Audit, in all significant respects, the controls and procedures utilized for the monitoring and administering electricity usage and costs were effectively designed and implemented. However, IA did identify a few items that are potential opportunities for reducing costs and usage**.** Such matters are discussed in detail in the ***Opportunities for Improvement*** section of this report.

Initial Inherent Business Process Risk: Low Risk #
Overall Assessment of Engagement Results: Satisfactory**

****** Engagement results are evaluated as satisfactory, generally satisfactory or unsatisfactory.

- **Satisfactory** *(clean opinion)* – No significant engagement findings or material weaknesses were noted.
- **Generally Satisfactory** (*qualified opinion, i.e. "except for*") – Results contain significant engagement findings. No material weaknesses were noted.
- **Unsatisfactory** (*adverse opinion, immediate Management attention required*) – Significant engagement findings and/or material weaknesses were noted.

^ DEFINITIONS

Engagement Finding (#*Low Risk*): An engagement finding is a condition that could adversely affect the organization but is less severe than a significant engagement finding or significant deficiency. Classification includes process or control deficiencies that are not significant deficiencies as well as includes other low risk or low impact conditions.

Significant Engagement Finding (# *Moderate to High Risk*): A significant engagement finding is a condition that could adversely affect the organization. Definition includes all types of findings, such as irregularities, waste, ineffectiveness, conflicts of interest, illegal acts, errors, and significant deficiencies in internal control over financial reporting as well as other significant internal control weaknesses. A significant deficiency is defined as a deficiency, or a combination of deficiencies, in internal control over financial reporting that is less severe than a material weakness, yet important enough to merit attention by those charged with governance.

Material Weakness (# *High Risk*): A material weakness is a deficiency, or a combination of deficiencies, in internal control, such that there is a reasonable possibility that a material misstatement of the financial statements will not be prevented or detected and corrected in a timely basis. For internal audit purposes, the definition also includes material and/or severe irregularities, waste, ineffectiveness, conflicts of interest, illegal acts, errors, and other material control weaknesses, etc.

(The term "material weakness" should be thought of as a serious category of significant engagement findings and/or significant deficiencies. However, not all significant engagement findings and significant deficiencies are material weaknesses.)

^ - Definitions are based on guidance from the IIA Standards, GAAS, and the PCAOB.

 # - Risk is assessed at the District (Entity) Level. (Risk to the District as a whole)

Demand and Power Factors

During procedures to analyze the overall electricity costs and usage, IA identified areas that appear to contain opportunities for reducing costs and/or improving efficiencies. The opportunities identified by IA are focused in two main areas: Demand and Power Factors.

Demand

Electric capacity, or the ability of a power company to meet the peak usage moment during a billing cycle, is commonly referred to as demand. Demand is usage in a single defined point in time (kW) whereas usage (kWh) measures the flow of electricity for the duration of the billing cycle.

The demand portion of the utility bill is a charge that is calculated based on the measured maximum demand established for peak (10am to 10pm) and off-peak hours (all other hours). The more demand, or peak power usage, can be reduced, the greater the savings to the District and the greater the contribution to the environment.

Demand can be affected by equipment such as motors, lack of load regulation controls and air-conditioning loads. In the case of the District, large motors in use would be the primary driver of demand. Exhibits 3, 4, and 5 show the demand by billing period.

For the two-year scope period, demand charges at Bissell Treatment, Lemay Treatment, and Lemay Pump amounted to approximately **$2.69 million, $213,000, and $207,000 respectively.** Demand charges represent a significant portion, approximately **40%**, of the electricity costs billed to the Bissell site (main account). See Exhibit 6 for a breakdown of the costs and a calculation of costs per kWh. The chart demonstrates the impact of the demand charges on costs per kWh used.

The demand charges at Bissell are affected by the service class rate structure that is utilized by Ameren as shown below:

Service Class/Location	**Summer Rate** (per kW of Total Billing Demand)	**Winter** (per kW of Total Billing Demand)
4(M) - Lemay	$3.82	$1.39
11(M) - Bissell	$19.36	$8.79

Power Factor

The power factor is the ratio between real power (power that performs work) and apparent power (reactive – supports delivery of real power) and it determines the efficiency of the delivered power's use. Power factors are concerned with the relationship between current and voltage and the ability of the electric system to deliver power for useful work. The power factor is the measurement of the efficiency of a metered facility.

For example, a power factor of 90% means that 90% of the current supplied is actually doing work. A 100% power factor occurs when the voltage and current are completely in phase and no inefficiencies exist.

1. Demand and Power Factors (Cont'd)

Anything less than one (100%) means that extra power is required to achieve the actual task at hand. This extra energy comes in the form of Reactive Power (kVARs). Reactive power does not actually perform useful work but is essential for motors (design characteristic) to operate and must be supplied to equipment that requires it. It should be noted that in most cases achieving a power factor of 100% is not practical from a cost-benefit perspective.

As more reactive power is required to be supplied and delivered through an electrical distribution system, the likelihood of the following issues increases:

- Reduction of distribution system capacity, reducing the ability to supply additional loads.
- Reduction of terminal voltage at equipment.
- Increases in heat loading at facility.
- Shortening of equipment life.
- Triggering of a "Reactive Charge" on the utility bill, increasing costs.
- Creation of kWh distribution losses that increase the need for kWhs, increasing costs.

The average monthly power factors for the scope period for two of the main meters at Bissell and Lemay are as follow:

- Bissell: meter # 02838227: 86.96%
- Lemay: meter # 02825404: 82.92%

It should be noted that, for the two-year scope reviewed, only minimal charges (reactive charges) for reactive power were assessed by Ameren. At this point, no quantifiable costs or effects have been identified as a result of the existing power factor levels and the amount of reactive power being supplied by Ameren. However, Management has not been monitoring power factor levels as part of their ongoing oversight process.

1. Demand and Power Factors (Cont'd)

Recommendation:

IA recommends that the District consider taking the following steps to improve efforts to reduce usage, costs and increase related efficiencies:

- To help reduce demand (kW) and usage (kWh) charges at the Lemay Treatment Plant, IA recommends that Management explore the possibility of installing a hydroelectric turbine/generator to take advantage of the head created by the hydraulic profile at average or non-flood conditions (approximately 40'). A turbine installed in this environment could be utilized as a base load unit. The optimum size would have to be determined through an engineering study, but 500Kw to 1Mw would seem to be the range for consideration. The discharge structure JC9 would be ideal for such an implementation. Approximately 120,000,000 gallons of water is discharged daily through this structure subsequent to the completion of UV processing. It should be noted that a similar concept was investigated by the District more than a decade ago. At the time, the concept was determined not to be a viable solution. IA recommends that Operations revisit the concept, using the previous study and the above information as starting points.

- Regarding the Bissell site, an opportunity for cost reduction appears to exist in the area of demand charges. As noted previously, demand charges represent approximately 40% of the overall costs billed through the Bissell main account. IA recommends that Management monitor and review this area for potential opportunities for reducing the costs resulting from demand charges. Discussions were held with Management regarding potential solutions, but, at this point, no one approach has been identified as a viable option or solution.

- Regarding Power factors, Management should monitor power factor levels and also review for any detrimental effects (as described earlier in the report) stemming from the supplied reactive power, including the potential assessment of reactive charges. The existing power factors reflect the District's efforts to reduce the use of excessive reactive power through the use of capacitor banks. If power factor levels decrease to an unacceptable level, the District's next step may be to consider replacing motors, as they fail, with more efficient motors and/or increase the use of capacitors where operationally feasible.

Risk Rating at District (Entity) Level: Low
Risk Rating at Business Process Level: Moderate

1. Demand and Power Factors (Cont'd)

Process Owner Action Plan:

1) Investigation into the potential of installing a turbine at the Lemay Treatment Plant to help reduce the demand and usage charges was investigated by the District, with the assistance of Black & Veatch, more than a decade ago. It was determined at that time to not be feasible to install the turbine. The Operations Department (Lemay Treatment Plant) with assistance from a qualified engineering company will review the previous study and determine if that conclusion is still valid. Completion of this item will be by **August 2015**.

2) Although demand charges for the Bissell Treatment Plant are high, the treatment plant does not have control over the demand and only operates enough equipment to process the incoming flow. The Operations Department (Bissell Treatment Plant) will meet with the District's Ameren/UE Account Representative to verify that the billing structure for the facility is appropriate for the amount of electricity consumed. **Completion of this item will be by May 2015, prior to the peak demand charge summer season.**

3) As noted in your report, the power factor dollar amounts charged for were almost zero over the two year period. Treatment Plant Management will monitor power factors and the associated cost on a quarterly basis. When charges increase to a substantial level or power factors dip substantially, plant management will investigate and execute the necessary plans to correct the issue. **Complete.**

Implementation Date:

SEE ABOVE

2. Unidentified Meter

During field work, IA identified an Ameren-owned meter at the Lemay Pump substation that had not been accounted for by either Ameren or the District. Through discussions with Ameren, it was determined that Ameren had no record of this meter. The discovered meter, which is used for general station services, has since been added to the District's account by Ameren. (It should be noted that the meter showed minimal usage (kWh).)

Recommendation:

IA recommends that operational/facilities personnel periodically (annually) reconcile the meters by physically reconciling meter numbers with the billings received from Ameren. Sites not included in the scope of this engagement, should be made a priority for this process.

This procedure will become increasingly important in future years with the continuing activities of the Consent Decree program and the significant increase in related construction activities.

Risk Rating at District (Entity) Level: Low
Risk Rating at Business Process Level: Low

Process Owner Action Plan:

Management will implement a process in which the various site meters are annually inspected and reconciled to the billings received from Ameren.

Implementation Date:

By December 31, 2015

ACKNOWLEDGEMENT

Internal Audit Engagement Team:

MSD Internal Audit:

Todd Loretta

***Brown Smith Wallace*:**

Ron Steinkamp
Adam Rouse
Bob Prosperi

We would like to thank MSD personnel for their excellent cooperation and assistance during this engagement.

APPENDIX

Exhibit 1 – Lemay Treatment Plant kWh usage compared to number of gallons treated water per month

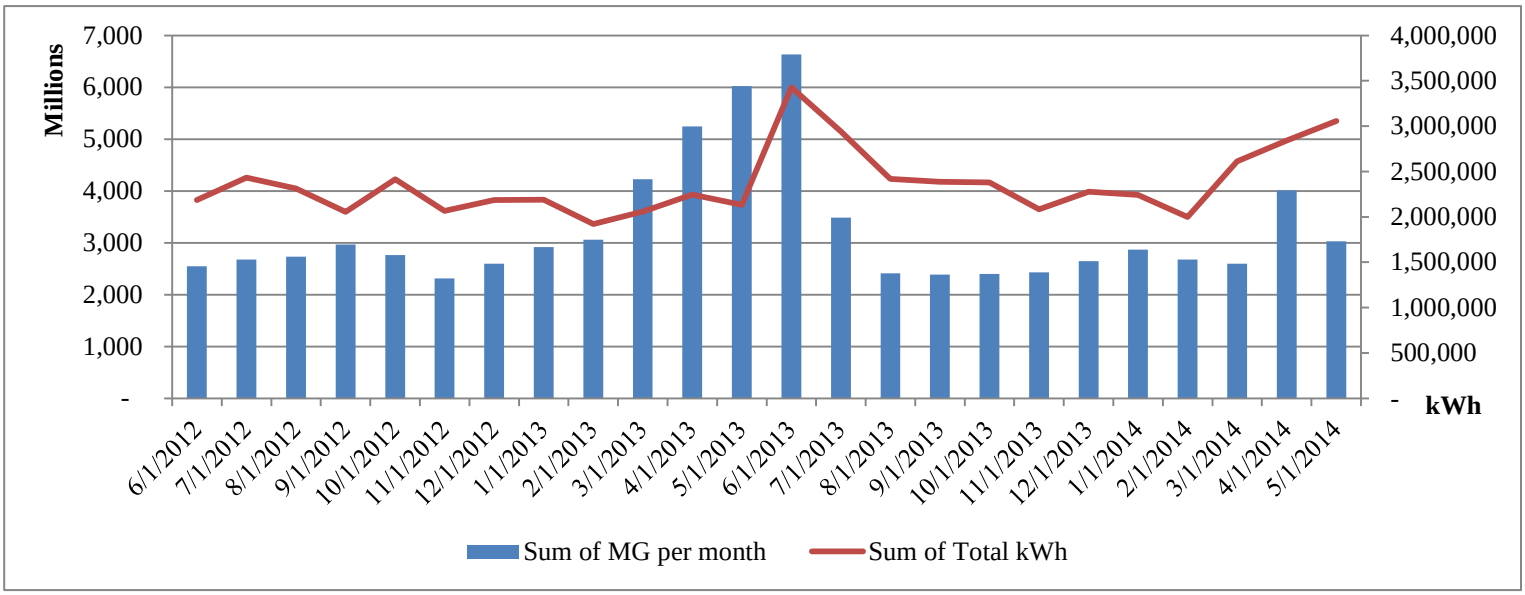
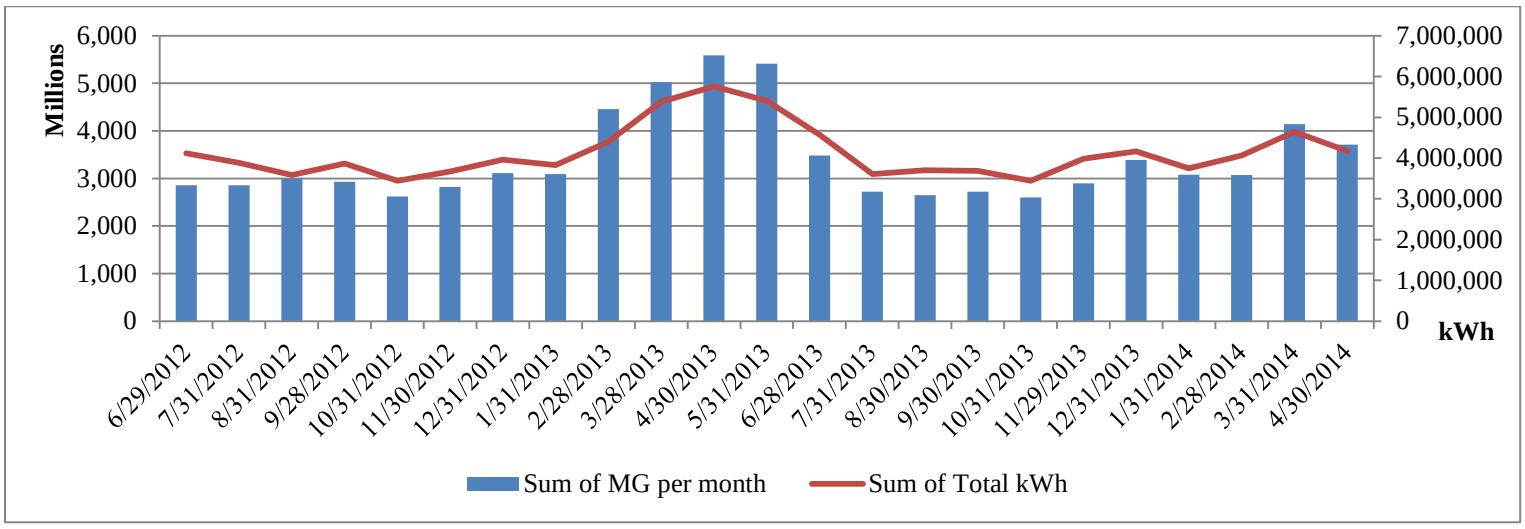


Exhibit 2 – Bissell Treatment Plant kWh usage compared to number of gallons treated water per month



APPENDIX

Exhibit 3 – Demand by Billing Period - Lemay Treatment Plant

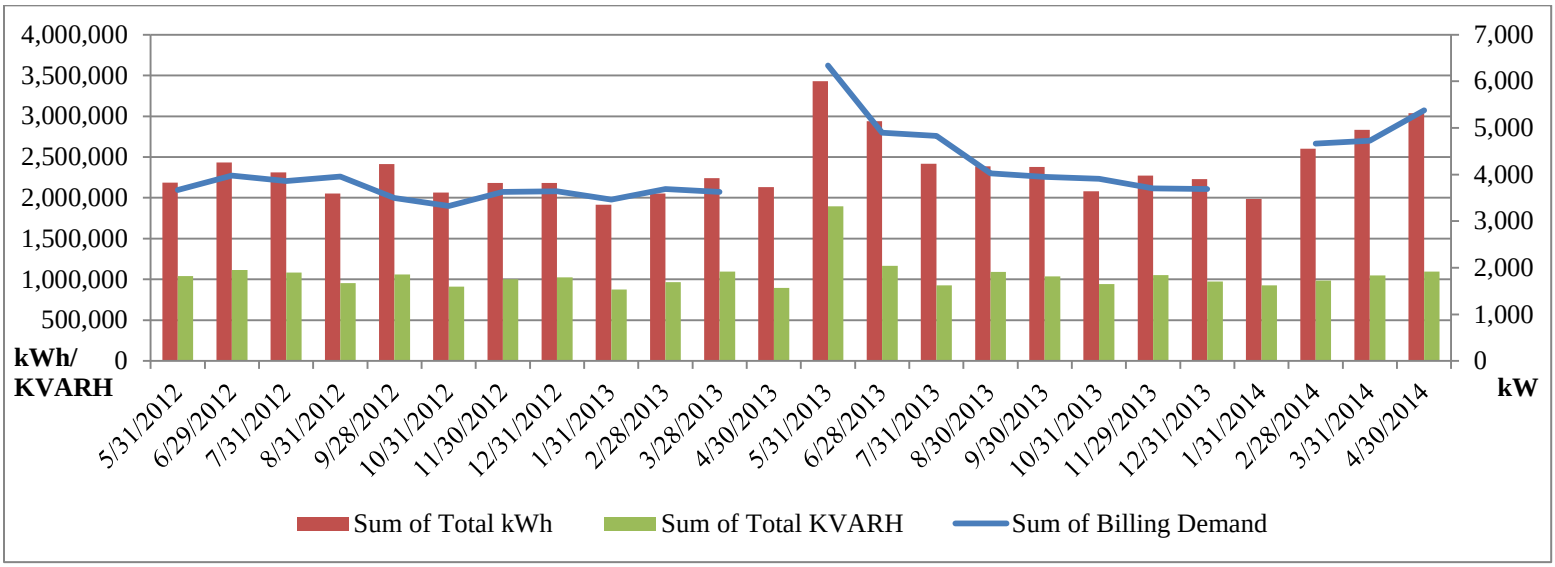
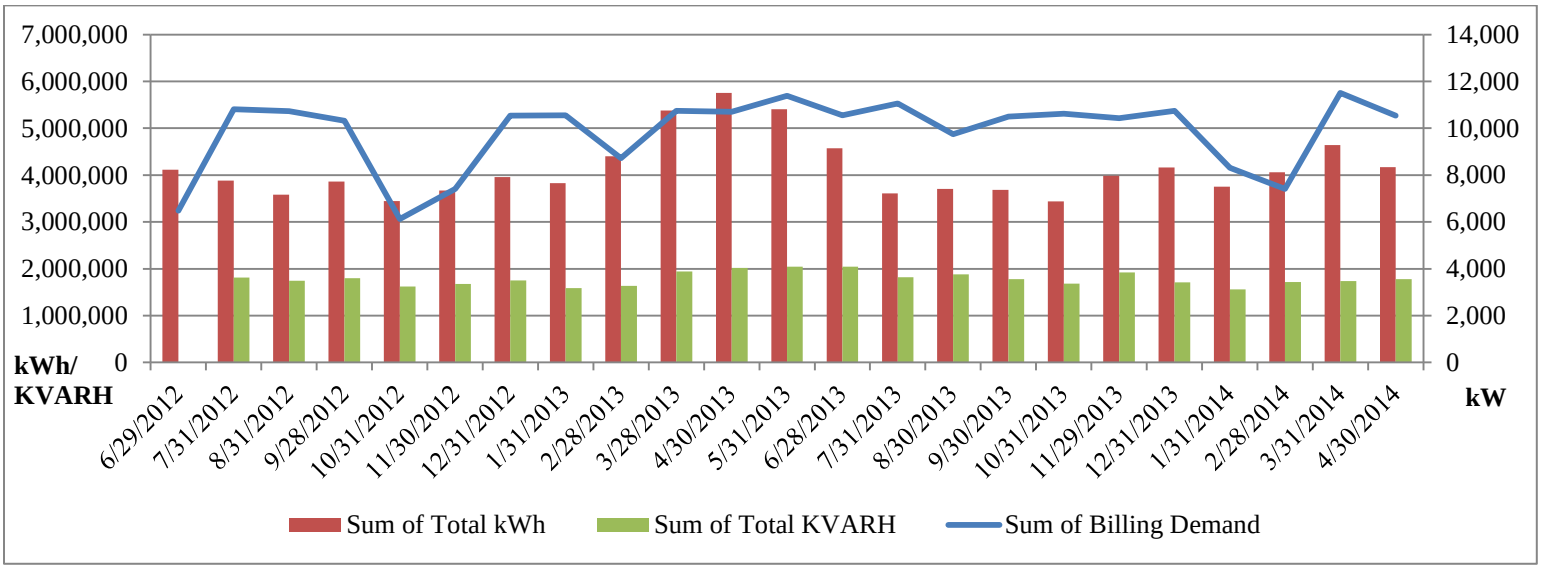
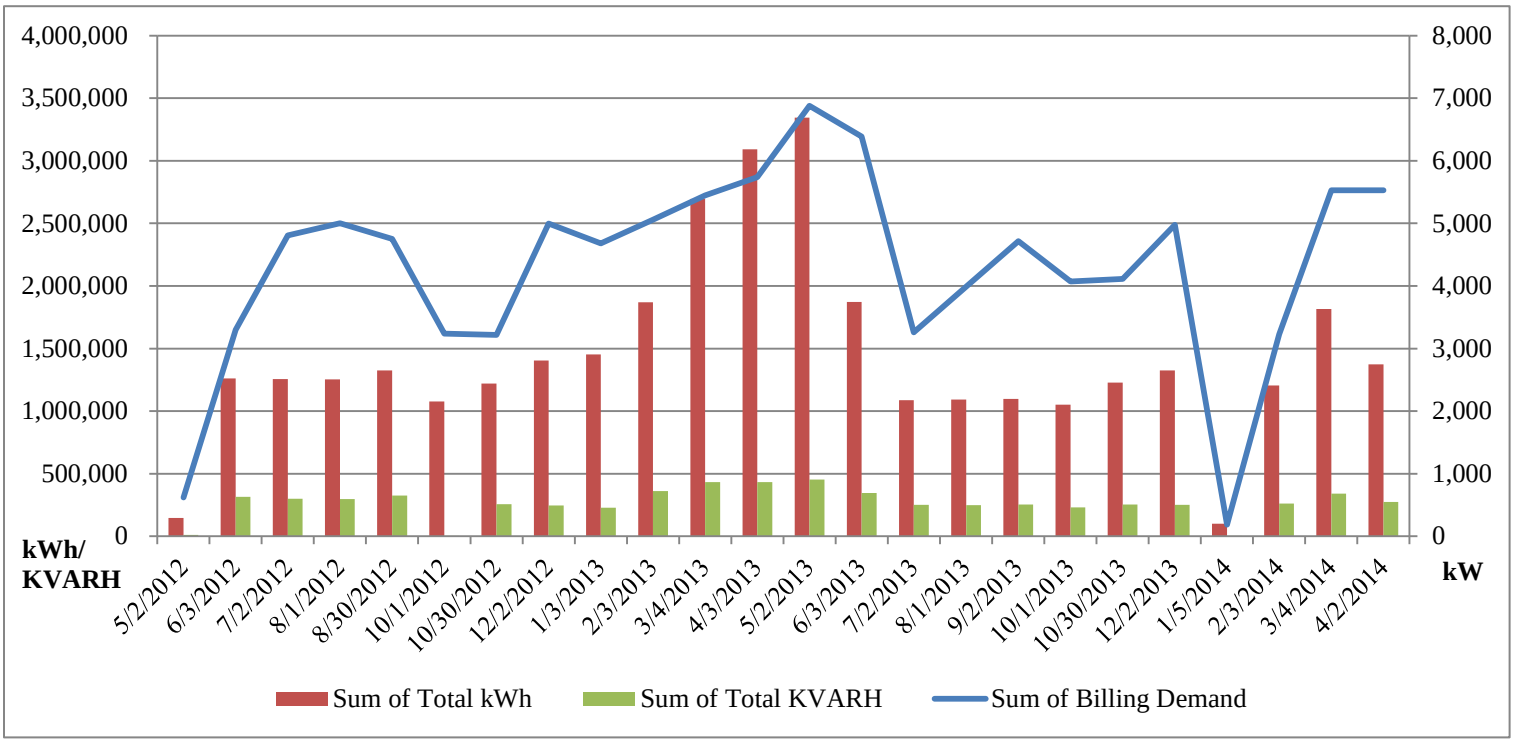


Exhibit 4 – Demand by Billing Period – Bissell Treatment Plant/Pump



APPENDIX

Exhibit 5 – Demand by Billing Period – Lemay Pump Station



APPENDIX

Exhibit 6 – Costs calculated per kWh

Bissell Treatment Plant				Lemay Combined			
Item	**Cost**	**kWh**	**Cost per kWh**	**Item**	**Cost**	**kWh**	**Cost per kWh**
Energy	$2,791,922.45	95,062,016	$0.02937	Energy	$4,714,417.42	90,037,433	$0.05236
Demand	$2,686,870.77		$0.02826	Demand	$420,523.41		$0.000467
Total Cost*	$6,674,551.01		$0.07021	Total Cost*	$6,131,331.94		$0.06810
Facility	Bissell Treatment Plant			Facility	Lemay Pump Station		
Account	23300-02016			Account	35600-02614		
Meter	02838082,02838227,02849591			Meter	02832650, 03454249		
Rate	**11M Large Primary Electric Service**			Rate	**4M Small Primary Electric Service**		
				Facility	Lemay Treatment Plant		
				Account	88100-06614		
				Meter	02825404, 02853889, 58617205		
				Rate	**4M Small Primary Electric Service**		

*Total cost includes, if applicable, reactive charges, customer charges, fuel adjustment charges, energy efficiency program charges, energy investment charges, St. Louis County municipal charges, St. Louis City municipal charges, seasonal energy charges, energy efficiency investment charges.