City of Riverside

WASTEWATER COLLECTION AND TREATMENT FACILITIES INTEGRATED MASTER PLAN

VOLUME 9: ENERGY MANAGEMENT SYSTEM
CHAPTER 4: ENERGY SAVING OPTIONS

FINAL
February 2008

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ENERGY SAVING OPTIONS

4.1 PURPOSE

The purpose of this chapter is to identify and discuss various energy saving options that can be implemented for the Regional Water Quality Control Plant (RWQCP) expansions. The chapter also presents some of the energy saving measures, which are already in place at the RWQCP and can be expanded in the future expansion projects.

4.2 CONCLUSIONS AND RECOMMENDATIONS

- Major energy saving measures such as Variable Frequency Drive (VFD) applications, efficient blowers and diffusers, cogeneration, premium efficiency motors, medium voltage motors and distribution system, natural lighting, and energy efficient lighting and controls are already in place at the RWQCP. These measures are recommended to be included as design criteria for any future expansion projects.
- Currently, the RWQCP is installing a 1,000-kW fuel cell cogeneration system by the end of year 2007 as part of its energy saving program. The City of Riverside (City) also plans to install an additional 1,200-kW fuel cell system by the year 2012.
- Recommendations:
  - Upgrade the existing plant Supervisory Control and Data Acquisition (SCADA) system to include a Computerized Load Management System (CLMS) to continuously monitor the plant power usage and provide energy management in terms of demand and supply. The CLMS can also provide a load-shedding and load-adding sequence. It will also help with peak-shaving, off-peak power use, and generator optimization.
  - Retrofit existing eddy-current drives with VFDs for the three 250-hp filter influent pumps and two 100-hp waste backwash pumps. Replace the pump motors with premium efficiency motors.
  - Use Title 24, Part 6, of the California Code of Regulations: “California’s Energy Efficiency Standards for Residential and Nonresidential Buildings” as a design guideline for new facility construction.

4.3 BACKGROUND

As discussed in Volume 9, Chapter 3 - Existing and Future Energy Uses, electrical power demand and energy consumption at the RWQCP will increase as the plant flow increases. For the year 2006, the RWQCP paid nearly $1.7 million for the Plant 1 and Plant 2 electric energy bill (average demand about 2,456 kW at an average rate of $0.09/kWh). It is anticipated that power demand and energy usage at the RWQCP will almost double by the year 2012. In the future, electricity rates are likely to continue increasing, prompting the RWQCP to take measures to implement energy saving projects.

4.4 IMPLEMENTED ENERGY SAVING MEASURES

The major existing energy consumption process for the RWQCP plant is the aeration process, which consumes about 50 percent of the total running load. Other substantial loads of the plant are Return Activated Sludge (RAS) pumps, Waste Activated Sludge (WAS) pumps, mixed liquor pumps, filter influent pumps, backwash pumps, and waste backwash pumps.

The following are energy saving measures, which are already incorporated at the RWQCP plant:

- Efficient blowers and diffusers.
- VFD application for all pumps except for three of the filter influent pumps and two of the waste backwash pumps.
- Premium efficiency motors.
- Gas engine cogeneration.
- Fuel cell cogeneration.
- Natural lighting.
- Energy efficient lighting and controls.
- Medium voltage motors.
- Medium voltage distribution system.

It is recommended that future RWQCP expansions continue to include these energy saving measures (except gas engine cogeneration).

4.5 ENERGY SAVING OPTIONS

The energy saving options that could be implemented at the RWQCP are described in this section.

4.5.1 Computerized Load Management System

As part of the electrical system upgrades and conversion of the cogeneration gas engine generators to backup standby power for the RWQCP expansion (Volume 9, Chapter 6 - Standby Power), a CLMS could be used to learn how and when each piece of equipment uses energy. The rate at which energy is used will vary throughout the day, depending upon factors such as influent flows and biological oxygen demand. A CLMS could plot daily electrical load as a function of time for different plant loading conditions and identify which large equipment can be operated off-peak. It could also examine all available rate schedules to determine which can provide the lowest cost in conjunction with appropriate operational changes by reducing peak demand or shifting loads to off-peak.

The CLMS would include, but not be limited to, the following functions:

- Power monitoring.
- Energy management.
- Load management and scheduler.
- Generator priority sequence and optimization.
- Circuit breaker control and monitoring.
- Load-shedding sequence.
- Load-adding sequence.
- Advanced power quality analysis.
- Reports, event records, trending, and historical data.
- Graphical user interface.
- Graphical plant electrical system.
- Password protected for different level access authority.

4.5.2 Retrofit Existing Eddy-Current Drives with VFDs

There are three 250-hp Filter Influent Pumps (Nos. 1 through 3) that use eddy-current drives and three other 125-hp Filter Influent Pumps (Nos. 4 through 6) that use VFDs. There are also two 100-hp Waste Backwash Pumps that currently use eddy-current drives. These loads constitute about 20 percent of the plant load when these pumps are running at full load.

A well-engineered and maintained eddy-current drive application can save energy by allowing motors to operate at reduced speed. However, in this case, the RWQCP plant flows have increased to the point that these eddy-current drives are operating at 100-percent speed the majority of the time. It is recommended that the eddy-current drives be replaced with VFDs to provide greater operating flexibility. In conjunction with the new VFDs, replace the pump motor with a VFD-rated and premium efficiency motor. This retrofit will yield energy and maintenance savings due to greater pumping system efficiency and less frequent maintenance when compared to eddy-current drives.

4.5.3 Implement Title 24 Design Guidelines

Part 6 of Title 24 of the California Code of Regulations contains standards for energy efficiency for buildings. The standards were established in 1978 in response to a legislative mandate to reduce California's energy consumption. The standards are updated periodically to allow consideration and possible incorporation of new energy efficiency technologies and methods.

The wastewater facility is not required to comply with this standard, but it is recommended that this standard act as a design guideline for new RWQCP facility construction.

4.5.4 Implement Leadership in Energy and Environmental Design Standard

The Leadership in Energy and Environmental Design (LEED) is the nationally accepted benchmark for the design, construction, and operation of high-performance green buildings. LEED encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria.

The City has adopted a “Green Municipal Building Policy,” for new City buildings in excess of 5,000 square feet, to meet the LEED standard. All buildings proposed as part of the Master Plan will be designed and constructed to meet the LEED standard.

4.5.5 Other Energy Saving Ideas

- Maintenance: A program of regular cleaning, replacement, and maintenance of lamps and luminaries can significantly save energy. A typical lamp, as it reaches 80 percent of its useful life, produces 15 to 35 percent less light due to lamp degradation. Dust, dirt, and other materials on lamps, reflectors, and lenses can decrease lighting output by 30 percent or more. Photocells used to activate outdoor lights should also be cleaned regularly.
- General Operation and Maintenance: For older space conditioning systems, replacing the heating pilot light with an electronic intermittent ignition device will eliminate unnecessary energy use. To prevent energy losses caused by dirt, maintenance routines should include regular cleaning of the cooling condenser, evaporator coils, and intake louvers. Regular cleaning of air filters alone can lower energy use as much as 20 percent and extend equipment life. Outside air economizers should be cleaned regularly and checked to ensure that they are functioning properly.
- Lighting Controls: Simple controls can eliminate unnecessary lighting in the many facility areas that do not require continuous lighting. Occupancy sensors detect the presence of personnel within an area and turn lights on and off accordingly. Time switches that turn lighting systems on and off are useful for outdoor signs, security lighting, and corridors. Dimming systems take advantage of daylight to further reduce

energy use and costs. Photocell controls provide easy, effective on/off switching of outdoor lighting. In addition, photocells can be combined with time switch controls for areas that do not require lighting all night.

- Power Factor Correction: A low power factor is frequently caused by motors that run less than fully loaded. This also wastes energy because motor efficiency drops off below 75-percent load. Examine motor systems to determine if the motor should be resized or if a smaller motor can be added to handle lower loads. Perform a plant-wide power factor study to determine which of the plant busses require power factor correction. A power factor can also be corrected by installing a capacitor in parallel with equipment that is run at less than full load.
- Reduction in Harmonics: As more and more applications of non-linear equipment such as VFDs, Uninterruptible Power Supplies (UPS), fluorescent lamps, computers, etc., are used in the plant, more harmonics are being introduced to the electrical system. Besides causing unwanted tripping to relaying, telephone interference, misoperation to electronic equipment, and resonance, harmonics also generate heat losses in transformers, cables, switchgear, motors, and generators. Measures such as harmonic filters and 18-pulse technology for VFDs rated 100 hp and above, can be used to mitigate the harmonics.
- Energy Efficient NEMA TP-1 Dry-Type Low-Voltage Distribution Transformers: The goal of NEMA TP-1 efficiency levels for 600-volt class distribution transformer is to reduce energy consumption when the transformer is lightly loaded. At low load levels, no load losses account for most of the losses of a transformer. A NEMA TP-1 transformer is the most efficient transformer and the most economical choice for applications where the anticipated daily loading of a distribution transformer is around 40 percent or less of the full capacity of the transformer.