City of Brisbane
Agenda Report

TO: Honorable Mayor and City Council

FROM: Caroline Cheung via Clay Holstine, City Manager

DATE: Meeting of November 5, 2012

SUBJECT: Community Pool Energy Efficiency Analysis & Recommendations

RECOMMENDATION: Consider a Variable Frequency Drive (VFD) retrofit and purchase of a web-based data-logging and solar control system in order to save on electrical costs at the Community Pool.

BACKGROUND:

On May 9, 2012, San Mateo County Energy Watch hosted the "Energy Watch Partners Meeting: Tools for Energy Saving" where they presented financing options, San Mateo County Energy Watch program updates as related to rebates and benchmarking, and lastly, innovative technologies for cost-effective energy savings. At that meeting, staff approached Gary Gockel of Pool Solutions Group, who presented on pool flow optimization. He was offering to perform free energy efficiency audits, and specialized in commercial-size pools. On May 21st, Gary along with Tim Rosenfeld of HMW International, Inc. conducted a preliminary on-site audit with the Marina & Aquatics Director. Gary conducted a second on-site audit on June 13th, also with the Marina & Aquatics Director. The information Gary and Tim collected during these site visits resulted in their Energy Efficiency Analysis & Recommendations report, which they presented to staff and representatives from PG&E and San Mateo County Energy Watch on August 22nd (see Attachment 1). The report had been reviewed by the City Engineer and Marina & Aquatics Director, both of whom have no problems with the report's findings and recommendations. On October 25th, the Facilities Subcommittee met with Gary, Tim, and staff to review the report's recommendations and also had no problems with its recommendations.

DISCUSSION:

The Brisbane Community Pool, which has a capacity of 142,000 gallons, requires a flow rate of 395 gallons per minute. It was found during the site visits that the circulation pump is sized to deliver a flow rate of 495 gpm, or 25% more flow than required by code when the Pool is open. A variable frequency drive will help to "right-size" the water flow

when the Pool is open as well as when it's closed, resulting in a potential savings of 44,236 kWh annually, or $6,315.

As part of their initial audits, Gary and Tim were also asked to examine the energy savings value of the existing solar thermal system for the Pool, which was installed in 2006. The solar thermal system is off-setting approximately 5,000 therms per year, saving about $5,000, but according to the manufacturer when it was installed, has the ability to offset 6,000 therms, or 20% more than what it has been over the last four years. With the installation of a web-based data-logging solar control system, there can be better optimization of the solar thermal system, as it gives the solar thermal system priority over the boiler. It will also allow the flow of water to be more in tune with the seasons and better match facility use, as trained facility staff will now have the ability to adjust the conventional boiler's operation.

FISCAL IMPACT/FINANCING ISSUES:

The cost of the VFD is $18,400, but this retrofit qualifies for a $4,149 rebate from PG&E, for a net cost of $14,691. The project should pay for itself in just over two years and provide a 43% annual return on investment. PG&E inspected the Pool facility on Monday, October 22nd, as they needed to approve the rebate reservation and Gary and Tim's engineering report, as well as Gary's bid document (see Attachment 2). The City is able to participate in PG&E's Energy Efficiency Retrofit Loan Program, or On-Bill Financing. In this case, PG&E will send the City a check, less the rebate amount, once the project has been completed. The City will then repay the loan, interest-free, through a line item on its monthly utility bills. These payments are structured to be no more than the monthly estimated savings resultant from the energy efficiency retrofit.

The cost of the SWIMPC is $950.00, but is not eligible for a PG&E rebate, as there is no provision or category for Pool Solar Thermal Measures. There are no labor costs as Gary and Tim are willing to cover these. Both items are being recommended by staff to be paid for out of the Park and Recreation Capital Fund, which earns 0% interest.

MEASURE OF SUCCESS:

Reduce the amount of greenhouse gases and save energy for the city.

Caroline Cheung
Management Analyst

Clay Holstine
City Manager

ATTACHMENTS:

Attachment 1 – "Energy Efficiency Analysis & Recommendations" Report
Attachment 2 – Pool Energy Upgrade Estimate/Bid Document

ATTACHMENT 1

Brisbane Community Swim Center

Energy Efficiency Analysis & Recommendations

Date: August 1, 2012

Prepared for:
Ted Warburton
Director of Marina and Aquatic Services
City of Brisbane

By:
Tim Rosenfeld
Pool Energy Savings Program
HMW International, Inc.
and
Gary Gockel
Pool Solutions Group

Introduction and Summary

HMW International's Pool Energy Savings Program and the Pool Solutions Group completed a preliminary evaluation of the Brisbane Community Swim Center for the City of Brisbane. This analysis includes a review of the Swim Center pool filtration and heating equipment, current operations, notes on specific issues found, and recommended measures to consider that will save energy, lower operating costs and improve the overall operation of the facility[1]. We were also asked to examine the energy savings value of the existing solar water heating system for the pool. Notes and recommendations on this system are also provided. Savings may be greater than shown.

The recommended retrofit of a variable frequency drive (VFD) on the existing pump is estimated to save about 49% of the electricity used by the pump, saving about $6,315 in annual energy cost[2]. The project is estimated to cost about $18,400 and receive a $4,149 rebate from the utility for a net cost of $14,691. The project should pay for itself in savings in just over 2 years and provide a 43 percent annual return on investment[3].

Pool Pump VFD Retrofit						
Energy Savings (kWh)	Cost	Rebate	Net Cost	Annual Savings	Simple Payback (Yrs)	Return on Investment (%)
44,238	$18,400	$4,149	$14,691	$6,315	2.33	43%

The solar pool heating system has offset about 5000 therms per year, saving about $5,000 annually. The system was originally estimated to save about 6,000 therms per year or about 20% more than the system appears to have offset over the past four years. There can be many reasons for the difference between estimated and actual savings such as the accuracy of the climate data and other modeling assumptions, unanticipated shading at the site, normal deviations in weather conditions in recent years from the long-term historical data, and operational inefficiencies.

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[1] The following information and comments regarding the function and condition of the facility and pool equipment are strictly the opinion of the authors and provide a limited analysis of the mechanical equipment for the purpose of reducing energy use. No comments or recommendations in this report should be construed as evidence of code, health or safety issues with the facility.

[2] The energy cost is based on the facility's current PG&E tariff. Rates change frequently but on average trend up over time.

[3] Based on a cash investment without energy price escalation or discount rates applied. The rebate is based on the current PG&E program and subject to availability of funds,

However, we have generally found that the solar estimation models don't adequately account for the real world operation of commercial pools. Also, most solar control technology isn't designed to adequately monitor and manage the integration of solar heating and conventional boiler operation with actual pool use. We recommend the installation of newly available (and low-cost) web-based monitoring and control technology that should provide better control and integration of the solar and conventional boiler, and help maximize the value of your solar investment.

Variable Frequency Drive Retrofit

Pool filtration pumps account for most of the electricity use in swimming pools. They are typically single-speed pumps sized to meet the maximum possible demand for the facility as defined by state code at the time the pool was built. This practice often results in "oversized" pumps that can't be controlled to better match a pool's actual operation and needs. Filtration pumps are typically operated 24/7 but generally require only about half the normal flow rate when pools are closed. A pump's energy use goes up exponentially with increasing speed making an oversized pump even more costly. Put simply, not being able to match a pump's speed to the need typically accounts for more than half the operating cost.

The Brisbane pool is 142,000 gallons which requires a flow rate of 395 gpm to meet the California code requirement for a 6-hour turnover of the pool's water. The circulation pump is sized to deliver a flow rate of 495 gpm, or 25% more flow than required by code when the pool is open.

Variable frequency drives (VFDs) are a type of power controller that can vary a pump's speed to better match the water flow and pressure requirements of a pool under different operating conditions. VFDs are typically installed to lower the speed of an oversized pump to deliver the water flow at the rate required by code for the size pool when it is open, a practice called "right-sizing". For the Brisbane pool, right-sizing the flow rate should save over 30,000 kWh annually, or about 37% of the pump energy use.

The VFD can also reduce the flow rate by as much as half when the pool is closed. Adding a constant flow control to the VFD can save even more while maintaining the code required flow rate when the pool is open. It continuously adjusts the speed of the pump to maintain a constant flow as system pressure increases from a dirty filter and other system changes. For Brisbane, the proposed VFD and operation will save about 44,236 kWh annually or about 49% of the pump's energy use. That will save the City about $6,315 annually at current rates.

Recommendations:

1. Install a variable frequency drive (VFD) with constant flow control on the existing pump. A VFD automatically controls power to the pump allowing you to lower the flow rate to that required by code and safe pool operation as well as a much lower flow rate when the pool is closed. The VFD also provides other power conditioning features that protect the pump motor and extends the pump life. The VFD will also be interfaced with the boiler and filter controls to increase the flow rate to the levels required during their operation. The installation should include the following easy-to-use manual controls:

- a time clock that provides at least 4 daily setpoints allowing the flow rate to be matched to the seasonal schedule for pool use such as when the pool is open or closed and lowered during periods of low bather loads as permitted by code,
- an override switch that allows staff to override any flow setback as needed for up to 2 hours at a time, and
- an exterior signal light that lets staff know when the pump is at full speed (6-hour turnover flow rate.)

These controls allow you to minimize the time that the pump operates at full speed yet provides an easy way for staff to bring the pump up to full speed during short periods of intermittent and exceptional operation.

The project is estimated to cost $18,400 and receive a $4,149 rebate from PG&E for a net cost of $14,691[4]. The project should pay for itself in savings in just over 2 years and provide a 43 percent annual return on investment[5].

Pool Solutions Group will provide a separate bid document for the recommended work.

Additional issues and recommendations:

2. At the time of audit, the pool pump was operating well below its design capacity and the code required flow rate. During a 2nd inspection, it was determined that the flow meter calibration set point was incorrectly set. The flow was within parameters once the correct set point was dialed. Had the flow meter set point been correct, then we would suspect that foreign matter may be clogging the pump's impeller and subject to inspection. If it were simply debris, it could be removed. If there were more serious problems, the pump would need to be repaired. The pump should be checked and repaired if needed as soon as possible regardless of the VFD retrofit but can be done as part of the retrofit work. The pump also has a leak in the shaft seal that can be fixed as part of the retrofit.

4.. The EPD sand filters may have higher than normal inlet pressure which could be the result of many things including insufficient backwashing (possibly a result of the reduced flow rate available from the pump), debris buildup in the sand requiring cleaning or sand replacement, or a misadjusted outlet throttle valve (EPD priority valve) setting. Optimizing the filter operation will further reduce energy use and cost as well as improve the overall filtration. The filter condition and operation should be thoroughly checked and optimized as part of the retrofit work.

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[4] The Brisbane pool pump uses a 15 HP 3 phase motor operating at 209 volts rather than 460 volts, which requires a VFD designed to handle the higher amperage required at the lower voltage. This adds about $4,000 more to the VFD equipment cost than for a pump motor operating at 460 volts.

[5] Based on a cash investment without energy price escalation or discount rates applied. The rebate is based on the current PG&E program and subject to availability of funds,

5. The facility has an automatic fill system to add water lost to evaporation and bather activity. This can hide potential pool leaks that may not be visible for a long time. While no submeter was visible in the equipment room, the blueprints show individual meters for the pool, main facility and irrigation. If so, the monthly water use for the pool can be compared to historical use to monitor for potential problems. Extraordinary water loss can be costly for both replacement and heating of the makeup water.

Financing Options

Low or no-cost financing may be available through two public programs, if needed.

On-bill financing: PG&E offers no-interest on-bill financing through a current program authorized by the California Public Utilities Commission. The loan is repaid monthly as a line-item on your utility bill. The payments are structured to be no more than the monthly savings you are estimated to receive from the energy efficiency retrofit. For your VFD retrofit, the loan would be repaid in two years, the time equal to your expected payback. The program funds are limited and subject to availability. If this financing is desirable and funds are still available, we will work with your PG&E representative to arrange the financing.

California Energy Commission Low-Interest Loans: The California Energy Commission (CEC) offers low-interest energy efficiency project loans to public agencies. The loans are also structured to be paid from the energy savings so that you have no out of pocket costs. Funds are subject to availability but the CEC maintains a large revolving fund. The application process is straightforward and we can help you apply.

Solar Pool Heating System

The solar pool heating system installed about 2006 uses glazed solar collectors manufactured by Heliodyne. Based on the data provided by staff, the system provided on average about 4,120 therms of heat to the pool annually over the past 4 years. Assuming a boiler efficiency of 82% for the facility's natural gas boiler, the solar system offset about 5,024 therms per year, saving about $5,000 annually[6]. While we don't have the original estimate of savings for the system, the public description provided by the solar installation company suggests that the annual savings had been estimated to be about 6,000 therms per year, or about 20% more than the system appears to have offset over the past four years.

There can be many reasons for the difference between estimated and actual savings such as the accuracy of the climate data and other modeling assumptions, unanticipated shading at the site, normal deviations in weather conditions in recent years from the long-term historical data, and operational inefficiencies. We have found that most solar control technology isn't designed to adequately monitor and manage the integration of solar heating and conventional boiler operation with actual pool use on commercial pools.

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[6] Natural gas prices are highly volatile and have bounced up and down considerably over the past several years. An average price of $1/therm is assumed for this report.

For example, solar controllers might lock out a conventional gas boiler when solar is available but can't prevent the boiler from firing ahead of the solar system coming on line. Except during summer conditions when high pool temperatures can occur from direct sunlight, solar models assume that all the available solar thermal energy is used by the pool. This assumption works pretty well for residential pools. On commercial pools, conventional pool boilers generally cycle all night to keep a pool up to temperature before solar is available. By the time the solar can contribute, the pool is already at its desired setpoint. The solar system can only make up for the daytime heat loss generally from 9AM to 3PM. Even if the pool is closed, the pool setpoint can't be automatically raised to make use of available solar to counter heat loss at night. Current technology lacks the ability to monitor and control for optimization between the conventional boiler and solar in conjunction with the actual daily pool scheduled use. Conventional monitoring and data logging equipment has been too costly to use and maintain as well.

Your pool is equipped with an Istec Model 5202 btu meter that measures the total energy transferred from the solar heating system. The unit constantly monitors the supply and return temperature as well as the water flow through the heat exchanger to calculate the heat energy. This meter is what staff uses to read and log the Btus generated from solar. While the unit has the ability to store up to 13 months of data that can be downloaded, it does not appear that it was set up for that purpose since staff has been logging the readings by hand. The new data logging controller may be able to take the output automatically from this unit to automate and integrate the btu data with system operation.

Recommendation: Install a new low-cost web-based data-logging and solar control system (the SWIMPC from Hotsun Technologies) that provides the needed functionality for monitoring and managing solar and conventional heating systems on commercial pool. Controller will provide real-time information and allow for web-based control and optimization of the solar and boiler operation. The new solar controller can be installed for about $950.00. It will provide facility staff with the ability to adjust the conventional boiler operation to better match facility use and optimize the solar contribution. While we can't estimate the savings potential, we are confident it will provide the data and control you need to maximize your investment in the solar heating system.

While the data logging function of the recommended controller can be set up in parallel to the existing controller, actual substitution of the new controller for the existing one to operate the solar system should not be done without the knowledge and consent of the solar installation company if the system is still under warranty.

Pool Solutions group will provide a separate bid document for the recommended installation.

Facility & Equipment Description

- **Location:** 2 Solano Ave., Brisbane, CA 94005
- **Facility Age:** 12 years old (built in 2000)
- **Facility Description:** Standalone multi-use swim center with a glazed solar pool heating system.
- **Seasonal Use:** The facility is open year-round
- **Daily Hours of Operation (approx)**:
    - Oct 31st to May 26th, Monday-Friday, 7 to 7; Saturday/Sunday – 9:30 to 1:30
    - May 27th to Oct. 30th, Mon-Fri- 6:30 to 7; Sat/Sun – 10:30 to 5
- **Pool Dimensions:**
    - **Capacity:** Approx. 142,000 gallons[7]
    - **Dimensions:** Rectangular pool 70 by 75 feet
    - **Perimeter:** 360 feet
    - **Surface Area:** 4,168 Sq Ft
    - **Depth:** to 8 feet
- **Bather Load:** 208
- **Surface Water Removal:** Skimmers
- **Filtration:** High Rate Sand Filter, EDP Model 206CP, 33 sf
- **Treatment:** Liquid Chlorine
- **Pump: Paco** Model 10-40957-140001 with 8.73" impeller diameter rated for 495 gpm at 68' of head; 15 HP 3-phase motor operating at 208 volts
- **Heating:**
    - **Natural Gas Boiler:** Raypak Model P-1826 1.497 million Btu/hr output with 82% thermal efficiency
    - **Solar Pool Heater:** 48 Heliodyne Gobi Max glazed solar collectors on a closed-loop glycol system

Utility Providers & Tariffs: Electricity - PG&E, A10; Natural Gas –PG&E GNR-1

[7] From original blueprints

Gary L. Gockel
Pool Energy Upgrade Estimate
for
Brisbane Community Swim Center
October 22, 2012

Caroline Cheung
Administrative Management Analyst
City of Brisbane | www.brisbaneca.org
50 Park Place, Brisbane, CA 94005
Ofc: (415) 508-2157
Fax: (415) 467-4989
ccheung@ci.brisbane.ca.us

Dear Ms Cheung;

Thank you for this opportunity to provide energy efficiency equipment and services for the "Brisbane Community Swim Center located at 2 Solano St, Brisbane, CA. 94005

A preliminary on-site audit was conducted by Tim Rosenfeld of HMW International and Gary Gockel on May 21, 2012. Gary Gockel conducted a second audit on June 13, 2012. The on-site audits provided the basic information to perform the engineering analysis and establishment of a "Whole Pool" energy reduction and system optimization strategy as detailed in the report of August 1, 2012 titled: "**Brisbane Community Swim Center, Energy Efficiency Analysis & Recommendations**".

Per the report, "The recommended retrofit of a variable frequency drive (VFD) on the existing pump is estimated to save about 49% of the electricity used by the pump, saving about $6,315 in annual energy cost[1]. The project is estimated to cost about $18,400 and receive a $4,149 rebate from the utility for a net cost of $14,691. The project should pay for itself in savings in just over 2 years and provide a 43 percent annual return on investment."

Overall project:

1) Install a variable frequency drive (VFD) with constant flow control on the existing pump.
2) A VFD automatically controls power to the pump allowing you to lower the flow rate to that required by code and safe pool operation as well as a much lower flow rate when the pool is closed.
3) The VFD also provides other power conditioning features that protect the pump motor and extends the pump life.
4) The VFD will also be interfaced with the boiler and filter controls to increase the flow rate to the levels required during their operation.

[1] The energy cost is based on the facility's current PG&E tariff. Rates change frequently but on average trend up over time.

5) The installation includes easy-to-use manual controls:

i) A 7 day time clock that provides at least 4 daily set-points allowing the flow rate to be matched to the seasonal schedule for pool use such as when the pool is open or closed and lowered during periods of low bather loads as permitted by code,

ii) A manual spring type time clock that allows staff to override any flow setback as needed for up to 2 hours at a time

iii) An exterior signal light that lets staff know when the pump is at full speed (6-hour turnover flow rate.)

iv) Keyed "Service switch" for staff to use when performing backwashing of the filters or manual override of the system.

v) Interlock shutdown of the chemical feed system when the VFD is OFF.

vi) Interlock shutdown of the heater when the VFD is OFF.

vii) Gas heater is to be controlled by a Master control-thermostat that will increase the pump speed to a pre-determined heater flow speed when heat is being called for.

viii) Interface with the new solar priority controller if installed per separate contract.

ix) A remote soft Start/Stop switch will be installed in the pit next to the pump for use when cleaning the pump basket.

x) An Auto-start upon restoration of power setting will be programmed into the VFD for when power is lost over a weekend.

xi) These controls allow you to minimize the time that the pump operates at full speed yet provides an easy way for staff to bring the pump up to full speed during short periods of intermittent and exceptional operation.

6) The VFD package includes:

a) Danfoss VLT Aqua Drive FC202, VFD, NEMA 12, 20 hp, 208VAC, 3 phase. Your pump is a 15 HP. The VFD is being upgraded to a 20 HP at NO additional cost to you. This upgrade may provide for longer term operational reliability.

b) The Variable Frequency Drive (VFD) being recommended is a NON-EXCLUSIVE, NON-PROPRIETARY products from Danfoss. These units are specially designed and suited for commercial pool pumps. For additional information please go to: http://danfoss.ipapercms.dk/Drives/DD/Global/SalesPromotion/Brochures/ProductBrochures/02VLTAQUADriveSG/

c) Aquatic Controller with components to control system as described in (5) above.

7) As the flow is reduced, the pump pressure decreases. In order to maintain the proper operation of the chemical sensing and feed system, a supplemental 100 sq. ft. cartridge filter is being installed. The chemical sensing and feed system piping is rerouted to pick up higher pre- filter pressure that is now filtered by the new ultra-low restriction cartridge filter.

8) Automatic filter tank air relief valves will be installed on each filter tank.

9) The pool and sand filters will be treated with enzymes to improve the water clarity and break down oils in the sand bed.

10) The filter flow valve will be inspected for proper operation.

11) Additional flow meters, pressure gauges and vacuum gauges will be installed as part of this project in order to properly analyze and tune-up the system for maximum energy efficiency and appropriate operation.

Conditions & Disclosure:

1. All values are approximate; the hours of operation and savings may vary due to usage, seasonal variations and/or weather conditions.
2. In this presentation, only a variable speed drive and related equipment is being added. There are no changes to the motor, pump, filters, chemical controlling, heaters, heat exchangers or solar panels.
3. Savings figures are based on an estimated cost per kWh as outlined in the above report.
4. Estimate includes material and labor for installation.
5. Subject to acceptance and approval of the San Mateo County Environmental Health department.
6. Rebates are available on a first come-first serve basis and may be modified, changed or withdrawn at any time by PG&E or the CPUC.
7. Estimated pricing is good for 30 days.
8. The energy audit is NOT a pool audit, safety inspection or complete site inspection. Only items of a general nature relating to energy efficiency are highlighted.
9. PG&E rebate forms and correspondence relating to the PG&E audit and their 3rd parties energy audit are included. Gary Gockel is the assigned Project Sponsor.
10. All Rebates are to be paid directly to the City of Brisbane.
11. A revised savings calculation will be provided once the official PG&E power measurements are known and presented in their acceptance of this project for rebate.
12. All work is above grade.
13. The report and this bid document contain information prepared for the exclusive use of the City of Brisbane. Savings estimates and recommendations were prepared using proprietary models developed by HMW International and Gary L. Gockel. No copying or use of this information by other parties is allowed without written permission.
14. The report discusses the installation and use of a new web-based monitoring and control device for better integration of the solar and conventional boiler. This product and its installation are not included in this estimate as it is not eligible for utility rebate.

Time frame:

1. PG&E Customized Retrofit rebate application has been assigned; the outside 3rd party reviewer has visited the site and begun the engineering documentation. Report is expected to be completed in14 days (two weeks).
2. Once approved by PG&E and a City of Brisbane purchase order is received, the materials will be ordered and work will begin.
3. Environmental Health Department permit time is 20 days
4. When materials arrive, allow 10 days for installation.

5. After materials delivery payment is received, on-site effort will proceed.
6. Project completion based upon estimated times noted above: 44 days. Pool use down time is estimated to be 1 day for the pump/VFD. Ideally, we would like to get this project completed within the 2012 PG&E cycle.

Contractors are required by law to be licensed and regulated by the Contractors' State License Board, which has jurisdiction to investigation complaints' against contractors if a complaint is filed within four years of the date of the alleged violation. Any questions concerning a contractor may be referred to the Registrar, Contractors' State License Board, PO Box 26000, Sacramento, CA. 95826.

Total for Variable Speed Pool Pump VFD and Controller $18,400.00

Payment terms:

- 90% due upon completion of installation $16,560.00
- 10% due upon PG&E 3rd party post-audit report
  Indicating that estimated electrical savings were achieved..... $ 1,840.00

All purchase orders and disbursements to be issued to Gary L. Gockel.

Please feel free to contact me to arrange for any meetings or additional information.

Respectfully submitted,

Gary L. Gockel

707-529-9432
Certified Aquatic Energy Auditor
Certified Pool Operator
California Contractor License #785971
C-61/D-35 Swimming Pool Service & Repair
C-53 Swimming Pool Contractor
1705 Jennings Ave., Santa Rosa, CA. 95401
Gary@PoolSolutionsGroup.com
www.PoolSolutionsGroup.com