MUNICIPAL POOL ENERGY EFFICIENCY PROJECT

Texas City Efficiency Leadership Council Best Practice

San Antonio: Municipal Pool Energy Efficiency Project

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Description of Best Practice

When thinking about energy efficiency retrofits, the focus is typically on lighting and heating, ventilation and cooling (HVAC). The City of San Antonio has been a leader in energy efficiency retrofits, realizing significant savings by doing the basics but always looking to do more. Several years ago, to determine its next cost-effectiveness project, city staff reviewed energy use data and were surprised to discover high energy consumption at its municipal swimming pools. In 2013, the 26 municipal pools used approximately 3,693,217 kilowatt hours (kWh) of electricity at a cost of $320,133. This was surprising, as the majority of the pools operate only four months out of the year, with two indoor pools operating year round. Because most pools only operate a portion of the year, they did not immediately come to mind when city staff were considering and prioritizing energy efficiency retrofit options.

The city began the pool energy efficiency project in 2012 and retrofitted 22 of its pools in 2014; hence, the first of its kind municipal swimming pool energy efficiency retrofit project in the country. The long lead-time was due to the project idea having little precedent. The pool retrofit took a significant amount of research and stakeholder engagement to ensure success. The primary hurdle was overcoming the commonly held belief that water quality and safety would be compromised when water circulation and energy consumption were reduced.

Pool water quality standards and the requirements to meet them largely were set in the 1920s and have changed little since then. The standards require that a pool "turns over" three to four times a day, meaning the entire volume of water is filtered several times each day. To accomplish this task, it is common practice to install more pumping capacity than is necessary in order to manage occasions when there are dirty filters and high-use days. However, in reality, normal operations of a pool, which occur 95 percent of the time, do not need the entire pumping horsepower available.

The city's goal was to ensure that all pools were meeting State of Texas water health and safety standards, while at the same time ensuring that the pools were not consuming more energy than necessary. This was accomplished by installing variable frequency drives (VFD) on the pool pumps with flow meters, which provide digital feedback to maintain proper flow rates, as well as filter and motor upgrades. The VFD approach allows the pools to meet water quality standards while maximizing efficiency. Variable frequency drives have been regularly installed in residential aquatic applications. However, there has been significant opposition to installing these drives in public pools due to the large number of pool users during a typical summer day. The concern is that this variable pumping frequency would not be able to maintain state water quality standards. However, through a three- year process of research, equipment testing, stakeholder engagement and training, the city has been able to significantly reduce pool energy consumption while meeting health and safety standards.

STATE OF TEXAS POOL STANDARDS

Texas legislative activity also Texas requires that all public pools built before 1999 have adequate circulation to achieve an eight-hour turnover. Those built after 1999 must achieve a six-hour turnover.

Texas Administrative Code, Title 25, Part 1, Section 265, Subchapter L: Standards for Public Pools and Spas.

All pool equipment must be ANSI/NSF 50 certified.

The city also uses the fund to pay the marginal costs of efficiency improvements within larger capital projects. As the city realizes savings in each project, it returns a portion of the savings to the fund to be used in future projects. Utility rebates supplement savings in avoided costs, and the reduced energy usage contributes significantly to lower local air emissions.

Motivation for Implementing Municipal Pool Retrofitting

The City of San Antonio has aggressively pursued lower energy and water consumption across its operations. The city is motivated to identify all reasonable, cost-effective retrofits to reduce costs, diminish environmental impact and ensure reliable and safe operation of municipal facilities.

To accomplish this level of activity, the city takes its energy data management quite seriously. Its data management practices provide a comprehensive picture of the city's energy consumption, allowing staff to measure and verify the performance of retrofits and proactively identify new opportunities.

The data provided a good picture of pool operations. Data analysis and initial research of pool efficiency indicated that significant savings would be realized that would cover the cost of the project within the lifetime of the equipment. As detailed below, these savings were significantly higher than anticipated, yielding a payback occurring before the end of the equipment's useful life.

Benefits of Retrofitting

Savings from the pool retrofit project exceeded staff expectations. It cost $136,674 (including labor) to retrofit the pool pumps with variable frequency drives (VFDs). To offset deferred maintenance costs, while installing the VFDs the city also replaced the pool filters and motors. These upgrades increased the total project cost to $145,747.

Without utility rebates, the energy efficiency retrofits on average recouped their costs in 2.1 years; the payback for eight pools was less than 10 months. CPS Energy utility rebates reduced the project cost and subsequent payback by $86,801. With rebates, the net cost of the project was $49,874, shortening the overall energy efficiency project payback time frame to less than one year. At the current average blended electricity rate of $0.096/kWh, the city is saving approximately $63,000 per year.

Beyond financial savings, the city is realizing significant environmental savings. The city was able to reduce its pool facilities' annual energy consumption from 3,693,217 kWh to 2,985,700 kWh, a 707,517-kWh reduction and an approximately 24 percent energy savings. The project saw a 151-kW peak demand reduction allowing greater utility rebates. Finally, the energy savings reduced greenhouse gases by 488 metric tons per year, the equivalent of taking 103 passenger vehicles off the road.

Challenges Faced and Addressed

Before proceeding, city staff began researching other related municipal pool retrofit activities. Through an exhaustive search they discovered a lack of precedent for variable speed pool pump retrofits in municipal pools. However, they did find a Department of Energy National Renewable Energy Laboratory paper titled "**Measure Guideline: Replacing Single-Speed Pool Pumps with Variable Speed Pumps for Energy Savings**," by Steve Easley and Andrew Hunt. This paper focuses solely on residential pool pumps but was seen as applicable to public pools as well.

The most significant concern was that, due to a lack of precedent, there were not any examples to assess the viability of such a retrofit, particularly when considering how the upgrade would influence pool safety and water quality. This concern was overcome by significant stakeholder engagement with local and state health authorities, as well as by bringing in pool experts that could speak to the relationship between water quality and variable speed pumps in a residential setting.

A pool retrofit of this kind requires collaboration with several stakeholders to ensure that the pool is operated and maintained in a manner that guarantees pool safety and optimal operation over time. The key decision-makers and stakeholders for this project included the city's executive leadership, the Parks and Recreation Department, the San Antonio Metropolitan Health District and the Texas Department of State Health Services (TDSHS).

The keys were local and state health departments' participation in the process and the approval of the upgrade. The TDSHS sets statewide pool health and safety standards, and the Metro Health District is responsible for ensuring that all of the pools meet code. The greatest concern was that the water turnover rates and circulation might be compromised when going from a standard single-speed pool pump to a variable-speed pump. However, because the majority of the municipal pools already exceeded mandated flow rates, the water circulation at most pools could be reduced. For those pools that did not exceed existing code flow rates, the variable-speed pumps were adjusted accordingly to ensure that all pools met code.

STATE OF TEXAS POOL STANDARDS

- Open communication between Office of Sustainability, swimming pool consultants and Parks and Recreation Department Operation and Maintenance (O&M) staff.
- Involve the O&M staff early on in the process to gain buy-in and foster understanding.
- Ensure proper training for O&M by including training requirements in contract.
- Conduct a post retrofit energy audit with appropriate commissioning and ensure that all warranties are in place.
- Track the pools' energy consumption in EPA Portfolio Manager to ensure proper operation over time.
- Certify at least one Parks and Recreation Department staff member as a pool operator.

Another significant issue was identifying ANSI/NSF 50-certified equipment. An ANSI/NSF 50-certified variable-speed pump was unavailable. To overcome this issue, it was proposed that external variable- speed control drives be installed. The TDSHS initially argued that by installing an external drive the NSF certification of the existing pumping equipment would be revoked. However, TDSHS subsequently reversed position after a demonstration of how the external drives would maintain water clarity and quality and without affecting the certification of existing equipment. Performing the demonstration were the city; Steve Easley, a pool consultant with Steve Easley and Associates; and Pentair Aquatic Systems, the city's pool retrofit vendor. More specific details about this process can be found in the *Swimming Pool Energy Efficiency Retrofit Final Report*[1].

Another key to success was partnering with the Parks and Recreation Department. The department is responsible for all pool operations and maintenance. The concern was that operations and maintenance (O&M) would be "business as usual" and that the pools would continue to be operated in the same manner as before. Prior to the retrofit, pool operators' focus was on water health and safety; little thought was given to energy consumption. With the retrofit, however, the role of the pool operators expanded beyond health and safety to include operational efficiency.

To ensure that health, safety and efficiency were key areas of focus, the department was involved from the outset of the retrofit process. Parks and rec staff participated from the initial auditing through the installation and commissioning of the pools. Further, pool operators received hands-on training along with operational guidebooks emphasizing best practices in safe and efficient pool operations.

[1] Steve Easley and Associates, et al. "City of San Antonio Public Swimming Pool Energy Efficiency Retrofit Final Report." Forthcoming

Description of Retrofit Process

Since 2011, San Antonio has been focused on identifying opportunities for energy and water efficiency in city operations. The ability to sustain this effort points up the city's exceptional efforts to obtain energy and water data. Without good data, and ongoing review, opportunities would not have been identified and savings would not have been realized. Therefore, the first step in this process was ensuring good data quality and continual review of the data. The city was able to identify other areas in which energy and water efficiency could be improved and to prioritize projects based on its analysis. Consequently, the city found that a significant opportunity was available through pool upgrades. However, staff were not certain what the upgrade should entail.

The next step was to begin researching pool retrofit methods and technologies that would make pools more energy efficient. Staff found little research and few case studies on this topic. They did find one resource, identified earlier, and directly engaged Steve Easley, the author of the work. They then began assembling a team of experts consisting of pool consultants, pool equipment manufacturers and staff of city departments, particularly Parks and Recreation and Health. With this team formed they began scoping the project, considering not only how to reduce energy consumption but also how to do so in a way ensuring compliance with state water health and safety standards. One of the more significant barriers they faced, described earlier in this paper, was identifying appropriate equipment and methods that met ANSI/NSF 50 certification.

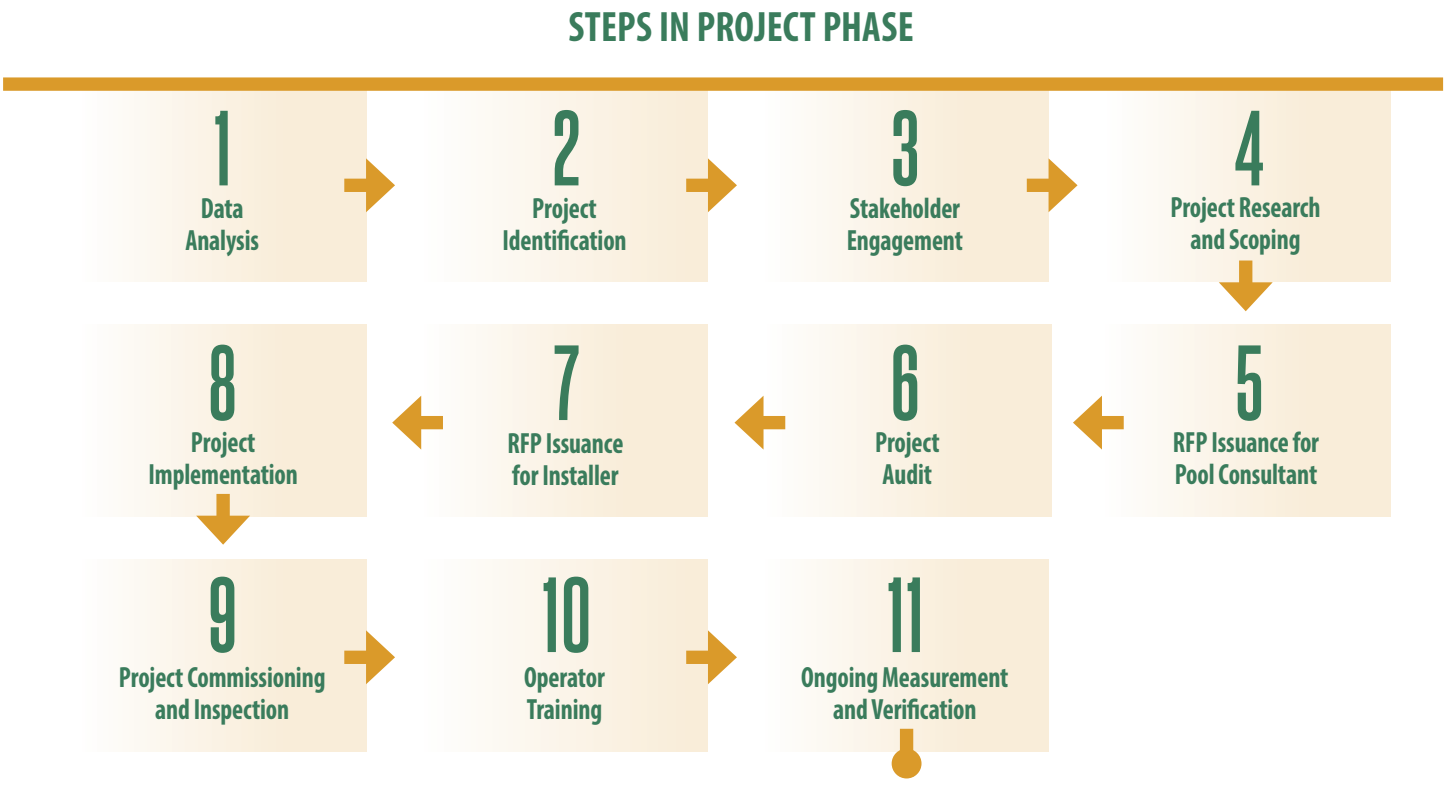
After working through many of the potential barriers and identifying the scope of work, the team issued a request for proposals (RFP). The city sought professional services from qualified pool consultants with expertise in swimming pool energy efficiency. Through this competitive process the city chose a team of pool experts to perform mechanical assessments of pool energy conservation. The team included Steve Easley and Associates, AquaStar Pool Products and Pentair Aquatic Systems. Upon contracting with this team, the city began the audit portion of the retrofit process.

The first step in the audit process included collecting utility data and information on pool facilities. Fortunately, Parks and Rec staff had comprehensive data on the pools' ages and flow rates, greatly aiding project development. The team then made site visits to all pools to conduct energy and hydraulic efficiency audits. The length of an audit largely depends on the number of pumps at a pool, typically requiring one hour per pump. For this particular project, and in general, audits are performed at no cost to the end-user.

Data collection and auditing were followed by the creation of a retrofit plan. The plan estimated energy savings, cost savings and payback for the project, taking into account existing equipment and flow meters. This information was combined into a bid specification provided to the city, which used it to solicit a contractor for the implementation. This was a competitive bid process to retrofit all eligible pool facilities. The selected contractor, Commercial Swim Management (CSM), was required to implement the retrofits during the six weeks between the time the pools were filled and opening day. A trial installation was conducted at the SA Natatorium to determine how the retrofit would affect water quality and clarity. Each installation took a couple of hours per pool.

Upon completion of the retrofits, the team conducted a post-retrofit audit. This audit included energy assessment, a quality assurance inspection and an inspection to ensure that the work complied with bid specifications. In parallel, the Parks and Rec staff were trained in the proper use and maintenance of the equipment. They were also provided a pool-specific operations plan. The final phase of the project was an assessment of pre- and post-retrofit energy usage and water quality, including on-going measurement and verification.

The flow chart below depicts each phase of the process.



Post Project Evaluation

Completing the project in the summer of 2014 provided two swimming seasons to test the new retrofits. The pool consultants worked closely with Parks and Rec staff during the previous two cycles to help them understand what to look for when monitoring the pools – what is important and should be viewed as a problem and what is not a problem. There were minimal problems the first year but several calls to the Office of Sustainability from Parks O&M staff for some minor technical assistance. These calls were largely due to the learning curve that the employees were quickly mastering. The O&M staff got up to speed with the training and field experience during the first summer, and there were very few calls in season two. This reduction in calls also was due to extremely low turnover of pool staff, allowing for a continuity of knowledge. Furthermore, because staff were brought into the project early on, they understood and appreciated what was being done and developed a sense of ownership over the project.

Conclusion

The City of San Antonio has improved the operations of its aquatic facilities in addition to reducing energy and water consumption where retrofits were implemented. The success of this initiative was predicated on several factors:

- Comprehensive energy audits
- Thorough review of facility properties and energy consumption data
- Development of robust bid specifications
- Ongoing communication among participating departments and agencies
- Selection of a qualified installation contractor
- Quality assurance of retrofits
- Commissioning of installed equipment
- Thorough training of operations personnel

A key component of the project was gaining the support and buy-in of the facility staff who maintain the pools. Once operational personnel saw the value of this effort, they took ownership of the technology and have been able to sustain energy savings. This approach is transferable to energy retrofits of almost any type. It helps ensure successful implementation and long-term savings resulting from energy conservation measures.