



Performance Tracking Quarterly Report - 3rd Quarter

Project Number: XXXX-XX
 Building Name: San Diego Building
 Provider Name: Provider
 Date Submitted: June 10, 2009

Summary

Fourteen measures were implemented under Phase 1 of the retrocommissioning project. The performance of seven of these measures is being tracked through analyzing trend data collected from the ECS control system. These seven measures were selected based on their energy savings, ability to be monitored, and high potential for persistence problems. The results of the performance tracking for the most recent three-month period are presented in this report.

The combined energy savings of the seven tracked measures, estimated post-implementation and pre-tracking, represents 45% and 83% of the total electricity and gas savings, respectively.

Tracking Summary and Recommended Action

Measure # & Description	Tracking Finding	Recommended Action	Responsibility
2 and 4: Add VFDs to evaporator and condenser water pumps	The evaporator and condenser pumps are not operating in accordance with the new control sequence (operate the two VFD-equipped pumps when just one chiller operates).	Operate the pumps based on the new control sequence, whether manually or automatically controlled.	San Diego Building owner / staff
12.1: Add VFD to AH-5 supply fan	The new VFD on air handler AH-5's supply fan is modulating the fan speed as expected. Sub-measure is persisting; energy savings are being realized.	none	n/a
12.3: Disable heating water pumps at OAT>65 degrees F.	The North Tower fan coil unit heating water pumps are not operating in accordance with the new control sequence (disable the pumps when the outside air temperature is above 65°F).	Operate the pumps based on the new control sequence.	San Diego Building owner / staff
	It is still questionable what information is being reported to the ECS control system by meter #45, "N HHWB Gas".	Investigate meter #45 to determine if the information being reported is indeed the gas consumption for the North Tower boilers.	San Diego Building owner / staff

Measure # & Description	Tracking Finding	Recommended Action	Responsibility
12.6: Modify SAT reset schedule and VAV box minimum flows AC-3	Air handler AC-3's supply fan is being modulated as expected. Sub-measure is persisting; energy savings are being realized	none	n/a
14 and 15: Add VFDs to domestic water booster pumps	The domestic water booster pumps are operating as expected. Measure is persisting; energy savings are being realized.	Continue to collect amp draw data.	San Diego Building owner / staff

1.0 Measure #2: Install VFD on one evaporator pump, Measure #4: Install VFD on one condenser pump

Tracking Performed

The VFDs for these pumps were installed in July 2006. These two pumps and the other four constant speed evaporator and condenser pumps are currently being started and stopped manually by the building operators. Automatic control of the pumps based on the new sequence of operations will begin when control is migrated from the existing Energy Control Systems (ECS) control system to the new Automated Logic (ALC) control system.

To track these measures, hourly pump and chiller status trend data were retrieved from the ECS control system for the period March 1, 2007 through May 31, 2007.

Tracking Results

Between 3/1/07 and 5/31/07, chiller #1 ran alone 46% of the time, chiller #2 ran alone 51% of the time, and both chillers ran simultaneously 3% of the time. There was never a period when both chillers were off. The following tables summarize the performance of the pumps during this period:

Evaporator (CHW) and Condenser (CDW) Pump Performance With One Chiller Running		
Pump	Percent of periods during which pump was operating alone	
	Expected	Actual
CHW-1	0%	53%
CHW-2*	100%	0%
CHW-3	0%	47%
CDW-17	0%	53%
CDW-18*	100%	0%
CDW-19	0%	47%

* - pump with VFD

Evaporator (CHW) and Condenser (CDW) Pump Performance With Both Chillers Running		
Pump Combination	Percent of periods during which pump combination was operating	
	Expected	Actual
CHW-1 & CHW-2*	0%	0%
CHW-2* & CHW-3	0%	0%
CHW-1 & CHW-3	100%	100%
CDW-17 & CDW-18*	0%	0%
CDW-18* & CDW-19	0%	0%
CDW-17 & CDW-19	100%	100%

* - pump with VFD

As indicated in the first table, the pumps are not operating in accordance with the new sequence of operations (one chiller operating: VFD-equipped pumps are on, constant speed pumps are off; both chillers operating: VFD-equipped pumps are off, constant speed pumps are on) when only one chiller is operating. The second table shows that the pumps are operating in accordance with the new sequence when both chillers are operating. This is similar to the pump performance reported in the previous Performance Tracking Report (3/26/07).

For this 92-day period, the expected energy savings of 58,100 kWh (\$7,320) was not realized since the pumps did not operate according to the new sequence of operations.

Recommended Action and Follow-Up

Operate the pumps based on the new sequence of operations referenced in the *RCx Final Report*, whether via manual or automatic control. If manual, develop a procedure and train the operating staff as necessary. The Provider will continue to track this measure, and will submit the findings in the next Performance Tracking Report.

2.0 Measure #12: Eliminate simultaneous heating and cooling

Tracking Performed

This measure consists of a number of sub-measures divided over two implementation phases. The three Phase 1 sub-measures being tracked as part of this performance tracking include:

Measure #	Description
12.1	Replace failed VFD on North Tower AH-5.
12.3	Repair North Tower guest room fan coil unit valves; cycle North Tower heating water pumps.
12.6	Modify reset schedules and VAV box minimum flows for South Tower air handler AC-3, to minimize reheat burden and fan energy.

The energy savings for these three sub-measures accounts for 85% of the electric savings and 83% of the gas savings related to Phase 1 Measure 12.

To track these three sub-measures, four specific HVAC system components were monitored through collection of trend data from the ECS control system:

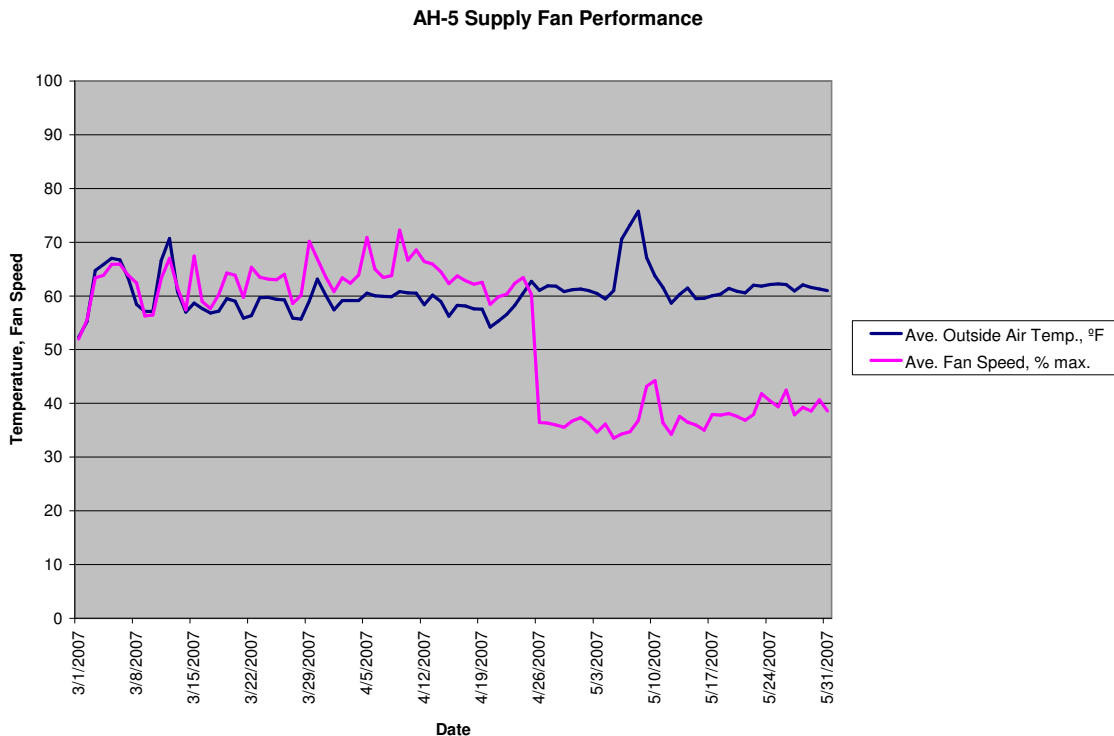
- Air handler AH-5 (60HP, serves public areas, e.g., registration desk and main lobbies, in the North Tower)
- Chillers
- North Tower heating water pumps
- Air handler AC-3 (40HP, 31,300 cfm, serves ballrooms in the South Tower)

Tracking Results

12.1: Replace failed VFD on North Tower AH-5

Prior to implementing this measure, the supply fan for air handler AH-5 was running at 100% speed, in bypass mode, due to a failed VFD. This was discovered during the retrocommissioning investigation.

The 01/25/2007 post-implementation Performance Tracking Report showed the new VFD modulating the fan speed adequately, and the speed closely correlating with outside air temperature. As indicated in the following chart, the fan speed is still being modulated, and the energy savings related to this sub-measure are persisting.



The chart shows a large change on 4/25/07. Prior to this date, the average fan speed was 63%; after this date, the average speed drops to 38%. This may be due to VAV boxes being shut off for remodel work being performed in the main Lobby.

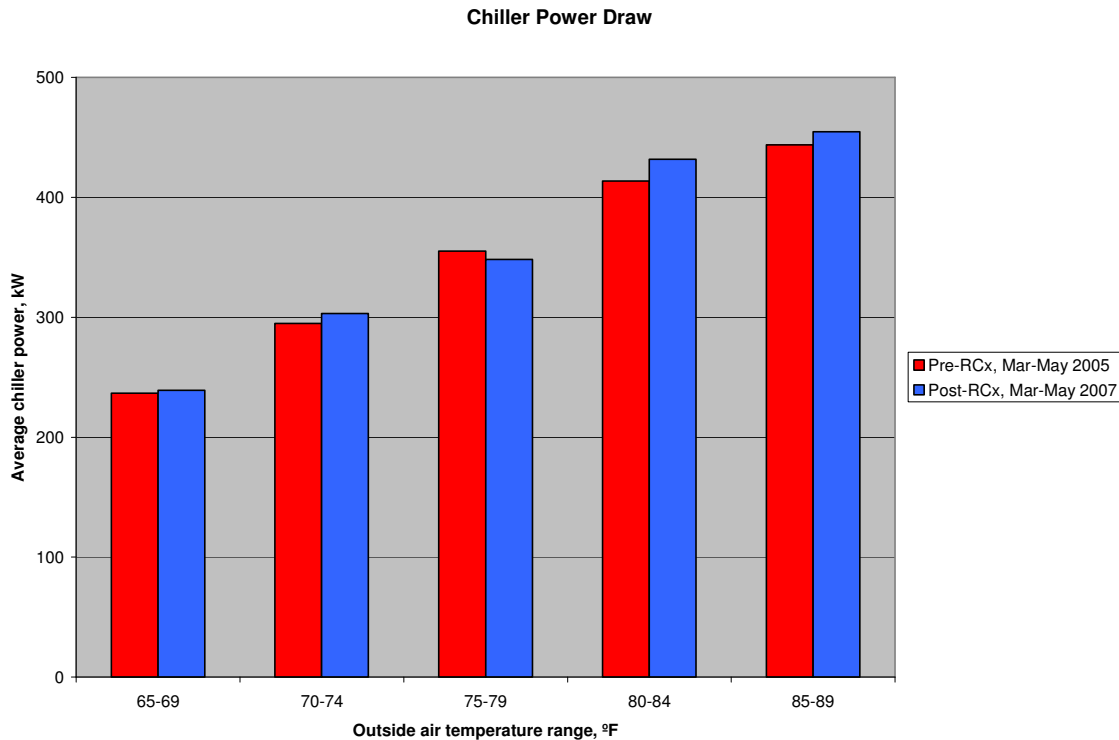
12.3: Repair North Tower guest room fan coil unit valves; cycle North Tower heating water pumps

This measure called for the two constant volume heating water pumps serving the North Tower fan coil units, HHWP-11 and HHWP-12, to be automatically disabled whenever the outside air temperature is above 65°F.

Prior to implementation of this measure, much of the load on the heating water system was the base load of the chilled water system; simultaneous heating and cooling was present and excessive. The plan for verifying that the heating system load has since been reduced included tracking gas usage through a meter installed in the gas piping to the North Tower heating water boilers. However, we’ve since learned that the ECS control system point related to the boilers’ gas usage, Meter #45 “N HHWB Gas”, may not be reporting valid data.

For this tracking period, chiller electricity consumption was monitored instead of boiler gas usage. The energy savings for this sub-measure included not only gas savings related to the boilers, but also electricity savings related to reduced chiller usage. A 50 kW reduction in chiller power for all chiller operating hours above 65°F was used in estimating the electricity savings related to turning off heating water pumps HHWP-11 and HHWP-12. This was based on testing in September 2005, which found that turning off these heating water pumps reduced both the chiller electricity and boiler gas consumption significantly.

The following chart and table show average chiller power draw.

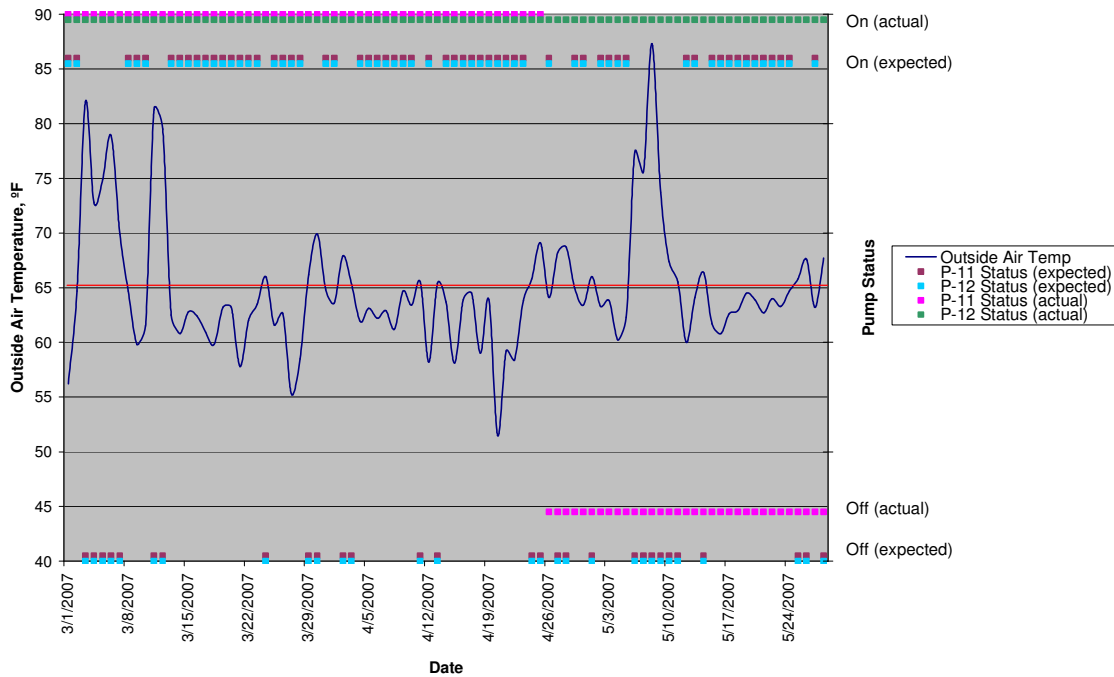


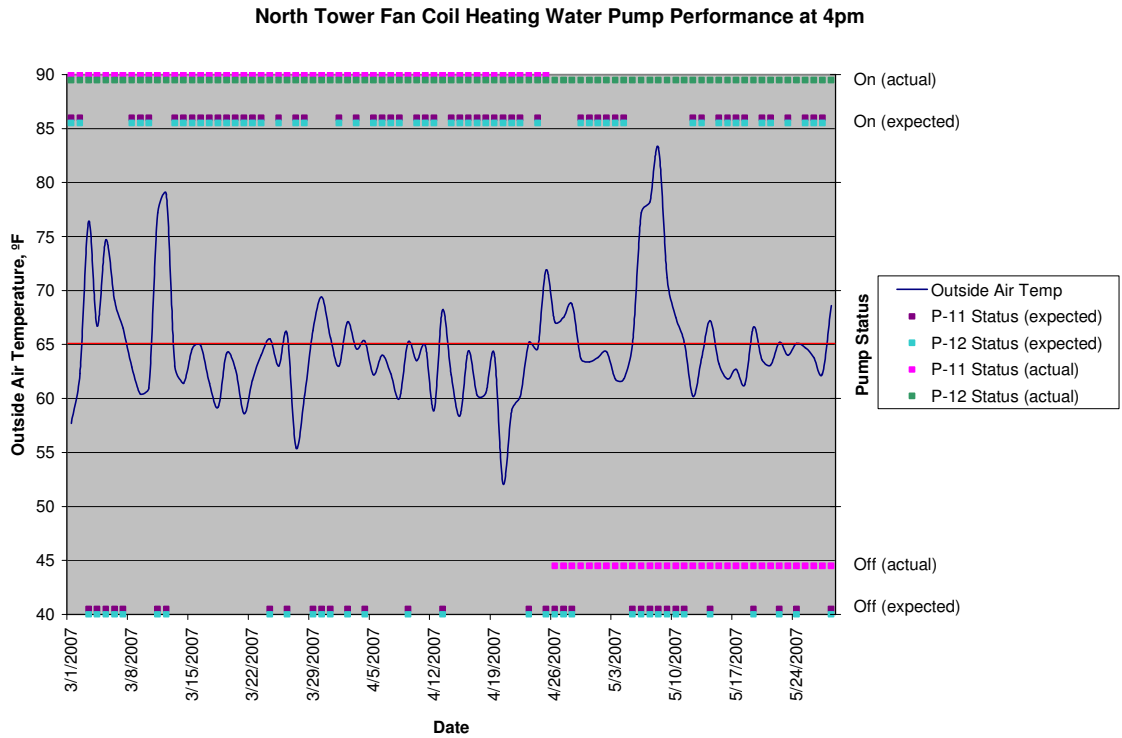
Period	Cooling Degree Days	Heating Degree Days	Average Temperature	Average kW
3/1/05 – 5/31/05	122	83	71.2°F	349
3/1/07 – 5/31/07	33	500	70.1°F	355

As shown in the chart, the chiller kW has not reduced by the anticipated 50 kW. The table shows that even though 2005 was warmer than 2007 for the same three-month period (March – May), the average chiller kW is approximately the same. The estimated energy savings related to this sub-measure is not being realized, likely due to the operation of the heating water pumps.

As shown in the next two charts, these pumps are not operating in accordance with the sequence related to this measure (automatically turn off both pumps when the outside air temperature is above 65°F). Two charts, one for 3pm and one for 4pm, are shown in order to account for duty cycling, which allows the pumps to be turned on for 20 minutes every three hours to keep the piping warm.

North Tower Fan Coil Heating Water Pump Performance at 3pm



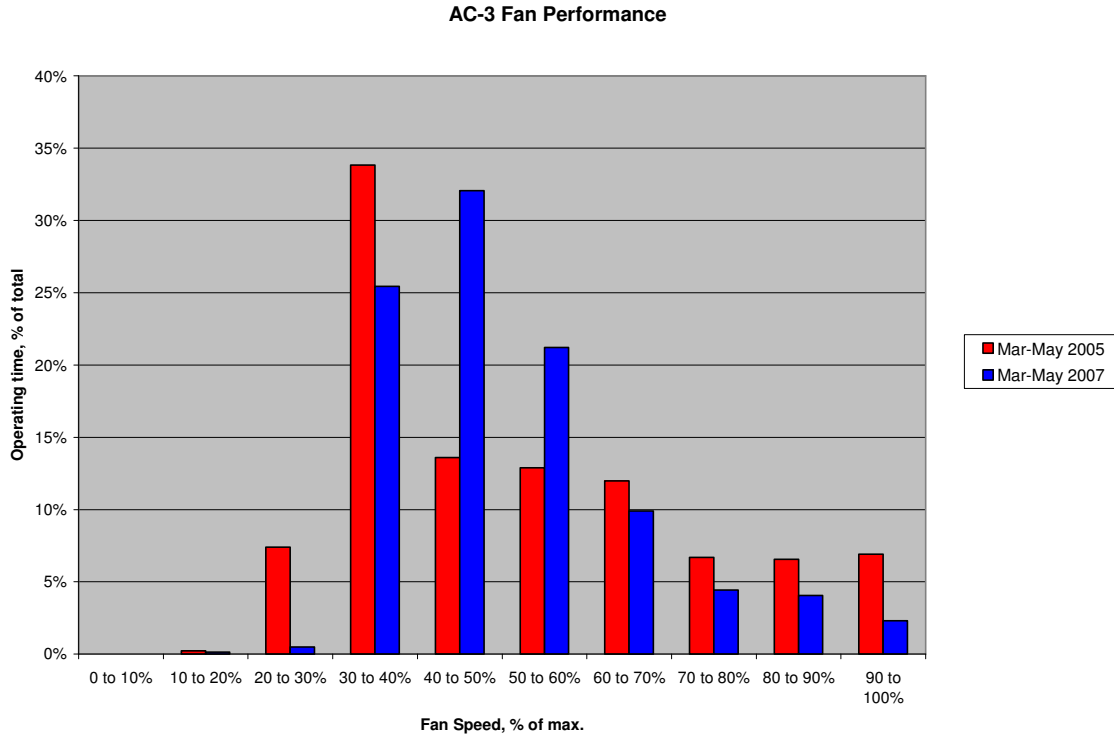


During this 92-day tracking period, at least one heating water pump was always operating, and there were 291 hours when the outside air temperature was above 65°F. The expected chiller and boiler energy savings of 14,550 kWh (\$1,620) and 5,240 therms (\$5,490) for this period was not realized since the heating water pumps operated at outside air temperatures above 65°F.

Measure 12.6: South Tower air handler AC-3: Modify reset schedules and VAV box minimum flows to minimize reheat burden and fan energy.

The energy savings for this sub-measure relate to lowering the speed of air handler AC-3’s supply fan, through narrowing the discharge air temperature reset schedule and lowering the VAV box minimum flow rate settings. The savings calculations estimated a 24% reduction in overall average fan speed, from 54% (the 8/23/04 – 5/19/05 average) to 41%.

The following chart and table compare the March-May performance of the fan, for 2005 and 2007.



Period	Average Speed	Estimated Fan Power Consumption, kWh	Average Outside Air Temp.	Number of Operating Hours
3/1/05 – 5/31/05	53.7%	11,100	68.2°F	931
3/1/07 – 5/31/07	52.9%	9,600	61.6°F	834

As indicated in the table, even though the 2007 average fan speed was approximately the same as in 2005, the fan motor consumed 1,500 less kWh in March-May 2007 than it did for the same three-month period in 2005. The above chart shows that the fan did not operate as often at speeds above 60% in 2007, which would be the reason for the reduction in consumption even though the average speed stayed the same (a given % reduction in fan speed will result in a greater % reduction in fan power).

The 1,500 kWh savings for this three-month period is 30% of the annual estimated energy savings, 5,067 kWh. Even though the predicted 41% average fan speed is not being achieved, this sub-measure seems to be persisting since the energy savings is being realized.

Recommended Action and Follow-Up

Operate the North Tower fan coil unit heating water pumps based on the new sequence of operations, referenced in the *RCx Final Report*. If necessary, hire the controls contractor to re-implement the new sequence. Investigate Meter #45 “N HHWB Gas” on the ECS control system, to determine if the values shown are indeed the gas consumption for the North Tower boilers. The Provider will continue to track the sub-measures related to Measure 12, and will submit the findings in the next Performance Tracking Report.

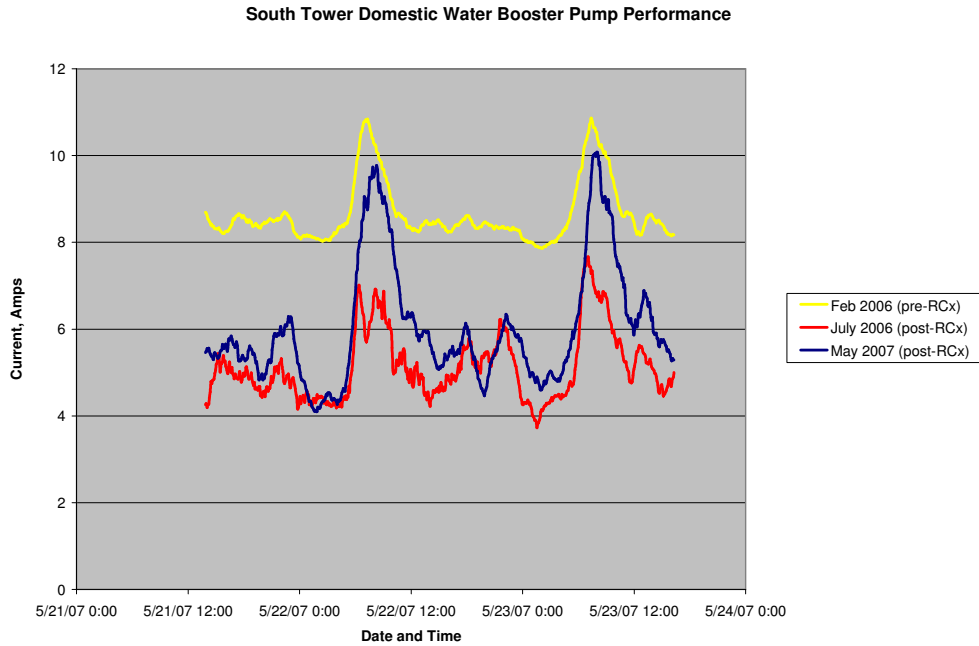
3.0 Measure #14: Optimize South Tower domestic water booster pump, Measure #15: Optimize North Tower domestic cold water booster pump

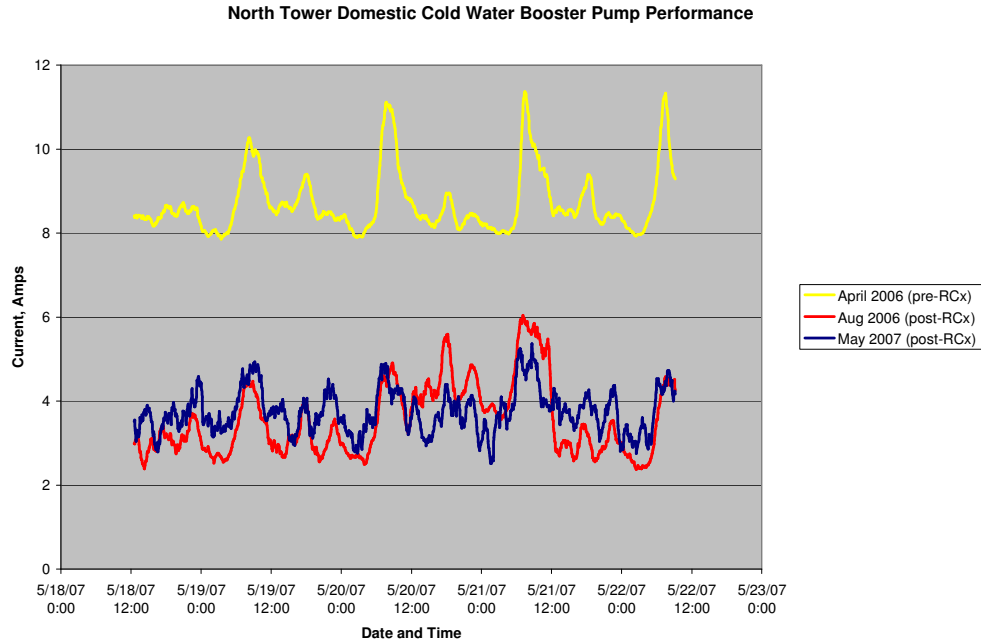
Tracking Performed

These measures included adding VFDs to constant speed booster pumps. The pumps operate automatically and are interfaced with the BAS. The BAS was used to collect pump amp draw data.

Tracking Results

The tracked amp draw data is shown in the following charts for the South Tower and North Tower booster pumps. Amp draw data for a similar period before and immediately after the measures were originally implemented is also shown in the charts.





The following tables include the data collection periods for the amp draw data shown in the previous charts, and the average amp draw for each period.

South Tower		
Data collection: Monday 1:30pm to Wednesday 5pm		
Dates	Before or after implementation?	Average current draw, amps
2/13/06 – 2/15/06	Before	8.6
7/24/06 – 7/26/06	After	5.1
5/21/07 – 5/23/07	After	6.0

North Tower		
Data collection: Friday 12pm to Tuesday 10am		
Dates	Before or after implementation?	Average current draw, amps
4/7/06 – 4/11/06	Before	8.7
8/25/06 – 8/29/06	After	3.6
5/18/07 – 5/22/07	After	3.8

As indicated in the charts and tables, these measures are persisting. The average amp draw for the most recent tracking period is close to that measured immediately after implementation, and is much less than the pre-implementation average amp draw.

Since the last Performance Tracking Report, a scaling error of two related to the data collected before and immediately after implementation was discovered. The data used in the above charts and tables includes a correction factor for this data. In previous calculations and reports, the documented amp draw data was twice the actual value.

Recommended Action and Follow-Up

Continue to collect amp draw data, for use in the next Performance Tracking Report.