Water and Energy Savings and GHG Calculations

This provides supporting information for the Excel workbook provided in file Att2_WE14_VenCo_WEGHG_1of3.xlsx. This proposal is essentially one project and in the accompanying Excel file only the "System Summary" and "Project 1" tabs have been populated.

Pre-Project Volume of Water Associated with the Project

Santa Paula Hospital has two accounts with City of Santa Paula Water Division (the local water purveyor). The baseline water use, in million gallons per year, is based on the quantities of water billed to the Hospital for both of its accounts for the period August 2013 to July 2014 (a one year period).

Volume of Water that will be Delivered after the Project is Implemented

The volume of water delivered after implementation of the Santa Paula Hospital Water and Energy Modernization Project is assumed to be the baseline water use less the savings anticipated from equipment changes.

Step 1 of the project will be to install four new air handling units, ductwork, and reheat coils to provide supply air to the ICU and ER as well as replacement of two chillers (CH-2 and CH-3). As currently configured CH-2 is a water cooled chiller. Upon replacement CH-2 will be an air cooled chiller. This means all water currently used by CH-2 will be saved. Estimated water use (and water saved upon replacement) is calculated in Table 1. As shown in Table 1, it is assumed that the replacement of CH-2 will save 215,000 gallons per year.

Step 2 of the project will be to remove and replace the existing chiller (CH-1) and pump that serves the main hospital with new equipment as well as the Hospital's cooling tower. Table 2 documents the estimated water use of the existing chiller and water cooling tower. Table 3 documents the estimated water use of the new chiller and new water cooling tower. The comparison of Table 2 and 3 shows that the replacement of CH-1 and the water cooling tower is estimated to save 238,000 gallons per year (630,000 less 392,000).

Step 3 of the project will be to remove and replace the existing two high-pressure boilers with new central steam equipment to serve the Hospital complex. Table 4 illustrates the estimated water use of the existing two high-pressure boilers. Table 5 shows the estimated water use once the two high-pressure boilers are replaced. Comparing Tables 4 and 5 shows that the estimated water savings is 26,000 gallons per year (54,000 less 28,000). This calculation likely under represents the water savings that will be achieved by replacing the two boilers. The calculation assumes the boilers always operate in parallel (with one boiler "on" and one boiler acting in standby). There may be times where both high-pressure boilers are operating and in these instances even more water savings will be realized.

Total water savings from all three steps is 479,000 gallons per year or 0.48 million gallons per year (MG/yr). Baseline water use is 6.36 MG/yr; with the anticipated savings from project implementation, Hospital water use will be approximately 5.88 MG/yr.

Table 1. Estimate of Current Water Use CH-2 and Water Saved Upon Replacement

Part 1 - Make-up Water for Condenser Evaporation (water lost at condenser through heat exchange process)			
			Notes
Parasitic Heat Load per Ton of Cooling	3429		
Heat Removal per Ton of Cooling	15429		
Water Circulation Rate per Ton of Cooling	3		
Condenser Water Circulation Rate	61.67	gal/hr	
Make-up Water for Condenser Evaporation per Ton of Cooling (gals/hr)	1.85		
Overall Make-up Water for Condenser Water Evaporation	37.00	gal/hr	
Part 2 - Make-up Water for Condenser Drift (water removed at Condenser from wind, fan operation)			
			Notes
Drift Coefficient	0.00008		
Make-up Water for Condenser Drift per Ton of Cooling (gals/hr)	0.0148		
Overall Make-up Water for Condenser Drift	0.296	gal/hr	
Part 3 - Make-up Water for Condenser Blowdown (water cycled through chilled water loop for maintaining water quality)			
			Notes
Cycles of Concentration	1.8		a
Make-up Water for Condenser Blowdown per Ton of Cooling (gals/hr)	2.3125		
Overall Make-up Water for Condenser Blowdown	46.25	gal/hr	
Total Water Use per Hour Equipment Operating	84	gals/hr	
Santa Paula California - Weather Data			
Average Max Temp	74.8	°F	
Average Min Temp	47.9	°F	
Assumed Economizer Temperature	55	°F	
Hours of Cooling Mode Operation	6448	hr	
Load Factor (Time of Chiller Operation Under Cooling Mode)	0.4		
Hours of Chiller Operation per Yar	2579	hr	
Total Water Use Per Year	**215,000**	**gals/yr**	

Notes:

a. Cycles of Concentration vary from 1.2[high mineral] - 10.0[low mineral] based on mineral content of water.

Table 2. Estimate of Current Water Use CH-1 and Water Cooling Tower

Part 1 - Make-up Water for Cooling Tower Evaporation (water lost at cooling tower through heat exchange process)			
			Notes
Parasitic Heat Load per Ton of Cooling	3092	BTU	
Heat Removal per Ton of Cooling	15092	BTU	
Water Circulation Rate per Ton of Cooling	2.74	gal/hr/ton	
Cooling Tower Water Circulation Rate	219.34	gal/hr	
Make-up Water for Cooling Tower Evaporation per Ton of Cooling	1.81		
Overall Make-up Water for Cooling Tower Water Evaporation	144.77	gal/hr	
Part 2 - Make-up Water for Cooling Tower Drift (water removed at cooling tower from wind, fan operation)			
			Notes
Drift Coefficient	0.00008		a
Make-up Water for Cooling Tower Drift per Ton of Cooling (gals/hr)	0.013		
Overall Make-up Water for Cooling Tower Drift	1.053	gal/hr	
Part 3 - Make-up Water for Cooling Tower Blowdown (water cycled through cooling tower for maintaining water quality)			
			Notes
Cycles of Concentration	1.8		
Make-up Water for Cooling Tower Blowdown per Ton of Cooling (gals/hr)	2.26		
Overall Make-up Water for Cooling Tower Blowdown	180.96	gal/hr	
Total Water Use When Equipment Operating	327	gals/hr	
Santa Paula California - Weather Data			
Average Max Temp	74.8	°F	
Average Min Temp	47.9	°F	
Assumed Economizer Temperature	60	°F	
Hours of Cooling Mode Operation	4820	hr	
Load Factor (Time of Chiller Operation Under Cooling Mode)	0.4		
Hours of Chiller Operation per Year	1928	hr	
Total Water Use Per Year	**630,000**	**gals/yr**	

Notes:

a. Cycles of Concentration vary from 1.2[high mineral] - 10.0[low mineral] based on mineral content of water.

Table 3. Estimate of Future Water Use CH-1 and Water Cooling Tower Replacement

Part 1 - Make-up Water for Cooling Tower Evaporation (water lost at cooling tower through heat exchange process)			
			Notes
Parasitic Heat Load per Ton of Cooling	3077	BTU	
Heat Removal per Ton of Cooling	15077	BTU	
Water Circulation Rate per Ton of Cooling	2.74	gal/hr/ton	
Cooling Tower Water Circulation Rate	219.13	gal/hr	
Make-up Water for Cooling Tower Evaporation per Ton of Cooling	1.81		
Overall Make-up Water for Cooling Tower Water Evaporation	144.62	gal/hr	
Part 2 - Make-up Water for Cooling Tower Drift (water removed at cooling tower from wind, fan operation)			
			Notes
Drift Coefficient	0.00008		
Make-up Water for Cooling Tower Drift per Ton of Cooling (gals/hr)	0.013		
Overall Make-up Water for Cooling Tower Drift	1.052	gal/hr	
Part 3 - Make-up Water for Cooling Tower Blowdown (water cycled through cooling tower for maintaining water quality)			
			Notes
Cycles of Concentration	3.5		a
Make-up Water for Cooling Tower Blowdown per Ton of Cooling (gals/hr)	0.72		
Overall Make-up Water for Cooling Tower Blowdown	57.85	gal/hr	
Total Water Use per Hour Equipment Operating	204	gals/hr	
Santa Paula California - Weather Data			
Average Max Temp	74.8	°F	
Average Min Temp	47.9	°F	
Assumed Economizer Temperature	60	°F	
Hours of Cooling Mode Operation	4820	hr	
Load Factor (Time of Chiller Operation Under Cooling Mode)	0.4		
Hours of Chiller Operation per Year	1928	hr	
Total Water Use Per Year	**392,000**	**gals/yr**	

Notes:

a. Cycles of Concentration vary from 1.2[high mineral] - 10.0[low mineral] based on mineral content of water.

Table 4. Estimate of Current Water Use Boilers 1 and 2

Part 1 - Annual Hours of Boiler Operation for Building Heating Not applicable, the high-pressure boilers are not used for building heating		
Part 2 - Annual Hours of Boiler Operation for Hot Water Heating		
Assumed Hot Water Usage	2000	gals/day
Assumed Hot Water Delivery Temp	180	°F
Energy for Hot Water Heating	730,584	MBtu/yr
Hours of Boiler Operation for Hot Water Heating/yr	588	hr/yr
Part 3 - Make-up Water for Boiler Blowdown (water cycled through steam loop for maintaining water quality)		
Cycles of Concentration	1.8	
Make-up Water for Boiler Blowdown per Ton of Heating	0.8	gals/hr
Overall Make-up Water for Boiler Blowdown	92.0	gals/hr
Total Water Use Per Year	**54,000**	**gals/yr**

Table 5. Estimate of Future Water Use Boilers 1 and 2 After Replacement

Part 1 - Annual Hours of Boiler Operation for Building Heating Not applicable, high-pressure boilers not used for building heating		
Part 2 - Annual Hours of Boiler Operation for Hot Water Heating		
Assumed Hot Water Usage	2000	gals/day
Assumed Hot Water Delivery Temp	180	°F
Energy for Hot Water Heating	730,584	MBtu/yr
Hours of Boiler Operation for Hot Water Heating/yr	588	hr/yr
Part 3 - Make-up Water for Boiler Blowdown (water cycled through steam loop for maintaining water quality)		
Cycles of Concentration	3.5	
Make-up Water for Boiler Blowdown per Ton of Heating	0.4	gals/hr
Overall Make-up Water for Boiler Blowdown	47.3	gals/hr
Total Water Use Per Year	**28,000**	**gals/yr**

Volume of Hot Water Saved

When makeup water is added to the high-pressure boilers, that water has to be heated to 180 degrees Fahrenheit. Each avoided increment of makeup water represents a savings of hot water. As described above, replacement of the high-pressure boilers is expected to reduce makeup water by 26,000 gallons per year, or 0.03 MG/yr.

Useful Life

The anticipated useful life of the equipment is 30 years.

Energy Intensity of the Water Saved

Santa Paula Hospital gets its water from the City of Santa Paula Water Division. All water provided by the City is groundwater that is filtered before delivery. Specific data was not provided from the City but energy intensity has been estimated assuming energy demands for groundwater pumping in Santa Paula are similar to those in Ventura County. According to the Ventura County Watershed Protection District, average agricultural groundwater pumping in Ventura County requires 500 kWh per AF (or 1534 MWh/MG) (personal communication R. Viergutz, July 2013). This value has been used as the energy intensity of water delivered to the Hospital. In actuality the energy intensity of water delivered to the Hospital is likely higher than 1534 MWh/MG because the MWh/MG only accounts for energy used in groundwater pumping and does not account for energy used for water filtration and treatment.

Additional Annual Energy Savings

In 2012 Ventura County undertook a scoping study to identify ways to reduce energy use in the Hospital (this report is provided as Att2_WE14_VenCo_WEGHG_3of3.pdf). This report found that the chilled water system (the three chillers and air cooling tower) represented 36 percent of the Hospital's electrical use and that the air distribution system accounted for 14

percent of the Hospital's electrical demand. The scoping study identified an estimated 170,352 kWh/yr savings from upgrading the chilled water systems and 106,894 kWh/yr savings from replacing the air handling units.