

Hybrid Wet/Dry Fluid Coolers: Notes From A Project

Mark Nieman, P.E., CEM
Sr. Energy Engineer
December 8, 2010

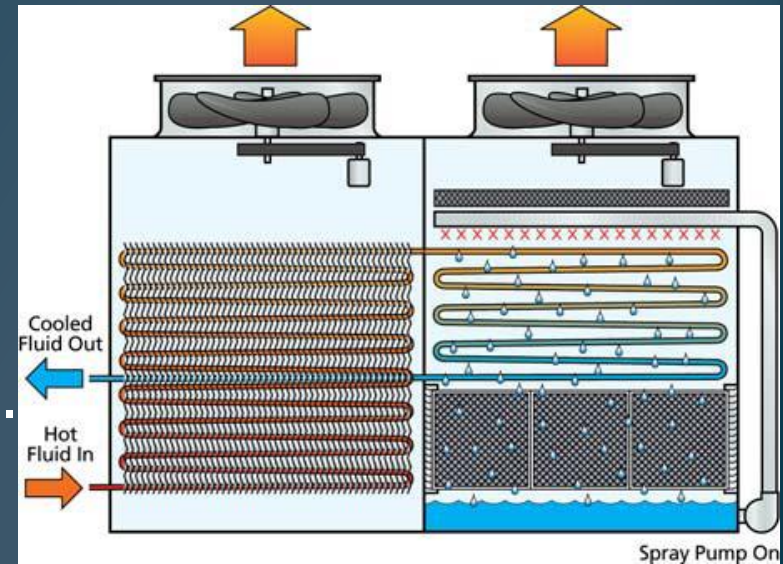
Cool Tunes: Run An Efficient Cooling
Tower

Original Goals of Project

- Save water
- Minimize plume hitting the building
- Add ability to do waterside economizer cooling at computer room units
- Add redundancy to cooling system – Two fans on new tower, two condenser water pumps, added condenser water loop. Has ability to go back to the original
- Electrical savings
- Chemical savings

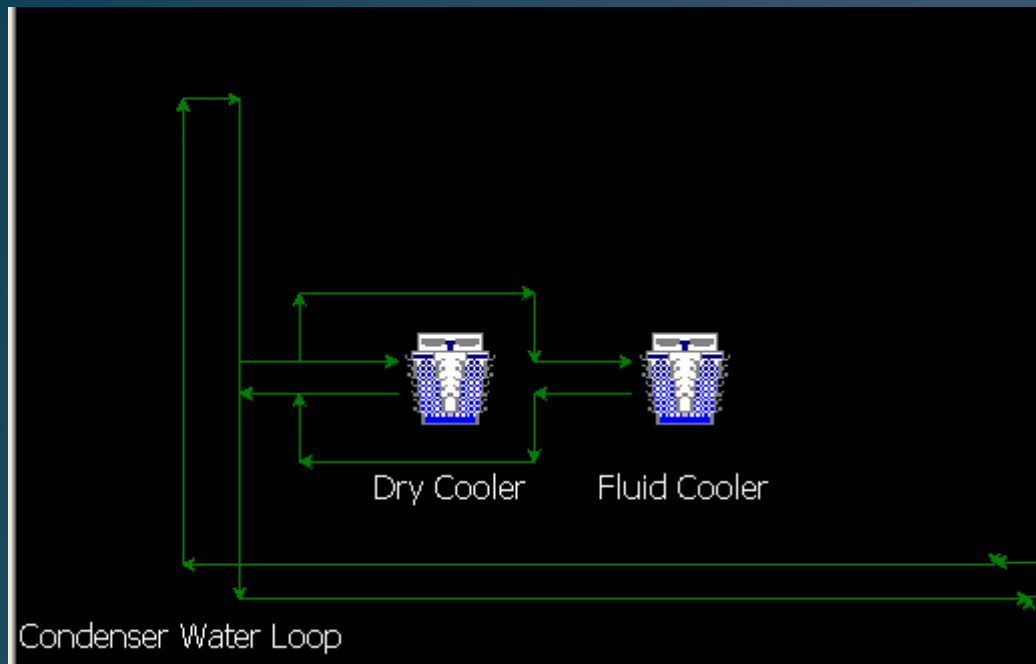
Original Basis of Design

- Up to 50% water savings
- Space and weight savings vs. dry coolers only
 - Four or five dry fluid coolers would be required, each with 10 fans and a footprint of 12'-6" x 8'-1" each
- Water-side Economizer available vs. dry coolers
- Final footprint at 28' x 8'
- Electrical Savings
- Non-chemical tower treatment



eQUEST Calculations for Electricity Wet-Dry Operation

- In eQUEST, simulated a dry tower as first stage and a wet tower as second stage



eQUEST Staging of Wet-Dry Operation

- Dry tower as first stage and a wet tower as second stage

Equipment Control Properties

Currently Active Equipment Control: **CW Equipment Control** Type: Heat Rejection

General Load Range 1 Load Range 2 Load Range 3 Load Range 4 Load Range 5

Flows Through: gpm

	Heat Reject Device	Seq	Max Flow
1	Dry Cooler	1	99,999.00
2	Fluid Cooler	2	99,999.00
3	- undefined -	3	99,999.00
4	- undefined -	4	99,999.00
5	- undefined -	5	99,999.00
6	- undefined -	6	99,999.00
7	- undefined -	7	99,999.00
8	- undefined -	8	99,999.00
9	- undefined -	9	99,999.00
10	- undefined -	10	99,999.00

	Ground Loop HX Name	Seq	Max Load
1	- undefined -	1	999.00
2	- undefined -	2	999.00
3	- undefined -	3	999.00
4	- undefined -	4	999.00
5	- undefined -	5	999.00
6	- undefined -	6	999.00
7	- undefined -	7	999.00
8	- undefined -	8	999.00
9	- undefined -	9	999.00
10	- undefined -	10	999.00

Raw Hourly Calculations for Wet-Dry Operation

- Sample output showing Dry Cooler & Fluid Cooler cycling on and off depending on OAT Dry/Wet Bulb

C:\Program Files\eQUEST 3-62\Projects\SMT\SMT-Dry-Wet FC - Baseline Design
 Simulated: 2007-Sep-27 14:27:38
 CSV Written: 2007-Sep-28 10:24:38
 eQUEST 3.62.5760

CWT Report										
OAT			Dry Cooler Block				Fluid Cooler Block			
Global			HEAT-REJECTION				HEAT-REJECTION			
			Dry Cooler		Fluid Cooler					
			Var 3	Var 4	Var 15	Var 24	Var 15	Var 24	Var 28	
Month	Day	Hour	Outside wet-bulb temp (F)	Outside dry-bulb temp (F)	Number of cells operating	Fan electrical power	Number of cells operating	Fan electrical power	Spray Pump	
5	5	7	53	57	1	1.8	-	-	-	
5	5	8	54	60	1	2.1	-	-	-	
5	5	9	56	60	1	2.2	-	-	-	
5	5	10	57	64	1	5.6	-	-	-	
5	5	11	58	66	1	1.6	1	1.5	2.6	
5	5	12	61	72	0	-	1	2.9	2.6	
5	5	13	62	74	0	-	1	3.3	2.6	
5	5	14	62	76	0	-	1	3.3	2.6	
5	5	15	63	76	0	-	1	3.4	2.6	
5	5	16	63	77	0	-	1	3.4	2.6	
5	5	17	63	73	0	-	1	3.4	2.6	
5	5	18	63	74	0	-	1	3.4	2.6	
5	5	19	60	69	1	2.4	1	2.1	2.6	
5	5	20	55	65	1	6.3	-	-	-	
5	5	21	55	66	1	1.5	1	1.0	2.6	
5	5	22	55	64	1	4.2	-	-	-	
5	5	23	55	62	1	2.6	-	-	-	

Project Target Savings

- Projected Savings

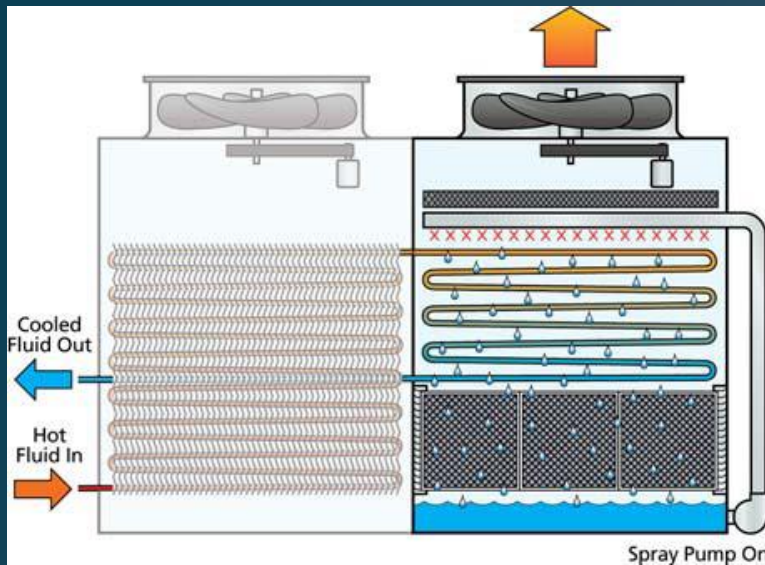
TARGET ENERGY CONSUMPTION SAVINGS ***										
Electricity					Water		Sewer		Other	Total
kWh	kWh (\$)	kW/Month	Months of kW Savings	kW (\$)	CCF	CCF (\$)	CCF	CCF (\$)	\$	Utility (\$)
166,241	\$8,861	23.7	12	\$228	946	\$2,669	946	\$7,051	\$2,489	\$21,297

Problems Encountered

- New Sage panel programming
- Operation of two fans off one VFD
- How often the wet-side fan engaged compared to the dry-side
 - Driven by condenser water setpoint
 - Fixed by condenser water reset schedule



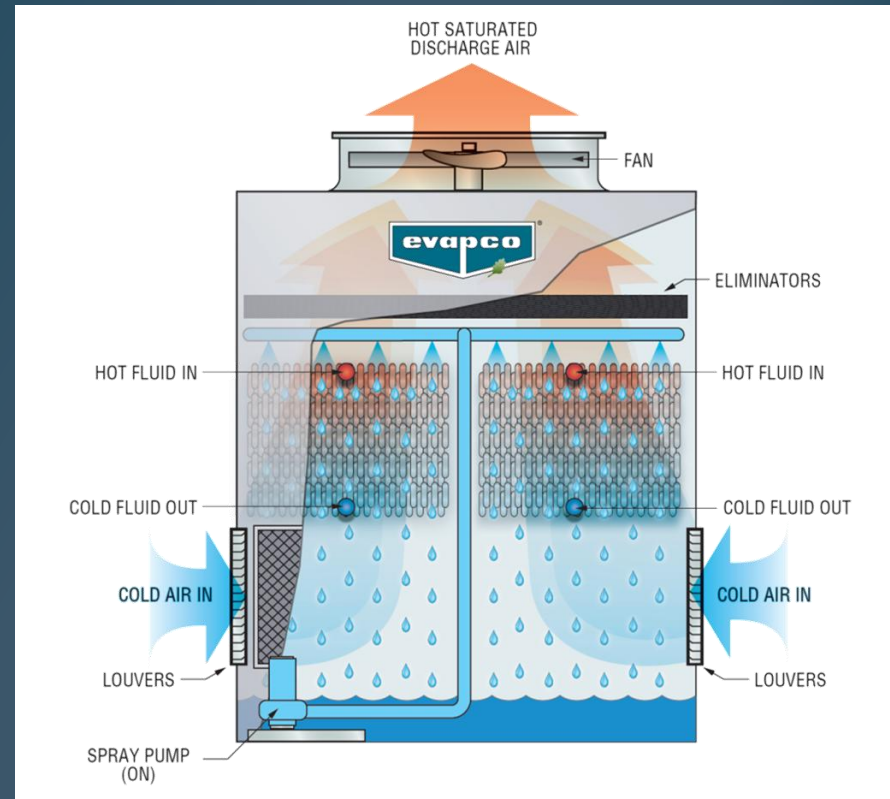
Then vs. Now



- Then
 - Old tower design
 - Coil from Italy (pressure rating issues and damage in shipment)
 - Sage Generation 1
 - LARGE footprint (two towers!)

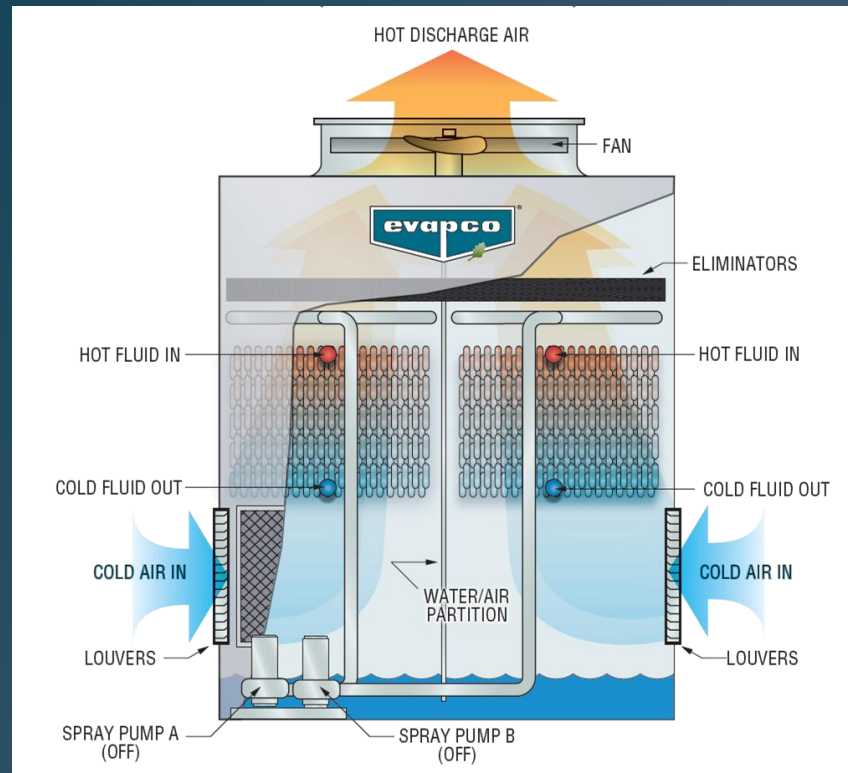
New Tower Improvement

- Now
 - On 3rd Generation SAGE Panel Programming
 - Smaller footprint
 - One fan instead of two for smaller tower lines (similar design to induced draft fan towers)
 - Spiral fins on elliptical tubes (3 fpi)
 - One VFD per motor



New Two Tower Options

- Dry or wet operation
- Hybrid operation: dry, dry/wet, wet operation modes



Challenges

- Not many left!
- More expensive than conventional towers
- Heavier equipment vs. dry cooler (similar problem with other fluid coolers)
 - Depending on selection, usually hybrid towers are now smaller and lighter than a wet-only tower of the same capacity.
- Developing technology (already on 3rd generation controls)

Benefits

- Less water consumption (water & sewer) = money saved
- In general, smaller footprint vs. other wet towers
- Less plume potential
- Manufacturer software improving to determine performance
- Increased evaporative capacity
- Less horsepower than first generation
- Increased dry capacity
- Fan savings in evaporative mode
- Most water efficient system type available

Questions?

Mark Nieman, P.E., CEM

McKinstry Co.

(206) 832-8152

markn@mckinstry.com