District Energy and Water Source Heat Pumps

Issues and Opportunities

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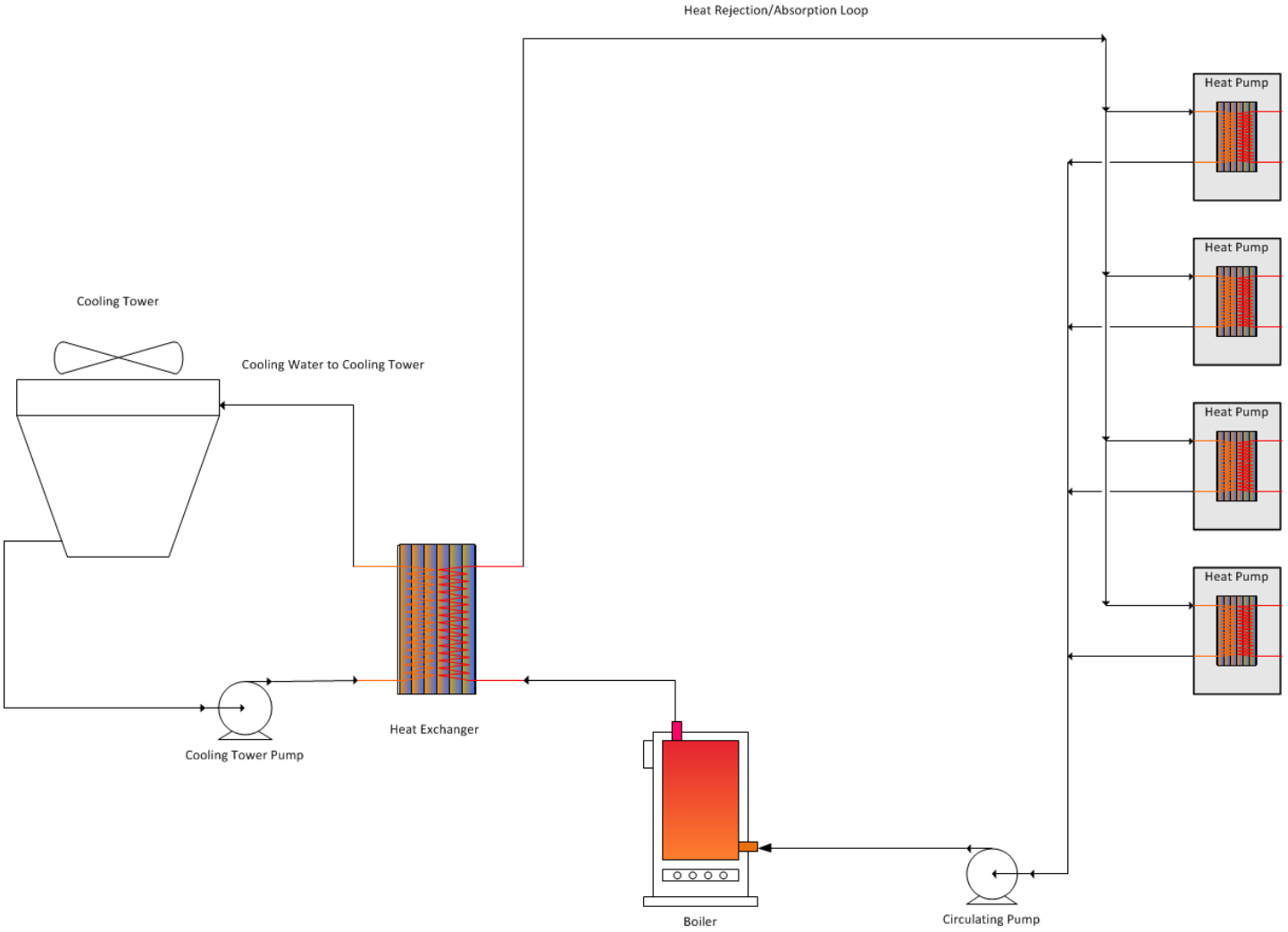
Water Source Heat Pumps – The Challenge

- Developers like Water Source Heat Pumps (WSHP)
- District Cooling systems see them as a competitor to the traditional four-pipe system
- Using chilled water (CHW) to cool the condenser loop can have benefits for the developer, the building operator, and the district cooling supplier
- It is a difficult sale, so…
- A comprehensive approach must be taken

The Technology – Typical WSHP



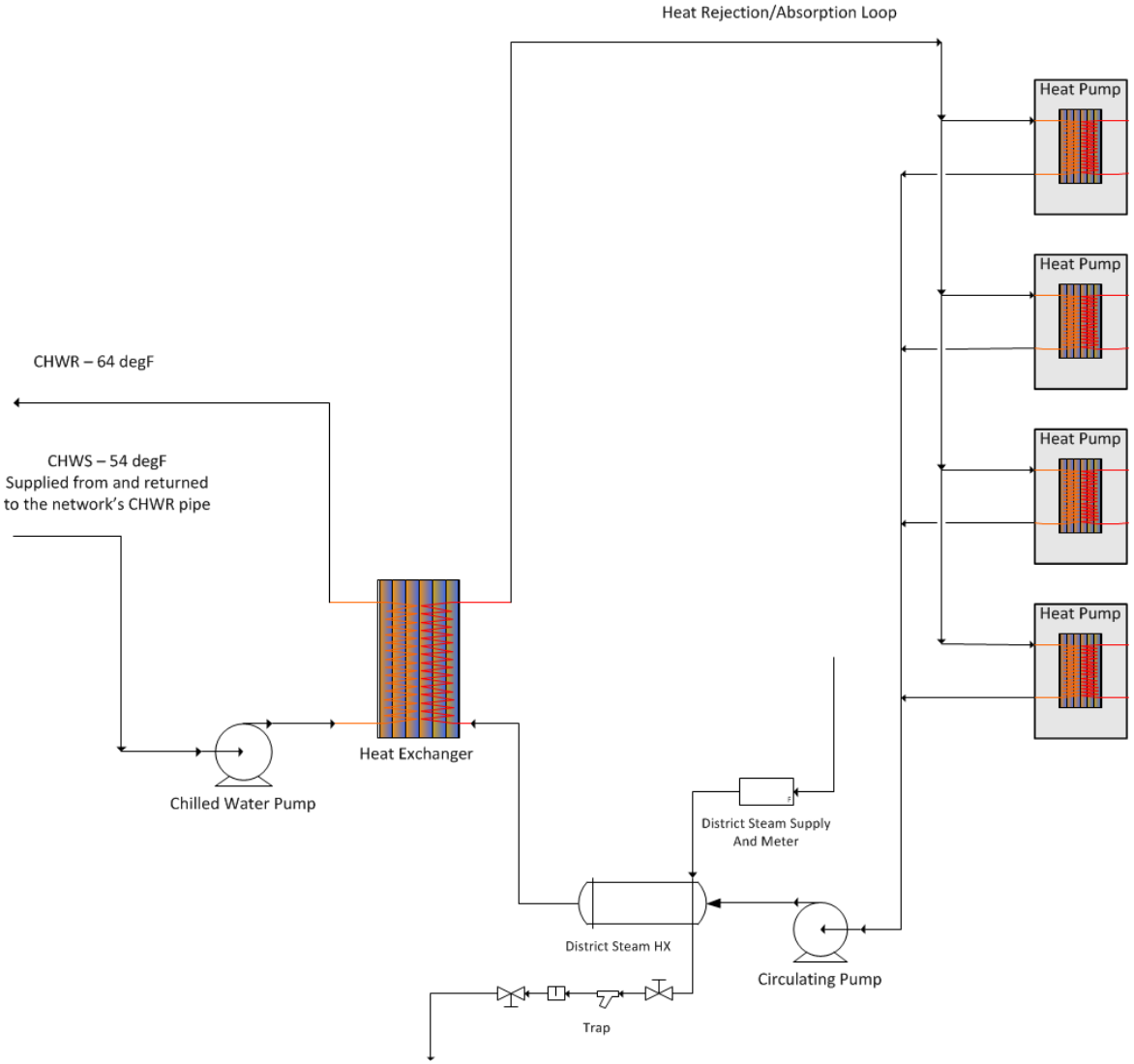
Developer's Viewpoint

- Pros:
  - *Easy to install in new construction*
  - *Relatively easy to install in retrofits/rehabs*
  - *More efficient than air cooled heat pumps*
  - *More efficient than split systems*
  - *Better individual control of comfort*
  - *Most of cost of heating/cooling is paid through the rental/condo unit's electric meter*
- Cons:
  - *Requires a boiler to heat the condenser loop*
  - *Requires a cooling tower to cool the loop*
  - *These use valuable space that could be used for additional revenue generation*

District Energy Viewpoint

- We would much rather have the customer install a four pipe system
- But, four pipe systems are expensive to install, especially in retrofit/rehab situations
- So, what can we do?
  - *Cool condenser loop with chilled water, to eliminate the cooling tower*
  - *Heat condenser loop with steam or hot water, eliminating the boiler*
- What else can we do?
  - *Use chilled water from the return side of the system, to improve central plant ΔT*
  - *Use the ability to cool the condenser loop to lower than 85 °F to improve the efficiency of the WSHP units*

WSHP with District Energy



Efficiency Benefits for Customer

Assumptions			
Performance Data from Trane EXH012 water source HP			
# Units:	1,200.00		
Loop Temperature	55	86	degF
gpm per unit	2.90	2.90	gpm
Total Cooling kbtuh	12.98	11.90	kbtuh
Total Heating kbtuh	12.67	17.24	kbtuh
Cooling compressor power - kW	0.51	0.82	kW
Heating compressor power - kW	0.80	0.88	kW
Cooling kW/Ton	0.48	0.83	kW/Ton
Heating kW/mbh	0.06	0.05	kW/mbh
DeltaP per floor (ft)	4.50	4.10	ft
Total DeltaP (ft)	44.82	44.42	ft
Circ Pump HP	52.52	52.05	HP
Rejected Heat - Cooling, kbtuh	14.73	14.53	kbtuh
Absorbed Heat - Heating, kbtuh	9.95	14.25	kbtuh
CT Pump HP @ 3 gpm/ton and 50 ft head		60.61	HP
CT Fan kW		111.90	kW
Total Demand:	52.52	224.55	kW

Example – Western USA

	Totals
Customer Ton-hrs	2,705,592
Customer Heating kbtu	776,726
Self Perform	
Cooling kWh @ 86 Loop Temp	2,242,686
Heating kWh @ 86 Loop Temp	39,422
Total HP kWh	2,282,108
Heat Rejected to Loop, kbtu	39,642,607
Heat Absorbed from Loop, kbtu	642,015
Heat added by Boiler, kbtu	-
Heat rejected to cooling tower, kbtu	39,000,591
Cooling Tower Fan kWh @ 0.1 kWh/ton-hr	260,004
CT Pump kWh @ 25ft Head	396,058
Circulating Pump kWh	340,129
Total kWh Consumed	**3,278,299**
CC CHW	
Cooling kWh @ 86 Loop Temp	2,242,686
Heating kWh @ 86 Loop Temp	39,422
Cooling kWh @ 55 Loop Temp	1,285,677
Heating kWh @ 55 Loop Temp	48,921
Total HP kWh	1,334,598
Heat Rejected to Loop, kbtu	36,844,410
Heat Absorbed from Loop, kbtu	609,978
Heat added by Boiler, kbtu	-
Heat rejected to Veolia, kbtu	36,234,432
Circulating Pump kWh	343,192
Total kWh Consumed	**1,677,270**
Veolia CHW Sales, Ton-Hrs	**3,019,536**
Customer kWh Saved:	**1,601,029**

Customer O&M Benefits

- These costs will be eliminated or substantially reduced:
  - *Repair and replace Cooling Tower*
  - *Cooling Tower PM*
  - *Water treatment PM*
  - *Chemicals*
  - *Pump PM*
  - *Pump Replacement*
  - *Make-up to Cooling Tower*
  - *Sewer Charges*

ΔT Improvement

Plant Peak:	10,000	tons
Design DeltaT:	16	degF
System Flow Rate:	15,000	gpm
WSHP Customer Tons:	1,200	tons
Customer Design DeltaT:	10	degF
Customer Flow Rate:	2,880	gpm
Actual Plant DeltaT:	12	degF
Actual System Flow Rate:	20,000	gpm
CHWST to Customer:	54	degF
CHWRT from Customer:	64	degF
Blended CHWRT after Customer:	55.44	degF
New system Flow Rate:	17,857	gpm
HP Savings at 150 psig:	249	HP
Savings at $0.10/kWh	$ 46,507	
Savings/ton-hr:	$ 0.02	

Economics

Potential Revenue Additions	$	90,000
Capital Plant Amortization	$	305,689
O&M Savings	$	88,315
Electric Savings @ $0.10/kWh	$	160,103
TOTAL	$	484,005
CHW purchases @ $0.15/ton-hr	$	452,930
Less Credit for deltaT improvement:	$	46,507
Net Cost of CHW to customer:	$	406,424
NET savings to Customer:	$	77,581

Conclusions

- It’s a difficult sale!
- Can be good for all parties
- Need to price the product creatively by sharing operational benefits with customer
- Definite life cycle benefits for the customer
- Definite operational and efficiency benefits for the DE Plant.

QUESTIONS?

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