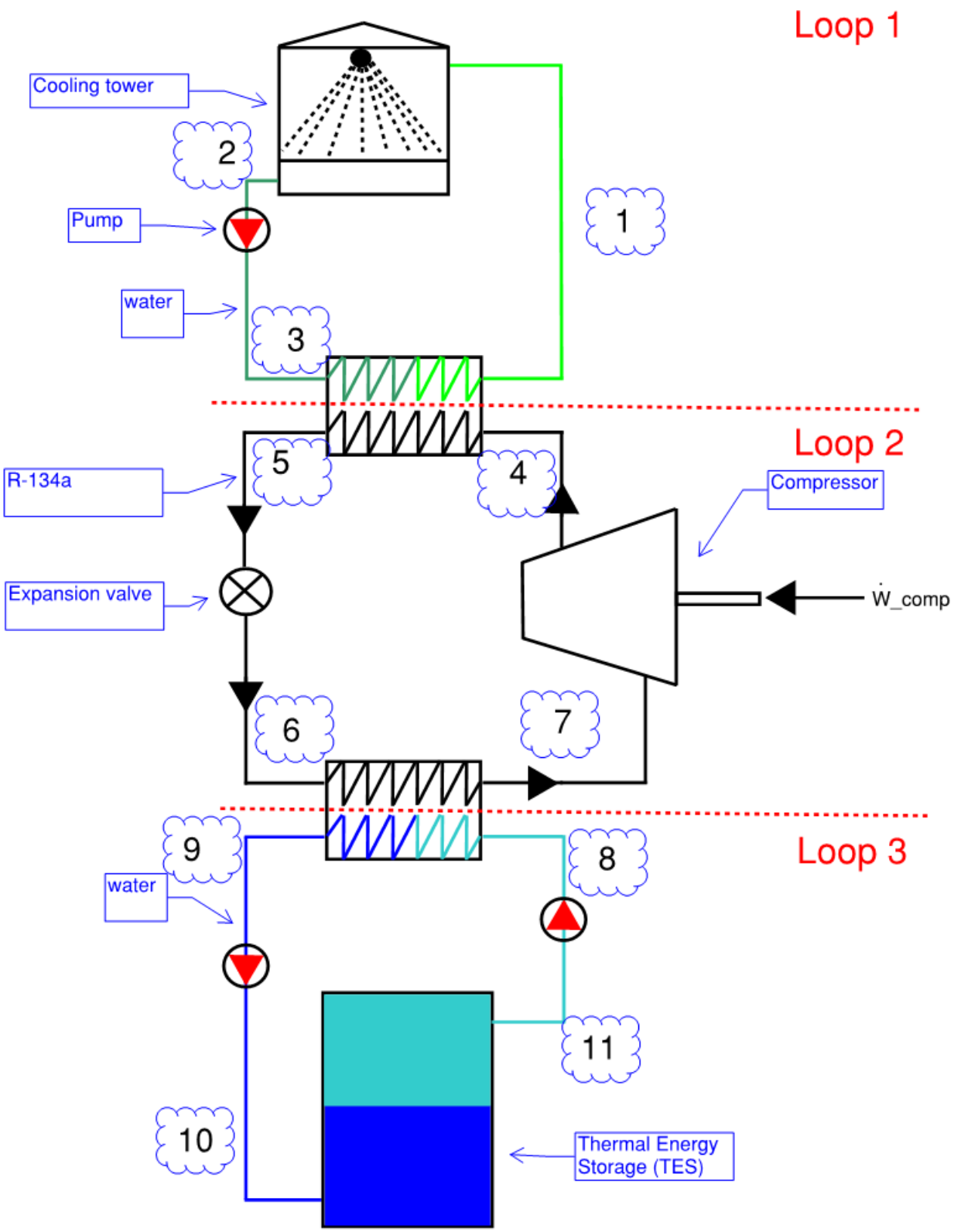

Loop 1

Cooling Tower Loop

==========

Fluid

$f1\$ = \text{'Steam}_{IAPWS}\text{'}$

First Law Analysis of Loop 1

$\dot{Q}_{CT} = \dot{W}_{CTP,1} + \dot{Q}_{Cond}$

Pump

$\dot{W}_{CTP,1} = 18.99 \ [kW] \cdot \left| 3412 \cdot \frac{Btu/hr}{kW} \right|$

$\dot{W}_{CTP,1} = \dot{m}_1 \cdot [h_3 - h_2]$

Condenser

$\dot{Q}_{Cond} = \dot{m}_1 \cdot [h_1 - h_3]$

State 1

$T_1 = 81.6 \ [F]$

$x_1 = 0$ *Assumption*

$h_1 = \mathbf{h}[f1\$, T = T_1, x = x_1]$

$P_1 = \mathbf{P}[f1\$, T = T_1, x = x_1]$

State 2

$x_2 = 0$ *Assumption*

$P_2 = \mathbf{P}[f1\$, x = x_2, h = h_2]$

$T_2 = \mathbf{T}[f1\$, x = x_2, h = h_2]$

State 3

$T_3 = 72.3 \ [F]$

$x_3 = 0$ *Assumption*

$h_3 = \mathbf{h}[f1\$, T = T_3, x = x_3]$

$P_3 = \mathbf{P}[f1\$, T = T_3, x = x_3]$

Loop 2

Refrigeration Loop

==========

Fluid

f2$ = 'R134a'

First Law Analysis of Loop 2

$\dot{Q}_{Evap} + \dot{W}_{Comp,1} = \dot{Q}_{Cond}$

Compressor

$\text{Power} = 234.2 \text{ [kW]} \cdot \left| 3412 \cdot \frac{\text{Btu/hr}}{\text{kW}} \right|$

$\dot{W}_{Comp,1} = \text{Power} \cdot \eta_{Comp}$

$\eta_{Comp} = 0.87$ *Place Holder*

$\dot{W}_{Comp,1} = \dot{m}_2 \cdot [h_4 - h_7]$

Condenser

$\dot{Q}_{Cond} = \dot{m}_2 \cdot [h_4 - h_5]$

Evaporator

$\dot{Q}_{Evap} = \dot{m}_2 \cdot [h_7 - h_6]$

State 4

$T_4 = \textbf{Average}[97.1 \text{ [F]}, 96.7 \text{ [F]}, 97.4 \text{ [F]}, 96.6 \text{ [F]}]$

$P_4 = \textbf{Average}[97.2 \text{ [psia]}, 98.1 \text{ [psia]}, 100.9 \text{ [psia]}, 98.8 \text{ [psia]}]$

$h_4 = \textbf{h}[f2\$, T = T_4, P = P_4]$

$x_4 = \textbf{x}[f2\$, T = T_4, P = P_4]$

State 5

$P_5 = P_4$

$T_5 = \textbf{T}[f2\$, P = P_5, h = h_5]$

$x_5 = \textbf{x}[f2\$, P = P_5, h = h_5]$

State 6

$P_6 = P_7$

$T_6 = \textbf{T}[f2\$, P = P_6, h = h_6]$

$x_6 = \textbf{x}[f2\$, P = P_6, h = h_6]$

State 7

$T_7 = \textbf{Average}[33.2\ [F], 35\ [F], 33.2\ [F], 33.8\ [F]]$

$P_7 = \textbf{Average}[35\ [psia], 34.7\ [psia], 35.3\ [psia], 35.5\ [psia]]$

$x_7 = \textbf{x}[f2\$, T = T_7, P = P_7]$

$h_7 = \textbf{h}[f2\$, T = T_7, P = P_7]$

Loop 3

Chilled Water Loop

==========

Fluid

$f3\$ = 'Steam_{IAPWS}'$

Evaporator

$\dot{Q}_{Evap} = \dot{m}_3 \cdot [h_8 - h_9]$

State 8

$T_8 = 54.2\ [F]$

$x_8 = 0$ *Assumption*

$Flow = 802\ [GPM] \cdot \left| 8.021 \cdot \frac{ft^3/hr}{GPM} \right|$

$\rho = \rho[f3\$, T = T_8, x = x_8]$

$\dot{m}_3 = Flow \cdot \rho$

$h_8 = \textbf{h}[f3\$, T = T_8, x = x_8]$

$P_8 = \textbf{P}[f3\$, T = T_8, x = x_8]$

State 9

$T_9 = 40.9\ [F]$

$x_9 = 0$ *Assumption*

$h_9 = \textbf{h}[f3\$, T = T_9, x = x_9]$

$P_9 = \textbf{P}[f3\$, T = T_9, x = x_9]$

SOLUTION

Unit Settings: Eng F psia mass deg

η_{Comp} = 0.87
f2$ = 'R134a'
Flow = 6433 [ft^3/hr]
$\dot{m}_2$ = 72574 [lb_m/hr]
Power = 799123 [Btu/hr]
$\dot{Q}_{CT}$ = 6.113E+06 [Btu/hr] {509.4 [Ton]}
ρ = 62.39 [lb_m/ft^3]
$\dot{W}_{CTP,1}$ = 64797 [Btu/hr] {18.99 [kW]}

f1$ = 'Steam_IAPWS'
f3$ = 'Steam_IAPWS'
$\dot{m}_1$ = 651064 [lb_m/hr]
$\dot{m}_3$ = 401345 [lb_m/hr]
$\dot{Q}_{Cond}$ = 6.048E+06 [Btu/hr] {504 [Ton]}
$\dot{Q}_{Evap}$ = 5.353E+06 [Btu/hr] {446 [Ton]}
$\dot{W}_{Comp,1}$ = 695237 [Btu/hr] {203.8 [kW]}

No unit problems were detected.

KEY VARIABLES

$\dot{Q}_{Evap}$ = 5.353E+06 [Btu/hr] {446 [Ton]}	*Capacity of a single chiller.*
$\dot{W}_{Comp,1}$ = 695237 [Btu/hr] {203.8 [kW]}	*Work input to the compressors.*
$\dot{m}_3$ = 401345 [lb_m/hr]	*Flow Rate*
$\dot{m}_1$ = 651064 [lb_m/hr]	*Flow Rate*
$\dot{m}_2$ = 72574 [lb_m/hr]	*Flow Rate*

Arrays Table: Main

	T_i [F]	P_i [psia]	h_i [Btu/lbm]	x_i
1	81.6	0.5346	49.66	0
2	72.2	0.3915	40.27	0
3	72.3	0.3929	40.37	0
4	96.95	98.75	118.3	100
5	70.42	98.75	34.92	-100
6	22.74	35.13	34.92	0.1791
7	33.8	35.13	108.7	100
8	54.2	0.208	22.27	0
9	40.9	0.1261	8.937	0