```
eta_p=0.7
eta_t=0.8
pw[1]=7
Tw[1]=t_sat(STEAM_NBS,p=pw[1])
hw[1]=enthalpy(STEAM_NBS,p=pw[1],x=0)
sw[1]=entropy(STEAM_NBS,p=pw[1],x=0)
pw[2]=17000
hw2i=enthalpy(STEAM_NBS,p=pw[2],s=sw[1])
eta_p=(hw[1]-hw2i)/(hw[1]-hw[2])
Wp=(hw[1]-hw[2])
Tw[2]=temperature(STEAM_NBS,p=pw[2],h=hw[2])
pw[3]=pw[2]
Tw[3]=t_sat(STEAM_NBS,p=pw[3])
Tw[4]=Tw[3]
pw[4]=pw[3]
hw[3]=enthalpy(STEAM_NBS,p=pw[3],x=0)
hw[4]=enthalpy(STEAM_NBS,p=pw[3],x=1)
Tw[5]=600
pw[5]=pw[4]
hw[5]=enthalpy(STEAM_NBS,p=pw[5],T=Tw[5])
sw[5]=entropy(STEAM_NBS,p=pw[5],T=Tw[5])
pw[6]=7
hw6i=enthalpy(STEAM_NBS,p=pw[6],s=sw[5])
eta_t=(hw[5]-hw[6])/(hw[5]-hw6i)
Wt=(hw[5]-hw[6])
Tw[6]=temperature(STEAM_NBS,p=pw[6],h=hw[6])

Th[1]=760
ph[1]=700
hh[1]=enthalpy(HELIUM,T=Th[1],P=Ph[1])
hh[2]=enthalpy(HELIUM,T=Th[2],P=Ph[1])
hh[3]=enthalpy(HELIUM,T=Th[3],P=Ph[1])
hh[4]=enthalpy(HELIUM,T=Th[4],P=Ph[1])

{In order to extract as much energy as possible from the He it must be cooled as much as possible.
It might appear that this could be done by reducing the delta T at the pinch point to as small a value as possible
but we hit another limit.  Because of the slope of helium cooling line, zero pinch point delta T results in a negative
terminal delta T at helium outlet.  Thus the limiting delta T is terminal delta T at the helium outlet.  Reducing this
to a very small value gives the maximum work per unit mass helium but gives a very big heat exhanger as shown in
the plot.  The design choice would depend upon the tradeoff between heat exchanger cost and energy efficiency.}

Th[4]=Tw[2]+Tterm
Tterm=0.1
m_dot_h*(hh[1]-hh[3])=m_dot_w*(hw[5]-hw[3])
m_dot_h*(hh[1]-hh[2])=m_dot_w*(hw[5]-hw[4])
m_dot_h*(hh[1]-hh[4])=m_dot_w*(hw[5]-hw[2])

m_dot_w*(Wt+Wp)=P_net
P_net=500e3

Q_dot_fw=m_dot_w*(hw[3]-hw[2])
Q_dot_boil=m_dot_w*(hw[4]-hw[3])
Q_dot_sh=m_dot_w*(hw[5]-hw[4])
```

```
Q_dot_total=m_dot_w*(hw[5]-hw[2])

F_fw=Q_dot_fw/Q_dot_total
F_boil=Q_dot_boil/Q_dot_total
F_sh=Q_dot_sh/Q_dot_total

LMDT_sh=((Th[1]-Tw[5])-(Th[2]-Tw[4]))/(ln(Th[1]-Tw[5])-ln(Th[2]-Tw[4]))
Arg_fw=((Th[3]-Tw[3])/(Th[4]-Tw[2]))
LMDT_fw=((Th[3]-Tw[3])-(Th[4]-Tw[2]))/ln(Arg_fw)
LMDT_boil=((Th[2]-Tw[4])-(Th[3]-Tw[3]))/(ln(Th[2]-Tw[4])-ln(Th[3]-Tw[3]))

h_av_sh=600
h_av_boil=1000
h_av_fw=800

C1=1000
h_av_boil*A_boil*LMDT_boil=Q_dot_boil*C1
h_av_fw*A_fw*LMDT_fw=Q_dot_fw*C1
h_av_sh*A_sh*LMDT_sh=Q_dot_sh*C1

{WW is the work per unit mass helium}
WW=P_net/m_dot_h

{dummy variables for T-Q plots}
yh[1]=Th[4]
yh[2]=Th[3]
yh[3]=Th[2]
yh[4]=Th[1]
xw[1]=Tw[2]
xw[2]=Tw[3]
xw[3]=Tw[4]
xw[4]=Tw[5]
xhw[1]=hw[2]
xhw[2]=hw[3]
xhw[3]=hw[4]
xhw[4]=hw[5]
```

SOLUTION
Unit Settings: [kJ]/[C]/[kPa]/[kg]/[degrees]

Arg_{fw} = 88.12 [-]	A_{boil} = 6092 [m^2]	A_{fw} = 406799 [m^2]	A_{sh} = 4076 [m^2]
C1 = 1000 [W/kW]	η_p = 0.7 [-]	η_t = 0.8 [-]	F_{boil} = 0.2539 [-]
F_{fw} = 0.445 [-]	F_{sh} = 0.3011 [-]	hw2i = 180.4 [kJ/kg]	hw6i = 2050 [kJ/kg]
$h_{av,boil}$ = 1000 [W/m^2-C]	$h_{av,fw}$ = 800 [W/m^2-C]	$h_{av,sh}$ = 600 [W/m^2-C]	$LMDT_{boil}$ = 59.29 [C]
$LMDT_{fw}$ = 1.945 [C]	$LMDT_{sh}$ = 175.2 [C]	$\dot{m}_h$ = 381.2 [kg/s]	$\dot{m}_w$ = 421.4 [kg/s]
P_{net} = 500000 [kW]	$\dot{Q}_{boil}$ = 361187 [kJ/s]	$\dot{Q}_{fw}$ = 633030 [kJ/s]	$\dot{Q}_{sh}$ = 428385 [kJ/s]
$\dot{Q}_{total}$ = 1.423E+06 [kJ/s]	Tterm = 0.1 [C]	Wp = -24.37 [kJ/kg]	Wt = 1211 [kJ/kg]
WW = 1312 [kJ/kg]			

No unit problems were detected.
Purple units were automatically set. Right click on the variable to confirm or change the units.

Arrays Table

	Th_i [C]	Tw_i [C]	hh_i [kJ/kg]	hw_i	ph_i [kPa]	pw_i [kPa]	sw_i [kJ/kg-K]	xhw_i	xw_i	yh_i
1	760	39.01	3819	163.4	700	7	0.559	187.7	41.26	41.36
2	543.6	41.26	2695	187.7		17000		1690	352.3	361.1
3	361.1	352.3	1748	1690		17000		2547	352.3	543.6
4	41.36	352.3	87.23	2547		17000		3564	600	760
5		600		3564		17000	6.603			
6		39.01		2353		7