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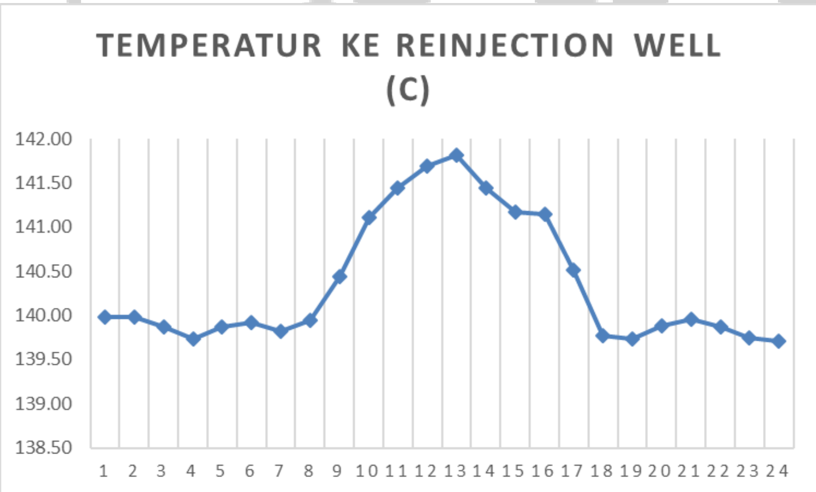
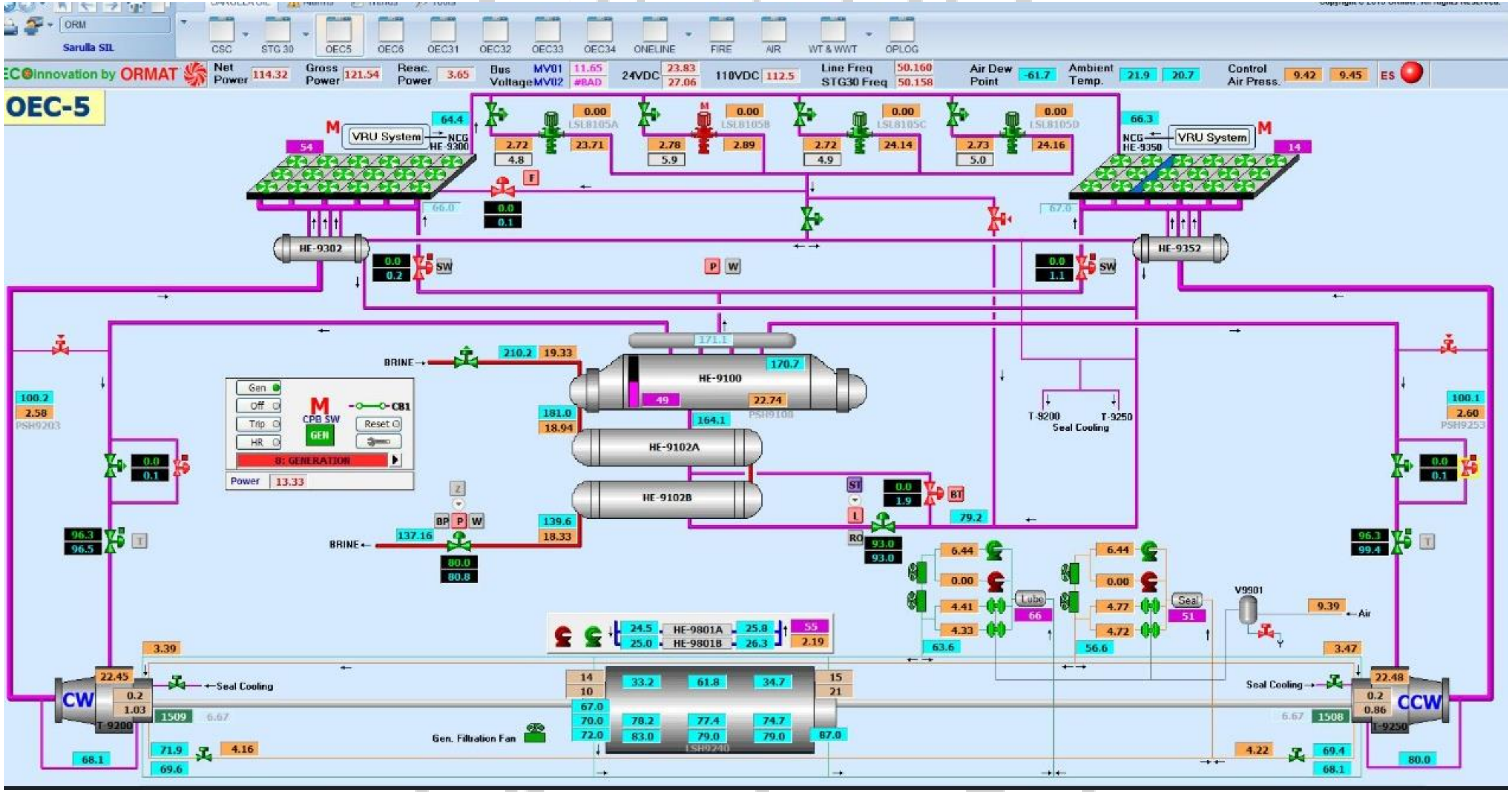
Data Lapangan :

Date	Time	ORC X							Ambient Temperatur
		Gross	Net	Brine Inlet Flow	In Press	In. Temp.	Ex. Press.	Ex. Temp	
		MW	MW	T/H	barg	°C	barg	°C	°C
June 17	0100H	13.43	11.94	1089.30	19.39	210.40	18.45	139.98	21.79
	0200H	13.42	11.93	1090.96	19.38	210.41	18.46	139.98	21.63
	0300H	13.42	11.93	1088.24	19.36	210.38	18.43	139.88	21.52
	0400H	13.47	11.98	1077.35	19.35	210.33	18.39	139.73	21.24
	0500H	13.50	12.01	1079.03	19.36	210.41	18.41	139.88	21.18
	0600H	13.51	12.03	1088.67	19.38	210.47	18.43	139.92	21.22
	0700H	13.53	12.05	1085.19	19.41	210.48	18.43	139.82	21.32
	0800H	13.49	12.00	1068.26	19.43	210.55	18.47	139.95	22.49
	0900H	13.26	11.79	1050.64	19.46	210.56	18.52	140.44	24.65
	1000H	12.89	11.42	1056.29	19.41	210.45	18.53	141.11	26.28
	1100H	12.61	11.15	1073.23	19.35	210.30	18.47	141.44	27.21
	1200H	12.44	10.96	1083.56	19.43	210.35	18.52	141.69	28.18
	1300H	12.36	10.88	1096.31	19.49	210.43	18.59	141.82	28.78
	1400H	12.50	11.02	1113.99	19.42	210.38	18.49	141.45	27.73
	1500H	12.66	11.19	1083.30	19.38	210.40	18.41	141.17	26.26
	1600H	12.61	11.14	1075.57	19.31	210.31	18.35	141.15	25.42
	1700H	12.92	11.44	1099.22	19.32	210.35	18.35	140.51	23.52
	1800H	13.40	11.91	1079.78	19.36	210.45	18.39	139.78	21.99
	1900H	13.49	12.00	1080.75	19.32	210.42	18.38	139.73	21.69
	2000H	13.49	12.00	1096.83	19.37	210.55	18.43	139.88	21.46
	2100H	13.47	11.98	1095.63	19.38	210.60	18.44	139.96	21.35
	2200H	13.47	11.98	1095.20	19.40	210.60	18.46	139.88	21.22
	2300H	13.49	11.99	1097.77	19.45	210.64	18.50	139.74	21.08
	2400H	13.50	12.01	1097.65	19.46	210.65	18.52	139.71	20.96
	Max	13.53	12.05	1113.99	19.49	210.65	18.59	141.82	28.78
	Ave	13.18	11.70	1085.11	19.39	210.45	18.45	140.36	23.34
	Min	12.36	10.88	1050.64	19.31	210.30	18.35	139.71	20.96



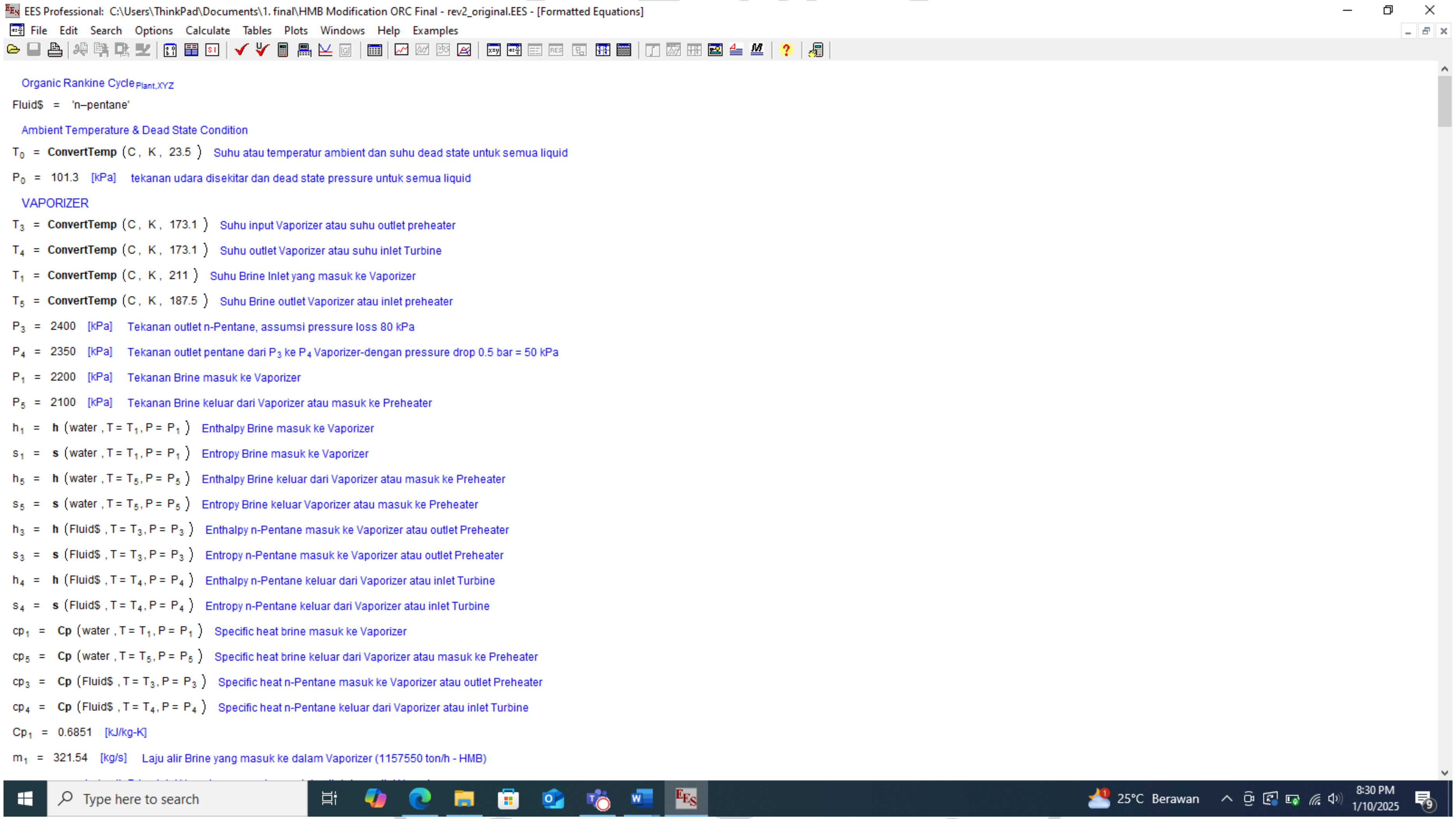
DATA ORC X																	CALCULATION			DATA ORC X				CALCULATION			
Date	Time	ORC X									OEC5_TE 9121	OEC5_TE 9121	OEC5_TE 9115	OEC5_TE 9115	OEC5_TE 9103	OEC5_TE 9103	Q Vaporizer	Q Preheater	Gross Power	OEC5_TE9 103	OEC5_TE9101	OEC5_TE9101	OEC5_TE9124	1.47	U (kW/m2K)	1.17	U (kW/m2K)
		Gross	Net	Brine Inlet Flow	In Press	In. Temp.	Ex. Press.	Ex. Temp	Ambient Temperatur	Brine Inlet Flow	Vaporizer Brine Inlet Temp	Vaporizer Brine Inlet Temp	Vaporizer Brine Outlet Temp	Vaporizer Brine Outlet Temp	Preheater HE-9102B Brine Outlet Temp	Preheater HE-9102B Brine Outlet Temp			ORC X	Preheater HE-9102B Brine Outlet Temp	Vaporizer MF Outlet Temp	Vaporizer MF Inlet Temp	FPs MF Outlet Temp	LMTD Vaporizer	A Vaporizer	LMTD Preheater	A Preheater
		MW	MW	T/H	barg		barg			kg/s	°C	°K	°C	°K	°C	°K	kW	kW	kW	°C	°C	°C	°C	°K	m2	°K	m2
June 17	0100H	13.43	11.94	1089.30	19.39	210.40	18.45	139.98	21.79	302.61	210.40	483.55	182.30	455.45	139.98	413.13	38071.93	55588.09	1342.79	139.98	170.91	164.75	80.77	27.05	957.32	34.26	1386.85
	0200H	13.42	11.93	1090.96	19.38	210.41	18.46	139.98	21.63	303.07	210.41	483.56	182.44	455.59	139.98	413.13	37954.37	55854.21	1342.38	139.98	170.65	165.3	80.86	26.88	960.42	33.91	1407.99
	0300H	13.42	11.93	1088.24	19.36	210.38	18.43	139.88	21.52	302.31	210.38	483.53	181.97	455.12	139.88	413.03	38453.70	55236.02	1341.86	139.88	170.70	164.55	80.8	27.04	967.40	34.11	1384.05
	0400H	13.47	11.98	1077.35	19.35	210.33	18.39	139.73	21.24	299.29	210.33	483.48	181.44	454.59	139.73	412.88	38712.68	54185.35	1346.66	139.73	170.56	164.27	80.76	26.91	978.74	33.88	1367.08
	0500H	13.50	12.01	1079.03	19.36	210.41	18.41	139.88	21.18	299.76	210.41	483.56	181.74	454.89	139.88	413.03	38469.75	54469.78	1350.04	139.88	170.86	164.75	80.55	26.70	980.20	33.86	1375.06
	0600H	13.51	12.03	1088.67	19.38	210.47	18.43	139.92	21.22	302.43	210.47	483.62	181.58	454.73	139.92	413.07	39112.05	54688.89	1351.22	139.92	170.11	164.7	79.91	26.93	987.84	34.00	1374.64
	0700H	13.53	12.05	1085.19	19.41	210.48	18.43	139.82	21.32	301.47	210.48	483.63	181.23	454.38	139.82	412.97	39481.63	54181.37	1353.31	139.82	170.68	164.86	79.79	26.37	1018.37	33.60	1378.18
	0800H	13.49	12.00	1068.26	19.43	210.55	18.47	139.95	22.49	296.76	210.55	483.70	181.06	454.21	139.95	413.10	39174.78	52955.69	1348.52	139.95	170.70	164.36	79.66	26.62	1001.25	33.95	1333.00
	0900H	13.26	11.79	1050.64	19.46	210.56	18.52	140.44	24.65	291.87	210.56	483.71	181.02	454.17	140.44	413.59	38602.06	51407.78	1326.31	140.44	170.42	164.02	79.38	26.93	974.97	34.46	1275.10
	1000H	12.89	11.42	1056.29	19.41	210.45	18.53	141.11	26.28	293.44	210.45	483.60	180.47	453.62	141.11	414.26	39387.18	50129.02	1289.23	141.11	170.58	164.27	78.89	26.28	1019.46	34.20	1252.81
	1100H	12.61	11.15	1073.23	19.35	210.30	18.47	141.44	27.21	298.14	210.30	483.45	180.49	453.64	141.44	414.59	39790.13	50532.03	1261.41	141.44	170.22	164.96	78.65	25.89	1045.35	33.83	1276.68
	1200H	12.44	10.96	1083.56	19.43	210.35	18.52	141.69	28.18	301.01	210.35	483.50	179.89	453.04	141.69	414.84	41046.57	49905.72	1244.01	141.69	170.97	164.9	76.83	25.25	1105.81	34.05	1252.86
	1300H	12.36	10.88	1096.31	19.49	210.43	18.59	141.82	28.78	304.56	210.43	483.58	180.33	453.48	141.82	414.97	41034.39	50906.37	1235.83	141.82	170.19	164.51	79.72	26.16	1067.26	33.84	1285.61
	1400H	12.50	11.02	1113.99	19.42	210.38	18.49	141.45	27.73	309.47	210.38	483.53	179.22	452.37	141.45	414.60	43169.70	50739.19	1249.74	141.45	170.20	164.65	78.71	25.25	1163.25	32.99	1314.50
	1500H	12.66	11.19	1083.30	19.38	210.40	18.41	141.17	26.26	300.94	210.40	483.55	179.78	452.93	141.17	414.32	41250.82	50435.98	1266.42	141.17	170.87	164.12	78.15	25.78	1088.60	34.01	1267.35
	1600H	12.61	11.14	1075.57	19.31	210.31	18.35	141.15	25.42	298.79	210.31	483.46	179.79	452.94	141.15	414.30	40828.36	50108.61	1261.02	141.15	170.18	165.05	79.03	25.35	1095.59	32.94	1300.26
	1700H	12.92	11.44	1099.22	19.32	210.35	18.35	140.51	23.52	305.36	210.35	483.50	179.47	452.62	140.51	413.66	42211.36	51640.01	1291.63	140.51	170.65	164.55	79.79	25.32	1134.13	32.63	1352.61
	1800H	13.40	11.91	1079.78	19.36	210.45	18.39	139.78	21.99	299.96	210.45	483.60	179.24	452.39	139.78	412.93	41915.09	51382.77	1339.62	139.78	170.36	165.01	79.79	24.97	1142.04	31.80	1380.94
	1900H	13.49	12.00	1080.75	19.32	210.42	18.38	139.73	21.69	300.23	210.42	483.57	179.40	452.55	139.73	412.88	41699.39	51695.59	1348.62	139.73	170.11	165.21	77.24	25.02	1133.83	32.58	1356.14
	2000H	13.49	12.00	1096.83	19.37	210.55	18.43	139.88	21.46	304.70	210.55	483.70	179.67	452.82	139.88	413.03	42126.19	52619.55	1349.40	139.88	170.42	164.77	77.23	25.47	1125.33	33.25	1352.66
	2100H	13.47	11.98	1095.63	19.38	210.60	18.44	139.96	21.35	304.36	210.60	483.75	180.23	453.38	139.96	413.11	41379.40	53197.97	1346.86	139.96	170.73	165.34	78.52	25.36	1109.94	32.84	1384.41
	2200H	13.47	11.98	1095.20	19.40	210.60	18.46	139.88	21.22	304.25	210.60	483.75	180.45	453.60	139.88	413.03	41070.25	53581.85	1347.13	139.88	170.88	164.69	78.11	25.92	1077.86	33.68	1359.66
	2300H	13.49	11.99	1097.77	19.45	210.64	18.50	139.74	21.08	304.96	210.64	483.79	180.78	453.93	139.74	412.89	40767.45	54321.47	1348.61	139.74	170.52	165.31	78.61	25.87	1072.17	33.23	1397.21
	2400H	13.50	12.01	1097.65	19.46	210.65	18.52	139.71	20.96	304.93	210.65	483.80	181.10	454.25	139.71	412.86	40338.12	54781.35	1350.46	139.71	170.78	164.83	78.9	26.33	1042.20	33.78	1385.98
	Max	13.53	12.05	1113.99	19.49	210.65	18.59	141.82	28.78	309.47	210.65	483.80	182.44	455.59	141.82	414.97	43169.70	55854.21	1353.31	141.82							
	Ave	13.18	11.70	1085.11	19.39	210.45	18.45	140.36	23.34	301.44	210.45	483.60	180.63	453.78	140.36	413.51	40251.97	52689.36	1318.04	140.36							
	Min	12.36	10.88	1050.64	19.31	210.30	18.35	139.71	20.96	291.87	210.30	483.45	179.22	452.37	139.71	412.86	37954.37	49905.72	1235.83	139.71							

Sample HMI



CSC
STG 30
OEC5
OEC6
OEC31
OEC32
OEC33
OEC34
ONLINE
FIRE
AIR
WT & WWT
OPLOG
Sarulla SIL
ECOInnovation by ORMAT
Net Power
Gross Power
Reac. Power
Bus Voltage
MV01
MV02
24VDC
110VDC
Line Freq
STG30 Freq
Air Dew Point
Ambient Temp.
Control Air Press.
ES
OEC-5
VRU System
NCG HE-9300
NCG HE-9350
HE-9302
HE-9352
HE-9100
HE-9102A
HE-9102B
BRINE
CPB SW
CB1
GEN
8: GENERATION
Power
T-9200
T-9250
Seal Cooling
HE-9801A
HE-9801B
Lube
Seal
V9901
Air
CW
CCW
Gen. Filtration Fan

EES Design


EES Professional: C:\Users\ThinkPad\Documents\1. final\HMB Modification ORC Final - rev2_original.EES - [Formatted Equations]
File Edit Search Options Calculate Tables Plots Windows Help Examples
Organic Rankine Cycle Plant.XYZ
Fluid$ = 'n–pentane'
Ambient Temperature & Dead State Condition
T_0 = ConvertTemp (C, K, 23.5) Suhu atau temperatur ambient dan suhu dead state untuk semua liquid
P_0 = 101.3 [kPa] tekanan udara disekitar dan dead state pressure untuk semua liquid
VAPORIZER
T_3 = ConvertTemp (C, K, 173.1) Suhu input Vaporizer atau suhu outlet preheater
T_4 = ConvertTemp (C, K, 173.1) Suhu outlet Vaporizer atau suhu inlet Turbine
T_1 = ConvertTemp (C, K, 211) Suhu Brine Inlet yang masuk ke Vaporizer
T_5 = ConvertTemp (C, K, 187.5) Suhu Brine outlet Vaporizer atau inlet preheater
P_3 = 2400 [kPa] Tekanan outlet n-Pentane, assumsi pressure loss 80 kPa
P_4 = 2350 [kPa] Tekanan outlet pentane dari P_3 ke P_4 Vaporizer-dengan pressure drop 0.5 bar = 50 kPa
P_1 = 2200 [kPa] Tekanan Brine masuk ke Vaporizer
P_5 = 2100 [kPa] Tekanan Brine keluar dari Vaporizer atau masuk ke Preheater
h_1 = h (water, T = T_1, P = P_1) Enthalpy Brine masuk ke Vaporizer
s_1 = s (water, T = T_1, P = P_1) Entropy Brine masuk ke Vaporizer
h_5 = h (water, T = T_5, P = P_5) Enthalpy Brine keluar dari Vaporizer atau masuk ke Preheater
s_5 = s (water, T = T_5, P = P_5) Entropy Brine keluar Vaporizer atau masuk ke Preheater
h_3 = h (Fluid$, T = T_3, P = P_3) Enthalpy n-Pentane masuk ke Vaporizer atau outlet Preheater
s_3 = s (Fluid$, T = T_3, P = P_3) Entropy n-Pentane masuk ke Vaporizer atau outlet Preheater
h_4 = h (Fluid$, T = T_4, P = P_4) Enthalpy n-Pentane keluar dari Vaporizer atau inlet Turbine
s_4 = s (Fluid$, T = T_4, P = P_4) Entropy n-Pentane keluar dari Vaporizer atau inlet Turbine
cp_1 = Cp (water, T = T_1, P = P_1) Specific heat brine masuk ke Vaporizer
cp_5 = Cp (water, T = T_5, P = P_5) Specific heat brine keluar dari Vaporizer atau masuk ke Preheater
cp_3 = Cp (Fluid$, T = T_3, P = P_3) Specific heat n-Pentane masuk ke Vaporizer atau outlet Preheater
cp_4 = Cp (Fluid$, T = T_4, P = P_4) Specific heat n-Pentane keluar dari Vaporizer atau inlet Turbine
Cp_1 = 0.6851 [kJ/kg-K]
m_1 = 321.54 [kg/s] Laju alir Brine yang masuk ke dalam Vaporizer (1157550 ton/h - HMB)
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$m_1 = m_5$ Laju alir Brine inlet Vaporizer sama dengan laju alir brine outlet Vaporizer

$m_3 = m_4$ Laju alir n-Pentane yang masuk ke Vaporizer sama dengan yang keluar dari Vaporizer

Mass Flow fluid kerja

$m_1 \cdot (h_1 - h_2) = m_4 \cdot (h_4 - h_{19})$ m_4 laju alir n-Pentane, assumsi pada kondisi steady state dimana energi potential dan Energi kinetik diabaikan

Vaporizer

$Q_{Vaporizer} = m_1 \cdot cp_1 \cdot (T_1 - T_5)$ Q = Heat Transfer di Vaporizer

atau

$Q_{Vaporizer2} = m_3 \cdot (h_4 - h_3)$ Q = Heat Transfer di Vaporizer

$U_{Vap,clean} = 2.53$ [kW/m^2*K] Overall Heat Transfer Coeficient Clean - Datasheet Vaporizer

$U_{Vap,service} = 1.4$ [kW/m^2*K] Overall Heat Transfer Coeficient Service - Datasheet Vaporizer

$LMTD_{Vaporizer} = \left[\dfrac{T_1 - T_4 - (T_5 - T_3)}{\ln\left[\dfrac{T_1 - T_4}{T_5 - T_3}\right]} \right] \cdot 1$ Log Mean Temperature Different Vaporizer

$Q_{Vaporizer} = U_{Vap,clean} \cdot A_{Vaporizer,Clean} \cdot LMTD_{Vaporizer}$ $A_{Vaporizer}$ = overall heat transfer Area Vaporizer

$Q_{Vaporizer} = U_{Vap,service} \cdot A_{Vaporizer,Service} \cdot LMTD_{Vaporizer}$ $A_{Vaporizer}$ = overall heat transfer Area Vaporizer

PREHEATER

P_5; T_5 = inlet brine ke Preheater

Suhu & tekanan inlet Preheater Brine sama dengan suhu dan tekanan outlet Vaporizer brine T_5, P_5

P_3; T_3 = outlet n-Pentane dari Preheater

Suhu & tekanan outlet Preheater n-Pentane sama dengan suhu dan tekanan inlet Vaporizer n-Pentane T_3, P_3

T_{19} = **ConvertTemp** (C, K, 71.3) Suhu inlet n-Pentane Preheater atau n-Pentane Recuperator Outlet

T_2 = **ConvertTemp** (C, K, 148.1) Suhu Brine menuju reinjection well

$P_{19} = 2480$ [kPa] Tekanan inlet n-Pentane Preheater, asumsi tidak ada pressure drop dari Recuperator ke Preheater

$P_2 = 2000$ [kPa] Tekanan Brine Preheater outlet, asumsi pressure drop 100 kPa

$m_{19} = m_{17} + m_{18}$ Laju alir n-Pentane yang masuk ke Preheater atau outlet Feed Pump

$m_2 = m_5$ Laju alir Brine outlet Preheater sama dengan inlet Vaporizer $m_1=m_5=m_2$

h_2 = **h** (water, T = T_2, P = P_2) enthalpi brine keluar dari Preheater

s_2 = **s** (water, T = T_2, P = P_2) entropy brine keluar dari Preheater

h_{19} = **h** (Fluid\$, T = T_{19}, P = P_{19}) enthalpi n-Pentane inlet preheater

s_{19} = **s** (Fluid\$, T = T_{19}, P = P_{19}) entropy n-Pentane inlet preheater

cp_2 = **Cp** (water, T = T_2, P = P_2) Specific heat Brine keluar dari Preheater

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$$\left[T_2 - T_{19}\right]$$

$Q_{preheater} = U_{preheater,clean} \cdot A_{preheater,clean} \cdot LMTD_{preheater}$ $A_{preheater}$ overall heat transfer Area Preheater

$Q_{preheater} = U_{preheater,service} \cdot A_{preheater,service} \cdot LMTD_{preheater}$ $A_{preheater}$ overall heat transfer Area Preheater

TURBINE CW

$T_6 = T_4$ Suhu n-Pentane Inlet Turbine CW

$T_8 = \mathbf{ConvertTemp}(C, K, 101.7)$ Suhu n-Pentane outlet Turbine CW atau inlet Recuperator CW

$P_6 = P_4$ Tekanan n-Pentane Inlet Turbine CW assumsi sama dengan outlet n-Pentane Vaporizer

$P_8 = 179$ [kPa] Tekanan n-Pentane outlet Turbine CW

$m_6 = \frac{m_4}{2}$ Laju alir n-Pentane inlet turbine CW

$m_8 = m_6$ Laju alir n-Pentane outlet turbine CW

$h_6 = \mathbf{h}(Fluid\$, T = T_6, x = 1)$ Enthalpi n-Pentane inlet Turbine CW, quality x=1

$s_6 = \mathbf{s}(Fluid\$, T = T_6, x = 1)$ Entropy n-Pentane inlet Turbine CW, quality x=1

$h_8 = \mathbf{h}(Fluid\$, T = T_8, P = P_8)$ Enthalpi n-Pentane outlet turbine CW

$s_8 = \mathbf{s}(Fluid\$, T = T_8, P = P_8)$ Entropy n-Pentane outlet Turbine CW

$h_{8s} = h_{14} + (h_8 - h_{14}) \cdot \left[\frac{s_6 - s_{14}}{s_8 - s_{14}}\right]$ ideal outlet entalphi turbine CW

$cp_6 = \mathbf{Cp}(Fluid\$, T = T_6, P = P_6)$ Specific heat n-Pentane masuk ke Turbine CW

$cp_8 = \mathbf{Cp}(Fluid\$, T = T_8, P = P_8)$ Specific heat n-Pentane keluar dari Turbine CW

GROSS MECHANICAL POWER TURBINE

$W_{Turbine,CW,Mec} = m_6 \cdot (h_6 - h_8)$ Gross Power Turbine Mechanical

atau

$W_{Turbine,CW,Mec2} = m_6 \cdot \frac{\eta_{Turbine,CW}}{100} \cdot (h_6 - h_{8s})$ Gross Power Turbine Mechanical

EFISIENSI

$\eta_{Turbine,CW} = \left[\frac{h_6 - h_8}{h_6 - h_{8s}}\right] \cdot 100$ Isentropic Turbine efficiency

$\eta_{generator} = 0.95 \cdot 100$ Generator efisiensi data sheet 0,95-0,97

GROSS ELECTRICAL POWER TURBINE

$W_{Turbine,gross,CW,electrical} = W_{Turbine,CW,Mec} \cdot \frac{\eta_{generator}}{100}$

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GROSS ELECTRICAL POWER TURBINE

$W_{Turbine,gross,CW,electrical} = W_{Turbine,CW,Mec} \cdot \frac{\eta_{generator}}{100}$

TURBINE CCW

$T_7 = T_4$ Suhu n-Pentane Inlet Turbine CCW

$T_9 = \textbf{ConvertTemp}(C, K, 101.7)$ Suhu n-Pentane outlet Turbine CCW atau inlet Recuperator CCW

$P_7 = P_4$ Tekanan n-Pentane Inlet Turbine CCW

$P_9 = 179$ [kPa] Tekanan n-Pentane outlet Turbine CCW

$m_7 = \frac{m_4}{2}$ Laju alir n-Pentane inlet turbine CCW

$m_9 = m_7$ Laju alir n-Pentane outlet turbine CCW

$h_7 = \textbf{h}(Fluid\$, T = T_7, x = 1)$ Enthalpi n-Pentane inlet Turbine CCW

$s_7 = \textbf{s}(Fluid\$, T = T_7, x = 1)$ Entropy n-Pentane inlet Turbine CCW

$h_9 = \textbf{h}(Fluid\$, T = T_9, P = P_9)$ Enthalpi n-Pentane outlet turbine CCW

$s_9 = \textbf{s}(Fluid\$, T = T_9, P = P_9)$ Entropy n-Pentane outletTurbine CCW

$h_{9s} = h_{14} + (h_9 - h_{14}) \cdot \left[\frac{s_7 - s_{14}}{s_9 - s_{14}}\right]$ ideal outlet entalphi turbine CCW

$cp_7 = \textbf{Cp}(Fluid\$, T = T_7, P = P_7)$ Specific heat n-Pentane masuk ke Turbine CCW

$cp_9 = \textbf{Cp}(Fluid\$, T = T_9, P = P_9)$ Specific heat n-Pentane keluar dari Turbine CCW

GROSS MECHANICAL POWER TURBINE

$W_{Turbine,CCW,Mec} = m_7 \cdot (h_7 - h_9)$ Gross Power Turbine Mechanical

atau

$W_{Turbine,CCW,Mec2} = m_7 \cdot \frac{\eta_{Turbine,CCW}}{100} \cdot (h_7 - h_{9s})$ Gross Power Turbine Mechanical

EFISIENSI

$\eta_{Turbine,CCW} = \left[\frac{h_7 - h_9}{h_7 - h_{9s}}\right] \cdot 100$ Isentropic Turbine efficiency

GROSS ELECTRICAL POWER TURBINE

$W_{Turbine,gross,CCW,electrical} = W_{Turbine,CCW,Mec} \cdot \frac{\eta_{generator}}{100}$

RECUPERATOR CW

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$W_{Turbine,gross,CCW,electrical} = W_{Turbine,CCW,Mec} \cdot \frac{\eta_{generator}}{100}$

RECUPERATOR CW

P_8; T_8

Hot side suhu dan tekanan inlet n-Pentane Recuperator CW sama dengan Suhu dan Tekanan outlet Turbine CW

T_{10} = **ConvertTemp** (C , K , 73.3) Hot side - Suhu outlet n-Pentane Recuperator CW to ACHE

T_{16} = **ConvertTemp** (C , K , 49) Cold side- Suhu keluar n-Pentane dari Feed Pump atau inlet Recuperatr (kenaikan suhu Pompa Feed Pump 1.8-2 C)

T_{17} = **ConvertTemp** (C , K , 71.3) Cold side- Suhu outlet n-Pentane Recuperator CW to Preheater

$m_{10} = m_8$ Laju alir n-Pentane dari sisi hot side Recuperator menuju ACHE

$m_{16} = \frac{m_{14}}{2}$ Laju alir n-Pentane dari outlet pompa feed pump atau inlet recuperator CW

$m_{17} = m_{16}$ Laju alir n-Pentane dari outlet recuperator CW ke Preheater

$P_{10} = 179$ [kPa] Hot side - Tekanan Outlet Recuperator asumsi tidak ada pressure drop

$P_{16} = 2480$ [kPa] Tekanan inlet disisi cold side Recuperator sama dengan tekanan keluar Feed Pump, asumsi tidak ada pressure drop

$P_{17} = 2480$ [kPa] Tekanan outlet disisi cold side Recuperator dengan asumsi tidak ada pressure drop

h_{10} = **h** (Fluid\$, $T = T_{10}$, $P = P_{10}$) Entalphi Hot side outlet n-Pentane Recuperator

s_{10} = **s** (Fluid\$, $T = T_{10}$, $P = P_{10}$) Entropy Hot side outlet n-Pentane Recuperator

h_{16} = **h** (Fluid\$, $T = T_{16}$, $P = P_{16}$) Entalphi cold side inlet n-Pentane Recuperator

s_{16} = **s** (Fluid\$, $T = T_{16}$, $P = P_{16}$) Entropy cold side inlet n-Pentane Recuperator

h_{17} = **h** (Fluid\$, $T = T_{17}$, $P = P_{17}$) Entalphi cold side outlet n-Pentane Recuperator

s_{17} = **s** (Fluid\$, $T = T_{17}$, $P = P_{17}$) Entropy cold side outlet n-Pentane Recuperator

cp_{10} = **Cp** (Fluid\$, $T = T_{10}$, $P = P_{10}$) Specific heat n-Pentane keluar dari Hot side Recuperator menuju ACHE

cp_{16} = **Cp** (Fluid\$, $T = T_{16}$, $P = P_{16}$) Specific heat n-Pentane dari outlet pompa feed pump atau inlet recuperator CW

cp_{17} = **Cp** (Fluid\$, $T = T_{17}$, $P = P_{17}$) Specific heat n-Pentane dari outlet recuperator CW ke Preheater

$Q_{recuperator,CW} = m_8 \cdot cp_8 \cdot (T_8 - T_{10})$ Heat Transfer di Recuperator CW

cp_{10} = **Cp** (Fluid\$, $T = T_{10}$, $P = P_{10}$) Specific heat n-Pentane keluar dari Hot side Recuperator menuju ACHE

cp_{16} = **Cp** (Fluid\$, $T = T_{16}$, $P = P_{16}$) Specific heat n-Pentane dari outlet pompa feed pump atau inlet recuperator CW

cp_{17} = **Cp** (Fluid\$, $T = T_{17}$, $P = P_{17}$) Specific heat n-Pentane dari outlet recuperator CW ke Preheater

$Q_{recuperator,CW} = m_8 \cdot cp_8 \cdot (T_8 - T_{10})$ Heat Transfer di Recuperator CW

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$LMTD_{Recuperator,CW} = \frac{\ldots}{\ln\left[\frac{T_8 - T_{17}}{T_{10} - T_{16}}\right]}$ Log Mean Temperature Different Recuperator CW

$Q_{recuperator,CW} = U_{RCW} \cdot A_{Recuperator,CW} \cdot LMTD_{Recuperator,CW}$ $A_{Recuperator,CW}$ = overall heat transfer Area

RECUPERATOR CCW

$P_9;T_9$

Hot side suhu dan tekanan inlet n-Pentane Recuperator CCW sama dengan Suhu dan Tekanan outlet Turbine CCW

$T_{11} = \textbf{ConvertTemp}(C, K, 73.3)$ Hot side - Suhu outlet n-Pentane Recuperator CCW to ACHE

$T_{15} = \textbf{ConvertTemp}(C, K, 49)$ Cold side- Suhu keluar n-Pentane dari Feed Pump atau inlet Recuperatr (kenaikan suhu Pompa Feed Pump 1.8-2 C)

$T_{18} = \textbf{ConvertTemp}(C, K, 71.3)$ Cold side- Suhu outlet n-Pentane Recuperator CCW to Preheater

$m_{11} = m_9$ Laju alir n-Pentane dari sisi hot side Recuperator menuju ACHE

$m_{15} = \frac{m_{14}}{2}$ Laju alir n-Pentane dari outlet pompa feed pump atau inlet recuperator CCW

$m_{18} = m_{15}$ Laju alir n-Pentane dari outlet recuperator CCW ke Preheater

$P_{11} = 179$ [kPa] Hot side - Tekanan Outlet Recuperator asumsi tidak ada pressure drop

$P_{15} = 2480$ [kPa] Tekanan inlet disisi cold side Recuperator sama dengan tekanan keluar Feed Pump, asumsi tidak ada pressure drop

$P_{18} = 2480$ [kPa] Tekanan outlet disisi cold side Recuperator dengan asumsi tidak ada pressure drop

$h_{11} = \textbf{h}(Fluid\$, T = T_{11}, P = P_{11})$ Entalphi Hot side outlet n-Pentane Recuperator

$s_{11} = \textbf{s}(Fluid\$, T = T_{11}, P = P_{11})$ Entropy Hot side outlet n-Pentane Recuperator

$h_{15} = \textbf{h}(Fluid\$, T = T_{15}, P = P_{15})$ Entalphi cold side inlet n-Pentane Recuperator

$s_{15} = \textbf{s}(Fluid\$, T = T_{15}, P = P_{15})$ Entropy cold side inlet n-Pentane Recuperator

$h_{18} = \textbf{h}(Fluid\$, T = T_{18}, P = P_{18})$ Entalphi cold side outlet n-Pentane Recuperator

$s_{18} = \textbf{s}(Fluid\$, T = T_{18}, P = P_{18})$ Entropy cold side outlet n-Pentane Recuperator

$cp_{11} = \textbf{Cp}(Fluid\$, T = T_{11}, P = P_{11})$ Specific heat n-Pentane keluar dari Hot side Recuperator menuju ACHE

$cp_{15} = \textbf{Cp}(Fluid\$, T = T_{15}, P = P_{15})$ Specific heat n-Pentane dari outlet pompa feed pump atau inlet recuperator CCW

$cp_{18} = \textbf{Cp}(Fluid\$, T = T_{18}, P = P_{18})$ Specific heat n-Pentane dari outlet recuperator CW ke Preheater

$Q_{recuperator,CCW} = m_9 \cdot cp_9 \cdot (T_9 - T_{11})$ Heat Transfer di Recuperator CCW

$U_{RCCW} = 0.14$ [kW/m²·K] datasheet Recuperator

$LMTD_{Recuperator,CCW} = \frac{T_9 - T_{18} - (T_{11} - T_{15})}{\ln\left[\frac{T_9 - T_{18}}{T_{11} - T_{15}}\right]}$ Log Mean Temperature Different Recuperator CCW

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$$LMTD_{Recuperator,CCW} = \frac{T_9 - T_{18} - (T_{11} - T_{15})}{\ln\left[\frac{T_9 - T_{18}}{T_{11} - T_{15}}\right]}$$ Log Mean Temperature Different Recuperator CCW

$Q_{recuperator,CCW} = U_{RCW} \cdot A_{Recuperator,CCW} \cdot LMTD_{Recuperator,CCW}$ $A_{Recuperator,CCW}$ = overall heat transfer Area

AIR COOLER HEAT EXCHANGER

$T_{12} = T_{10}$ Suhu n-Pentane Inlet ACHE Hot side atau suhu outlet recuperator CW dan CCW

T_{13} = **ConvertTemp** (C , K , 47) Suhu n-Pentane outlet ACHE atau inlet Feed pump

$T_{20} = T_0$ Ambient Temperature atau suhu yang dihisap inlet Fan ACHE

T_{21} = **ConvertTemp** (C , K , 32) Suhu Fan udara outlet ACHE

P_{12} = 172 [kPa] Tekanan n-Pentane Hot side ACHE atau suhu outlet recuperator

P_{13} = 167 [kPa] Tekanan n-Pentane outlet ACHE

$P_{20} = P_0$ Tekanan inlet Fan ACHE

$P_{21} = P_0$ Tekanan outlet Fan ACHE

$m_{12} = m_{10} + m_{11}$ Laju alir pentane inlet ACHE

$m_{12} = m_{13}$ Laju alir pentane outlet ACHE

U_{ACHE} = 0.501 [kW/m^2*K] U_{ache} (Light organic cooling) overall heat transfer correction factor - Chemical process design computer-aided case- hal 499

ρ_{air} = 0.0709 [lbm/ft^3] assumsi rho_{air} 0,0709 process heat transfer - hal 688

$\rho_{air,convert}$ = 1.153 [kg/m^3]

V_{fan}=245455 $_{ACFM}$

existing fan capacity

h_{12} = **h** (Fluid\$, $T = T_{12}$, $P = P_{12}$) Enthalpi n-Pentane Inlet ACHE

s_{12} = **s** (Fluid\$, $T = T_{12}$, $P = P_{12}$) Entropy n-Pentane Inlet ACHE

h_{13} = **h** (Fluid\$, $T = T_{13}$, $x = 0$) enthalpy liquid outlet ACHE atau inlet Feed Pump

s_{13} = **s** (Fluid\$, $T = T_{13}$, $x = 0$) entropy liquid outlet ACHE atau inlet Feed Pump

h_{20} = **h** (Air , $T = T_0$) enthalpy udara di hisap ACHE

s_{20} = **s** (Air , $T = T_0$, $P = P_0$) entropy udara di hisap ACHE

h_{21} = **h** (Air , $T = T_{21}$) enthalpy udara di keluarkan ACHE

s_{21} = **s** (Air , $T = T_{21}$, $P = P_{21}$) entropy udara di keluarkan ACHE

P_{diff} = 0.431 [in·H2O]

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$W_{fan,actual} = 15.2 \cdot 42$ Rotor shaft power - fan datasheet

$W_{fin,fan,actual} = 18.5 \cdot 42$ Motor - fan datasheet

FEED PUMP

Feed Pump inlet

Temperature dan pressure inlet Feed Pump sama dengan temperature dan pressure outlet ACHE T_{13}, P_{13}

Feed Pump Outlet

$T_{14} = \textbf{ConvertTemp}(C, K, 49)$ Temperature keluaran pompa kenaikan 1.8 - 2 deg C

$P_{14} = 2480$ [kPa] Pressure discharge pompa - data operasi

$h_{14} = \textbf{h}(Fluid\$, T = T_{14}, P = P_{14})$ enthalpy n-Pentane tekanan Feed Pump

$s_{14} = \textbf{s}(Fluid\$, P = P_{14}, h = h_{14})$ entropy n-Pentane Feed Pump

$m_{14} = m_{13}$ mass flow n-Pentane

$cp_{14} = \textbf{Cp}(Fluid\$, T = T_{14}, P = P_{14})$ Specific heat pentane keluar dari Feed Pump

$$h_{14s} = h_{11} + (h_{14} - h_{11}) \cdot \left[\frac{s_{14} - s_{11}}{s_{13} - s_{11}}\right]$$

Feed Pump Work

$W_{pump} = m_{13} \cdot (h_{14} - h_{13})$

$$\eta_{pump} = \left[\frac{h_{14} - h_{13}}{h_{14s} - h_{13}}\right] \cdot 100$$

EXERG

Specific Exergy

$h_{22} = \textbf{h}(Air, T = T_0)$ enthalpy - dead state - Udara

$s_{22} = \textbf{s}(Air, T = T_0, P = P_0)$ entropy - dead state - Udara

$h_{23} = \textbf{h}(water, T = T_0, P = P_0)$ enthalpy liquid - dead state - Brine

$s_{23} = \textbf{s}(water, T = T_0, P = P_0)$ entropy liquid - dead state - Brine

$h_{24} = |\textbf{h}(n\text{–}pentane, T = T_0, P = P_0)|$ enthalpy liquid - dead state - n-Pentane

$s_{24} = |\textbf{s}(n\text{–}pentane, T = T_0, P = P_0)|$ entropy liquid - dead state - n-Pentane

Specific Exergy Brine From Well resources

$E_1 = h_1 - h_{23} - T_0 \cdot (s_1 - s_{23})$ specific exergy Brine dari Sumur Produksi ke Vaporizer

$E_2 = h_2 - h_{23} - T_0 \cdot (s_2 - s_{23})$ specific exergy Brine dari Preheater ke reinjection system

Exergetic Power

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Specific Exergy

$h_{22} = \mathbf{h}(Air, T = T_0)$ enthalpy - dead state - Udara

$s_{22} = \mathbf{s}(Air, T = T_0, P = P_0)$ entropy - dead state - Udara

$h_{23} = \mathbf{h}(water, T = T_0, P = P_0)$ enthalpy liquid - dead state - Brine

$s_{23} = \mathbf{s}(water, T = T_0, P = P_0)$ entropy liquid - dead state - Brine

$h_{24} = |\mathbf{h}(n\text{-}pentane, T = T_0, P = P_0)|$ enthalpy liquid - dead state - n-Pentane

$s_{24} = |\mathbf{s}(n\text{-}pentane, T = T_0, P = P_0)|$ entropy liquid - dead state - n-Pentane

Specific Exergy Brine From Well resources

$E_1 = h_1 - h_{23} - T_0 \cdot (s_1 - s_{23})$ specific exergy Brine dari Sumur Produksi ke Vaporizer

$E_2 = h_2 - h_{23} - T_0 \cdot (s_2 - s_{23})$ specific exergy Brine dari Preheater ke reinjection system

Exergetic Power

$Ex = m_1 \cdot E_1$

Vaporizer Exergy

$E_3 = h_3 - h_{24} - T_0 \cdot (s_3 - s_{24})$ specific exergy n-Pentane sebelum Vaporizer

$E_4 = h_4 - h_{24} - T_0 \cdot (s_4 - s_{24})$ specific exergy n-Pentane setelah Vaporizer

specific exergy Brine masuk ke Vaporizer sama dengan E_1

$E_5 = h_5 - h_{23} - T_0 \cdot (s_5 - s_{23})$ specific exergy brine setelah Vaporizer

Exergy Rate Vaporizer

$E_1 = m_1 \cdot E_1$ Exergy rate Brine inlet Vaporizer

$E_5 = m_5 \cdot E_5$ Exergy rate Brine outlet Vaporizer

$E_3 = m_3 \cdot E_3$ Exergy rate Inlet n-Pentane Vaporizer

$E_4 = m_4 \cdot E_4$ Exergy rate Outlet n-Pentane Vaporizer

Exergy Balance Vaporizer

$m_1 \cdot E_1 + m_3 \cdot E_3 = m_5 \cdot E_5 + m_4 \cdot E_4 + E_{destruction,Vaporizer,2}$

$E_{destruction,vaporizer} = m_4 \cdot (E_3 - E_4) + m_1 \cdot (E_1 - E_5)$

$E_{input,Vaporizer} = m_1 \cdot E_1 + m_3 \cdot E_3$

$E_{output,Vaporizer} = m_5 \cdot E_5 + m_4 \cdot E_4$

Turbine Exergy CW

$E_8 = h_8 - h_{24} - T_0 \cdot (s_8 - s_{24})$ specific exergy inlet Turbine CW

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$E_{output,Vaporizer} = m_5 \cdot E_5 + m_4 \cdot E_4$

Turbine Exergy CW

$E_6 = h_6 - h_{24} - T_0 \cdot (s_6 - s_{24})$ specific exergy inlet Turbine CW

$E_8 = h_8 - h_{24} - T_0 \cdot (s_8 - s_{24})$ specific exergy outlet Turbine CW

Exergy Rate Turbine CW

$E_6 = m_6 \cdot E_6$ Exergy rate inlet Turbine CW

$E_8 = m_8 \cdot E_8$ Exergy rate outlet Turbine CW

Exergy Balance Turbine CW

$m_6 \cdot E_6 = W_{Turbine,gross,CW,electrical} + m_8 \cdot E_8 + E_{destruction,Turbine,CW,2}$

$E_{destruction,Turbine,CW} = m_6 \cdot (E_6 - E_8) - W_{Turbine,gross,CW,electrical}$

$E_{input,turbine,CW} = m_6 \cdot E_6$

$E_{output,turbine,CW} = W_{Turbine,gross,CW,electrical} + m_8 \cdot E_8$

$\eta_{Exergi,Turbine,CW} = \left[\frac{W_{Turbine,gross,CW,electrical} + E_8}{E_6} \right] \cdot 100$ efisiensi eksergi dari Turbine

Turbine Exergy CCW

$E_7 = h_7 - h_{24} - T_0 \cdot (s_7 - s_{24})$ specific exergy Inlet Turbine CCW

$E_9 = h_9 - h_{24} - T_0 \cdot (s_9 - s_{24})$ specific exergy Outlet Turbine CCW

Exergy Rate Turbine CCW

$E_7 = m_7 \cdot E_7$ Exergy rate inlet Turbine CCW

$E_9 = m_9 \cdot E_9$ Exergy rate outlet Turbine CCW

Exergy Balance Turbine CCW

$m_7 \cdot E_7 = W_{Turbine,gross,CCW,electrical} + m_9 \cdot E_9 + E_{destruction,turbine,CCW,2}$

$E_{destruction,Turbine,CCW} = m_7 \cdot (E_7 - E_9) - W_{Turbine,gross,CCW,electrical}$

$E_{input,turbine,CCW} = m_7 \cdot E_7$

$E_{output,turbine,CCW} = W_{Turbine,gross,CCW,electrical} + m_9 \cdot E_9$

$m_7 \cdot E_7 = W_{Turbine,gross,CCW,electrical} + m_9 \cdot E_9 + E_{destruction,turbine,CCW,2}$

$E_{destruction,Turbine,CCW} = m_7 \cdot (E_7 - E_9) - W_{Turbine,gross,CCW,electrical}$

$E_{input,turbine,CCW} = m_7 \cdot E_7$

$E_{output,turbine,CCW} = W_{Turbine,gross,CCW,electrical} + m_9 \cdot E_9$

$\left[W_{Turbine,gross,CCW,electrical} + E_9 \right]$

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$E_{input,turbine,CCW} = m_7 \cdot E_7$

$E_{output,turbine,CCW} = W_{Turbine,gross,CCW,electrical} + m_9 \cdot E_9$

$\eta_{Exergi,Turbine,CCW} = \left[\frac{W_{Turbine,gross,CCW,electrical} + E_9}{E_7} \right] \cdot 100$ efisiensi eksergi dari Turbine

Recuperator exergy CW

specific exergy masuk ke recuperator sisi hot side sama dengan specific exergy dari Turbine CW (E_8)

$E_{10} = h_{10} - h_{24} - T_0 \cdot (s_{10} - s_{24})$ specific exergy outlet recuperator sisi hot side

$E_{16} = h_{16} - h_{24} - T_0 \cdot (s_{16} - s_{24})$ specific exergy inlet recupreator sisi cold side

$E_{17} = h_{17} - h_{24} - T_0 \cdot (s_{17} - s_{24})$ specific exergy outlet recupreator sisi cold side

Exergy Rate Recuperator CW

exergy rate masuk ke recuperator sisi hot side sama dengan E_8

$E_{10} = m_{10} \cdot E_{10}$ Exergy rate outlet recuperator - hot side

$E_{16} = m_{16} \cdot E_{16}$ Exergy rate inlet recuperator - cold side

$E_{17} = m_{17} \cdot E_{17}$ Exergy rate outlet recuperator - cold side

Exergy Balance Recuperator CW

$m_8 \cdot E_8 + m_{16} \cdot E_{16} = m_{10} \cdot E_{10} + m_{17} \cdot E_{17} + E_{destruction,recuperator,CW,2}$

$E_{destruction,recuperator,CW} = m_8 \cdot (E_8 - E_{10}) + m_{16} \cdot (E_{16} - E_{17})$

$E_{input,recuperator,CW} = m_8 \cdot E_8 + m_{16} \cdot E_{16}$

$E_{output,recuperator,CW} = m_{10} \cdot E_{10} + m_{17} \cdot E_{17}$

Recuperator exergy CCW

specific exergy masuk ke recuperator sisi hot side sama dengan specific exergy dari Turbine CCW (E_9)

$E_{11} = h_{11} - h_{24} - T_0 \cdot (s_{11} - s_{24})$ specific exergy outlet recuperator sisi hot side

$E_{15} = h_{15} - h_{24} - T_0 \cdot (s_{15} - s_{24})$ specific exergy inlet recupreator sisi cold side

$E_{18} = h_{18} - h_{24} - T_0 \cdot (s_{18} - s_{24})$ specific exergy outlet recupreator sisi cold side

Exergy Rate Recuperator CCW

exergy rate masuk ke recuperator sisi hot side sama dengan E_9

$E_{11} = m_{11} \cdot E_{11}$ Exergy rate outlet recuperator - hot side

$E_{15} = m_{15} \cdot E_{15}$ Exergy rate inlet recuperator - cold side

$E_{18} = m_{18} \cdot E_{18}$ Exergy rate outlet recuperator - cold side

Exergy Balance Recuperator CCW

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$E_{input,recuperator,CCW} = m_9 \cdot E_9 + m_{15} \cdot E_{15}$

$E_{output,recuperator,CCW} = m_{11} \cdot E_{11} + m_{18} \cdot E_{18}$

ACHE Exergy

$E_{12} = h_{12} - h_{24} - T_0 \cdot (s_{12} - s_{24})$ specific exergy inlet ACHE-pentane

$E_{13} = h_{13} - h_{24} - T_0 \cdot (s_{13} - s_{24})$ specific exergy outlet ACHE-pentane

$E_{20} = h_{20} - h_{22} - T_0 \cdot (s_{20} - s_{22})$ specific exergy inlet ACHE-udara

$E_{21} = h_{21} - h_{22} - T_0 \cdot (s_{21} - s_{22})$ specific exergy outlet ACHE-udara

Exergy Rate ACHE

$E_{12} = m_{12} \cdot E_{12}$ Exergy rate inlet ACHE (n-Pentane) - hot side

$E_{13} = m_{13} \cdot E_{13}$ Exergy rate outlet ACHE (n-Pentane) - hot side

$E_{20} = m_{wf,Air} \cdot E_{20}$ Exergy rate inlet ACHE (udara) - cold side

$E_{21} = m_{wf,Air} \cdot E_{21}$ Exergy rate outlet ACHE (udara) - cold side

Exergy balance ACHE

$m_{12} \cdot E_{12} + m_{wf,Air} \cdot E_{20} = m_{13} \cdot E_{13} + m_{wf,Air} \cdot E_{21} + E_{destruction,ACHE,2}$

$E_{destruction,ACHE} = m_{wf,Air} \cdot (E_{20} - E_{21}) + m_{12} \cdot (E_{12} - E_{13})$

$E_{input,ACHE} = m_{12} \cdot E_{12} + m_{wf,Air} \cdot E_{20}$

$E_{output,ACHE} = m_{13} \cdot E_{13} + m_{wf,Air} \cdot E_{21}$

Feed Pump Exergy

specific exergy inlet Feed Pump sama dengan E_{13}

$E_{14} = h_{14} - h_{24} - T_0 \cdot (s_{14} - s_{24})$ specific exergy outlet Feed Pump

Exergy Rate Pump

Exergy rate masuk ke Feed Pump E_{13}

$E_{14} = m_{14} \cdot E_{14}$ Exergy rate outlet Feed Pump

Exergy balance pump

$m_{13} \cdot E_{13} + W_{pump} = m_{14} \cdot E_{14} + E_{destruction,Feed,Pump,2}$

Exergy Rate Pump

Exergy rate masuk ke Feed Pump E_{13}

$E_{14} = m_{14} \cdot E_{14}$ Exergy rate outlet Feed Pump

Exergy balance pump

$m_{13} \cdot E_{13} + W_{pump} = m_{14} \cdot E_{14} + E_{destruction,Feed,Pump,2}$

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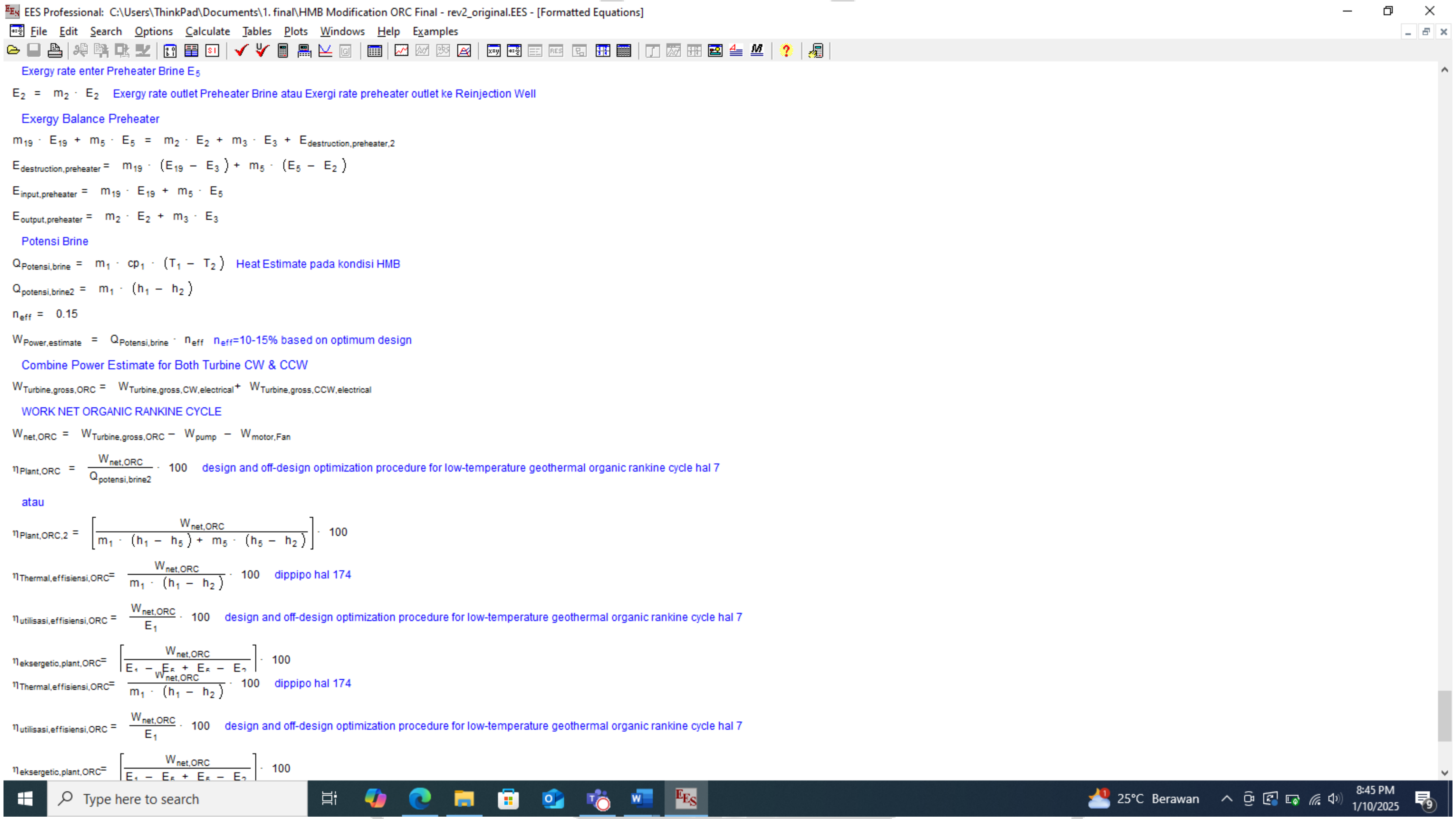
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File Edit Search Options Calculate Tables Plots Windows Help Examples
Exergy rate enter Preheater Brine E_5
$E_2 = m_2 \cdot E_2$ Exergy rate outlet Preheater Brine atau Exergi rate preheater outlet ke Reinjection Well
Exergy Balance Preheater
$m_{19} \cdot E_{19} + m_5 \cdot E_5 = m_2 \cdot E_2 + m_3 \cdot E_3 + E_{destruction,preheater,2}$
$E_{destruction,preheater} = m_{19} \cdot (E_{19} - E_3) + m_5 \cdot (E_5 - E_2)$
$E_{input,preheater} = m_{19} \cdot E_{19} + m_5 \cdot E_5$
$E_{output,preheater} = m_2 \cdot E_2 + m_3 \cdot E_3$
Potensi Brine
$Q_{Potensi,brine} = m_1 \cdot cp_1 \cdot (T_1 - T_2)$ Heat Estimate pada kondisi HMB
$Q_{potensi,brine2} = m_1 \cdot (h_1 - h_2)$
$n_{eff} = 0.15$
$W_{Power,estimate} = Q_{Potensi,brine} \cdot n_{eff}$ n_{eff}=10-15% based on optimum design
Combine Power Estimate for Both Turbine CW & CCW
$W_{Turbine,gross,ORC} = W_{Turbine,gross,CW,electrical} + W_{Turbine,gross,CCW,electrical}$
WORK NET ORGANIC RANKINE CYCLE
$W_{net,ORC} = W_{Turbine,gross,ORC} - W_{pump} - W_{motor,Fan}$
$\eta_{Plant,ORC} = \frac{W_{net,ORC}}{Q_{potensi,brine2}} \cdot 100$ design and off-design optimization procedure for low-temperature geothermal organic rankine cycle hal 7
atau
$\eta_{Plant,ORC,2} = \left[\frac{W_{net,ORC}}{m_1 \cdot (h_1 - h_5) + m_5 \cdot (h_5 - h_2)}\right] \cdot 100$
$\eta_{Thermal,effisiensi,ORC} = \frac{W_{net,ORC}}{m_1 \cdot (h_1 - h_2)} \cdot 100$ dippipo hal 174
$\eta_{utilisasi,effisiensi,ORC} = \frac{W_{net,ORC}}{E_1} \cdot 100$ design and off-design optimization procedure for low-temperature geothermal organic rankine cycle hal 7
$\eta_{eksergetic,plant,ORC} = \left[\frac{W_{net,ORC}}{E_1 - E_5 + E_5 - E_2}\right] \cdot 100$
$\eta_{Thermal,effisiensi,ORC} = \frac{W_{net,ORC}}{m_1 \cdot (h_1 - h_2)} \cdot 100$ dippipo hal 174
$\eta_{utilisasi,effisiensi,ORC} = \frac{W_{net,ORC}}{E_1} \cdot 100$ design and off-design optimization procedure for low-temperature geothermal organic rankine cycle hal 7
$\eta_{eksergetic,plant,ORC} = \left[\frac{W_{net,ORC}}{E_1 - E_5 + E_5 - E_2}\right] \cdot 100$
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Main
Unit Settings: SI K kPa kJ mass deg
A_{ACHE} = 4758 [m^2]
$A_{preheater,clean}$ = 841 [m^2]
$A_{preheater,service}$ = 1298 [m^2]
$A_{Recuperator,CCW}$ = 1443 [m^2]
$A_{Recuperator,CW}$ = 1443 [m^2]
$A_{Vaporizer,Clean}$ = 560.3 [m^2]
$A_{Vaporizer,Service}$ = 1012 [m^2]
Cp_1 = 0.6851 [kJ/kg-K]
$\eta_{eksergetic,plant,ORC}$ = 40.09 [%]
$\eta_{Exergi,Turbine,CCW}$ = 86.23 [%]
$\eta_{Exergi,Turbine,CW}$ = 86.23 [%]
$\eta_{generator}$ = 95 [%]
$\eta_{Plant,ORC}$ = 13.81 [%]
$\eta_{Plant,ORC,2}$ = 13.81 [%]
η_{pump} = 70.97 [%]
$\eta_{Thermal,effisiensi,ORC}$ = 13.81 [%]
$\eta_{Turbine,CCW}$ = 81.74 [%]
$\eta_{Turbine,CW}$ = 81.74 [%]
$\eta_{utilisasi,effisiensi,ORC}$ = 20.77 [%]
Ex = 59300 [kW]
E_1 = 59300 [kW]
E_{10} = 3721 [kW]
E_{11} = 3721 [kW]
E_{12} = 7206 [kW]
E_{13} = 306.1 [kW]
E_{14} = 1084 [kW]
E_{15} = 541.8 [kW]
E_{16} = 541.8 [kW]
E_{17} = 1117 [kW]
E_{18} = 1117 [kW]
E_{19} = 2235 [kW]
E_2 = 28569 [kW]
E_{20} = 0 [kW]
E_{21} = 977.4 [kW]
E_3 = 16589 [kW]
E_4 = 27308 [kW]
E_5 = 46651 [kW]
E_6 = 13647 [kW]
E_7 = 13647 [kW]
E_8 = 4671 [kW]
E_9 = 4671 [kW]
$E_{destruction,ACHE}$ = 5922 [kW]
$E_{destruction,ACHE,2}$ = 5922 [kW]
$E_{destruction,Feed,Pump}$ = 469.3 [kW]
$E_{destruction,Feed,Pump,2}$ = 469.3 [kW]
$E_{destruction,preheater}$ = 3729 [kW]
$E_{destruction,preheater,2}$ = 3729 [kW]
$E_{destruction,recuperator,CCW}$ = 374.1 [kW]
$E_{destruction,recuperator,CCW2}$ = 374.1 [kW]
$E_{destruction,recuperator,CW}$ = 374.1 [kW]
$E_{destruction,recuperator,CW,2}$ = 374.1 [kW]
$E_{destruction,Turbine,CCW}$ = 1879 [kW]
$E_{destruction,turbine,CCW,2}$ = 1879 [kW]
$E_{destruction,Turbine,CW}$ = 1879 [kW]
$E_{destruction,Turbine,CW,2}$ = 1879 [kW]
$E_{destruction,vaporizer}$ = 1929 [kW]
$E_{destruction,Vaporizer,2}$ = 1929 [kW]
$E_{input,ACHE}$ = 7206 [kW]
$E_{input,FP}$ = 1553 [kW]
$E_{input,preheater}$ = 48886 [kW]
$E_{input,recuperator,CCW}$ = 5213 [kW]
$E_{input,recuperator,CW}$ = 5213 [kW]
$E_{input,turbine,CCW}$ = 13647 [kW]
$E_{input,turbine,CW}$ = 13647 [kW]
$E_{input,Vaporizer}$ = 75889 [kW]
$E_{output,ACHE}$ = 1283 [kW]
$E_{output,FP}$ = 1084 [kW]
$E_{output,preheater}$ = 45158 [kW]
$E_{output,recuperator,CCW}$ = 4839 [kW]
$E_{output,recuperator,CW}$ = 4839 [kW]
$E_{output,turbine,CCW}$ = 11768 [kW]
$E_{output,turbine,CW}$ = 11768 [kW]
$E_{output,Vaporizer}$ = 73960 [kW]
Fluid$ = 'n-pentane'
h_{14s} = 59.32 [kJ/kg]
h_{8s} = 485.4 [kJ/kg]
h_{9s} = 485.4 [kJ/kg]
$LMTD_{ACHE}$ = 31.57 [C]
$LMTD_{preheater}$ = 37.28 [C]
$LMTD_{Recuperator,CCW}$ = 27.24 [C]
$LMTD_{Recuperator,CW}$ = 27.24 [C]
$LMTD_{Vaporizer}$ = 24.28 [C]
$m_{wf,Air}$ = 8812 [kg/s]
n_{eff} = 0.15 [%]
P_{diff} = 0.431 [in H2O]
Q_{ACHE} = 75245 [kW]
$Q_{ACHE,2}$ = 75245 [kW]
$Q_{Potensi,brine}$ = 92133 [kJ/s]
$Q_{potensi,brine2}$ = 89173 [kW]
$Q_{preheater}$ = 56145 [KW]
$Q_{recuperator,CCW}$ = 5504 [KW]
$Q_{recuperator,CW}$ = 5504 [KW]
$Q_{Vaporizer}$ = 34422 [KW]
$Q_{Vaporizer2}$ = 31986 [kW]
ρ_{air} = 0.0709 [lbm/ft^3]
$\rho_{air,convert}$ = 1.153 [kg/m^3]
U_{ACHE} = 0.501 [kW/m^2*K]
$U_{preheater,clean}$ = 1.791 [kW/m^2*K]
$U_{preheater,service}$ = 1.16 [kW/m^2*K]
U_{RCCW} = 0.14 [kW/m^2*K]
U_{RCW} = 0.14 [kW/m^2*K]
$U_{Vap,clean}$ = 2.53 [kW/m^2*K]
$U_{Vap,service}$ = 1.4 [kW/m^2*K]
$V_{Fan,each}$ = 192779 [ACFM]
$V_{fan,total}$ = 229273 [m3/min]
$V_{fan,total,convert}$ = 8.097E+06 [ACFM]
W_{fan} = 673.5 [kW]
$W_{fan,actual}$ = 638.4 [kW]
$W_{fin,fan,actual}$ = 777 [kW]
$W_{motor,Fan}$ = 627.8 [kW]
$W_{net,ORC}$ = 12319 [kW]
$W_{Power,estimate}$ = 13820 [kW]
W_{pump} = 1247 [kW]
$W_{Turbine,CCW,Mec}$ = 7470 [kW]
$W_{Turbine,CCW,Mec2}$ = 7470 [kW]
$W_{Turbine,CW,Mec}$ = 7470 [kW]
$W_{Turbine,CW,Mec2}$ = 7470 [kW]
$W_{Turbine,gross,CCW,electrical}$ = 7097 [kW]
$W_{Turbine,gross,CW,electrical}$ = 7097 [kW]
$W_{Turbine,gross,ORC}$ = 14193 [kW]
Click on this line to see the array variables in the Arrays Table window
28 potential unit problems were detected.
Check Units
Calculation time = 656 ms
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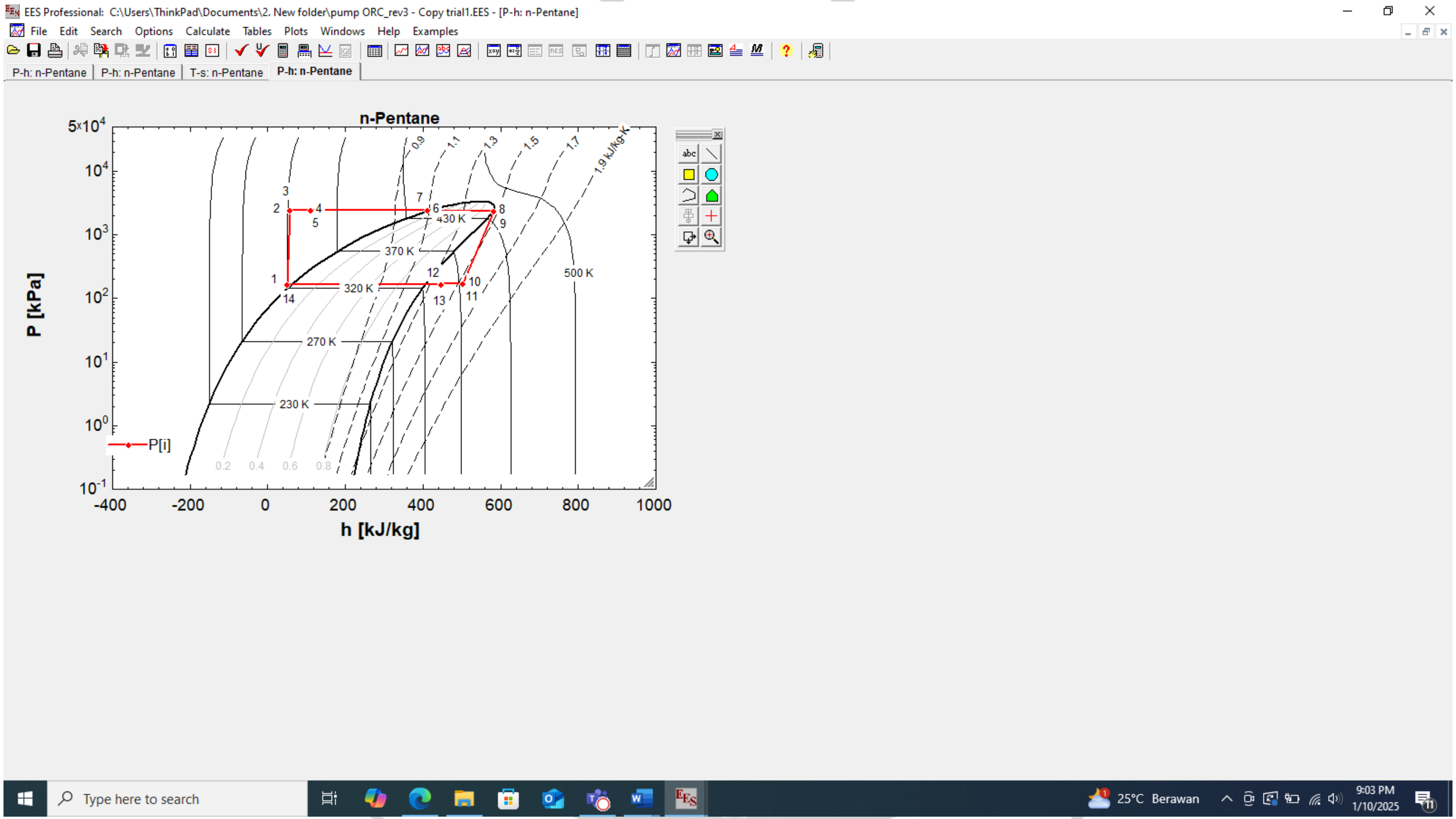
Sort	h_i [kJ/kg]	s_i [kJ/kg-K]	m_i [kg/s]	P_i [kPa]	T_i [K]	E_i [kJ/kg]	cp_i [kJ/kg-K]
[0]				101.3	296.7		
[1]	902.3	2.433	321.5	2200	484.2	184.4	4.555
[2]	625	1.821	321.5	2000	421.3	88.85	4.297
[3]	413.4	1.098	189.6	2400	446.3	87.47	3.912
[4]	582.1	1.476	189.6	2350	446.3	144	3.907
[5]	796.7	2.21	321.5	2100	460.7	145.1	4.432
[6]	581.8	1.475	94.82	2350	446.3	143.9	3.907
[7]	581.8	1.475	94.82	2350	446.3	143.9	3.907
[8]	503	1.529	94.82	179	374.9	49.26	2.044
[9]	503	1.529	94.82	179	374.9	49.26	2.044
[10]	446.5	1.372	94.82	179	346.5	39.25	1.935
[11]	446.5	1.372	94.82	179	346.5	39.25	1.935
[12]	446.8	1.377	189.6	172	346.5	38	1.933
[13]	50.06	0.1624	189.6	167	320.2	1.614	2.423
[14]	56.63	0.1707	189.6	2480	322.2	5.714	2.42
[15]	56.63	0.1707	94.82	2480	322.2	5.714	2.42
[16]	56.63	0.1707	94.82	2480	322.2	5.714	2.42
[17]	111.9	0.3365	94.82	2480	344.5	11.78	2.538
[18]	111.9	0.3365	94.82	2480	344.5	11.78	2.538
[19]	111.9	0.3365	189.6	2480	344.5	11.78	2.538
[20]	297.1	5.691	8812	101.3	296.7	0	1.005
[21]	305.6	5.719	8812	101.3	305.2	0.1109	1.005
[22]	297.1	5.691					
[23]	98.65	0.3461					
[24]	5.552	0.01776					


EES Professional: C:\Users\ThinkPad\Documents\2. New folder\pump ORC_rev3 - Copy trial1.EES - [P-h: n-Pentane]
File Edit Search Options Calculate Tables Plots Windows Help Examples
P-h: n-Pentane
P-h: n-Pentane
T-s: n-Pentane
P-h: n-Pentane
n-Pentane
P [kPa]
h [kJ/kg]
500 K
430 K
370 K
320 K
270 K
230 K
1.9 kJ/kg-K
P[i]
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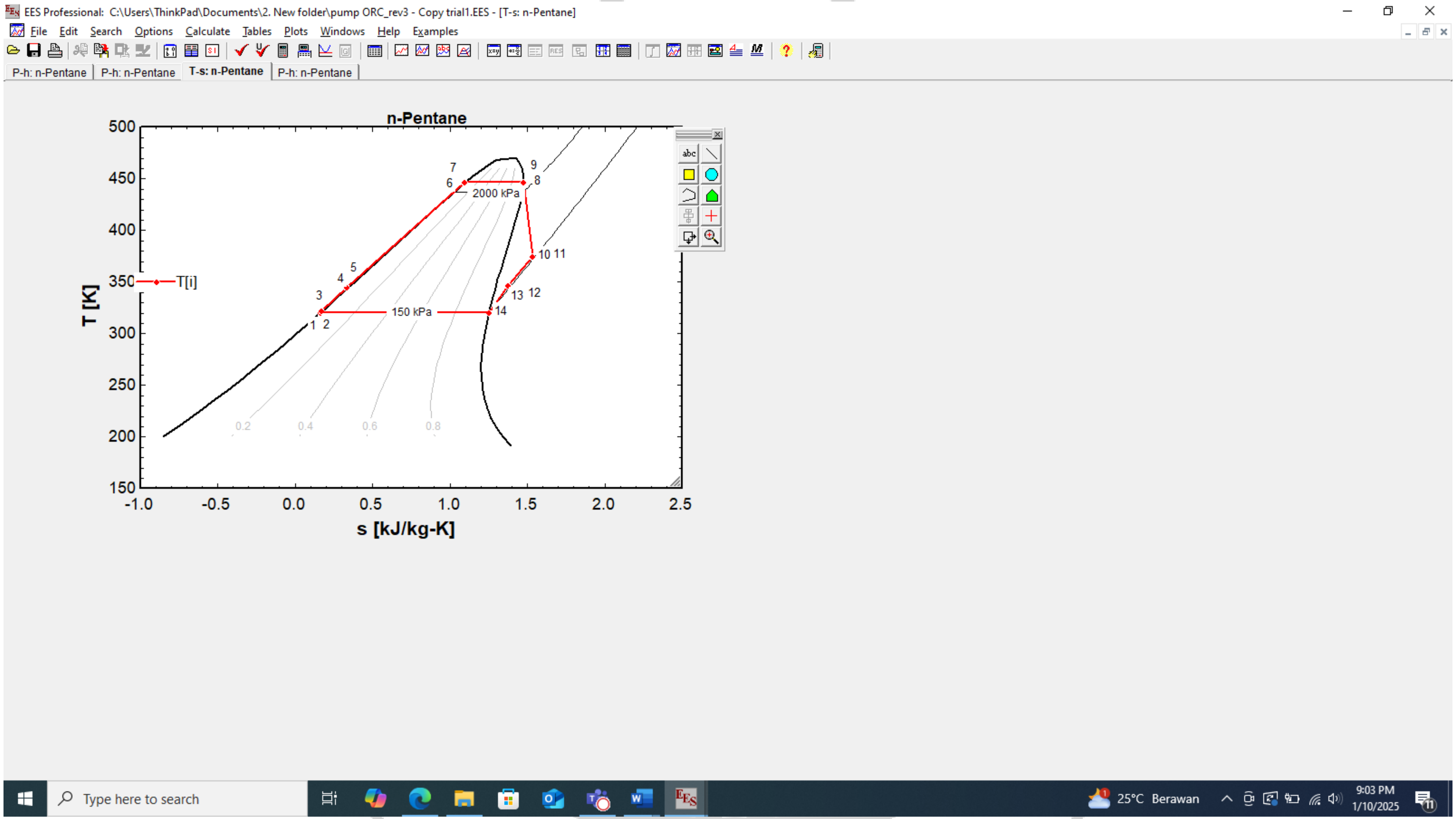
EES Professional: C:\Users\ThinkPad\Documents\2. New folder\pump ORC_rev3 - Copy trial1.EES - [T-s: n-Pentane]
File Edit Search Options Calculate Tables Plots Windows Help Examples
P-h: n-Pentane
P-h: n-Pentane
T-s: n-Pentane
P-h: n-Pentane
n-Pentane
2000 kPa
150 kPa
T[i]
0.2
0.4
0.6
0.8
T [K]
s [kJ/kg-K]
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ORC Modification

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Organic Rankine Cycle $_{Plant,XYZ}$

Fluid\$ = 'n–pentane'

Ambient Temperature & Dead State Condition

T_0 = **ConvertTemp** (C , K , 23.5) Suhu ambient and suhu dead state untuk semua liquid

P_0 = 101.3 [kPa] tekanan udara disekitar dan dead state pressure untuk semua liquid

Pump Flow Modification

H_a = 1502 [feet]

D_a = 10.55 [inch]

H_b = 1657.3 [feet] 3164-new discharge pressure

$n_a = n_b$

n_a = 1500 [rpm]

$$D_b = \left[D_a^{\ 2} \cdot \frac{H_b}{H_a} \right]^{0.5}$$ diameter Impeller new Feed Pump

F_c = 195 [kg/s] laju alir pentane HMB

$$F_d = F_c \cdot \left[\frac{D_b}{D_a} \right]^3$$ laju alir pentane akibat perubahan impeller pompa feed pump

Feed Pump Modification

T_{13}=converttemp(C,K,47)

temperature Feed Pump inlet atau outlet ACHE

T_{14} = **ConvertTemp** (C , K , 49) Temperature Feed Pump outlet

P_{13}=167 $_{kPa}$

Pressure outlet ACHE atau inlet Feed Pump

P_{14} = 3164 [kPa] Pressure discharge pompa

h_{13}=enthalpy(Fluid\$,T=T_{13},x=0)

enthalpy n-pentane suction pressure pump

s_{13}=entropy(Fluid\$,T=T_{13},x=0)

entropy n-pentane suction pressure pump

Cp_{13}=cp(Fluid\$,T=T_{13},P=P_{13})

Specific Heat n-Pentane suction pump

h_{14} = **h** (Fluid\$, T = T_{14} , P = P_{14}) enthalpy n-pentane Discharge pump

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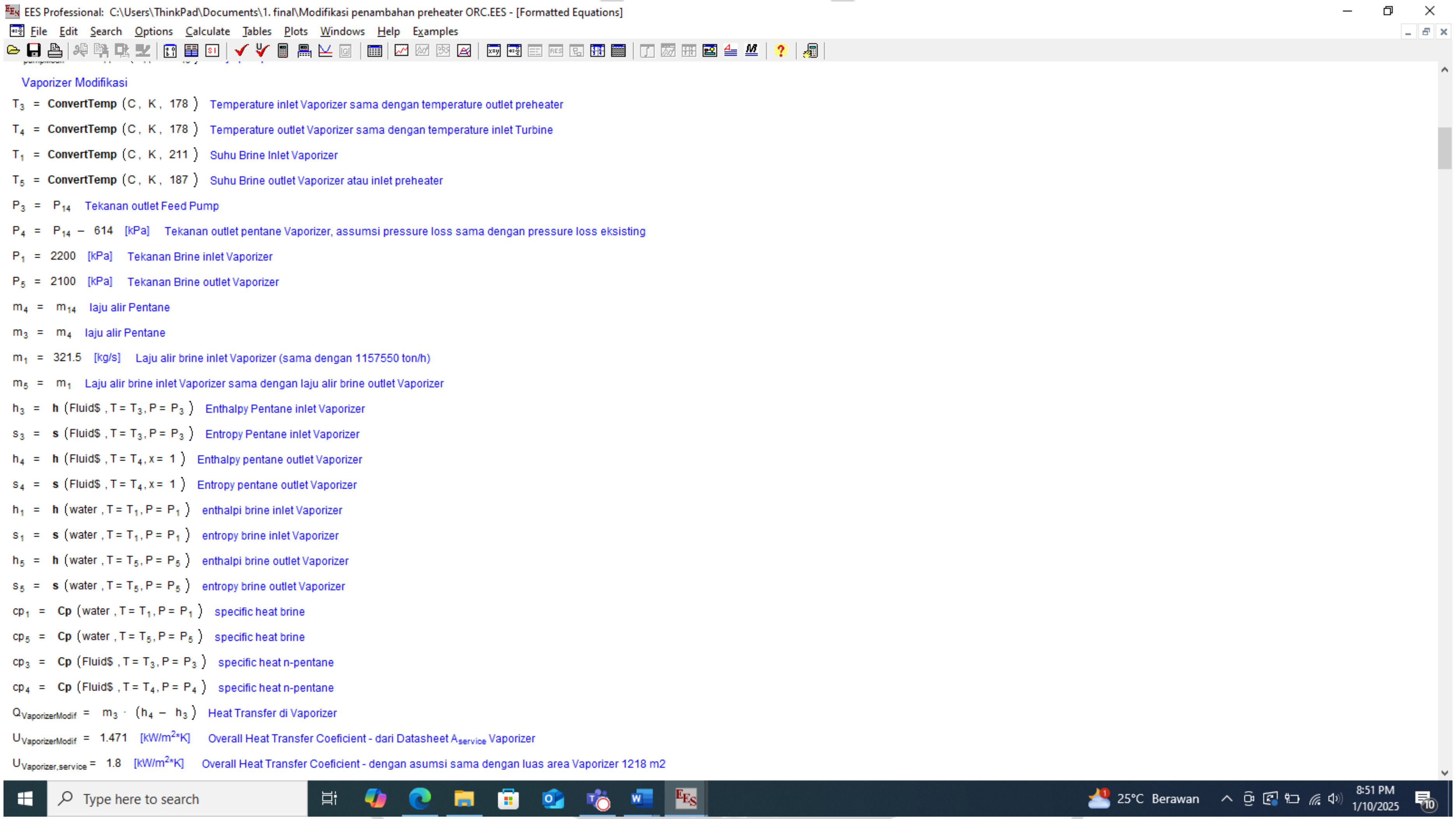
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Vaporizer Modifikasi
T3 = ConvertTemp (C, K, 178) Temperature inlet Vaporizer sama dengan temperature outlet preheater
T4 = ConvertTemp (C, K, 178) Temperature outlet Vaporizer sama dengan temperature inlet Turbine
T1 = ConvertTemp (C, K, 211) Suhu Brine Inlet Vaporizer
T5 = ConvertTemp (C, K, 187) Suhu Brine outlet Vaporizer atau inlet preheater
P3 = P14 Tekanan outlet Feed Pump
P4 = P14 – 614 [kPa] Tekanan outlet pentane Vaporizer, assumsi pressure loss sama dengan pressure loss eksisting
P1 = 2200 [kPa] Tekanan Brine inlet Vaporizer
P5 = 2100 [kPa] Tekanan Brine outlet Vaporizer
m4 = m14 laju alir Pentane
m3 = m4 laju alir Pentane
m1 = 321.5 [kg/s] Laju alir brine inlet Vaporizer (sama dengan 1157550 ton/h)
m5 = m1 Laju alir brine inlet Vaporizer sama dengan laju alir brine outlet Vaporizer
h3 = h (Fluid$, T = T3, P = P3) Enthalpy Pentane inlet Vaporizer
s3 = s (Fluid$, T = T3, P = P3) Entropy Pentane inlet Vaporizer
h4 = h (Fluid$, T = T4, x = 1) Enthalpy pentane outlet Vaporizer
s4 = s (Fluid$, T = T4, x = 1) Entropy pentane outlet Vaporizer
h1 = h (water, T = T1, P = P1) enthalpi brine inlet Vaporizer
s1 = s (water, T = T1, P = P1) entropy brine inlet Vaporizer
h5 = h (water, T = T5, P = P5) enthalpi brine outlet Vaporizer
s5 = s (water, T = T5, P = P5) entropy brine outlet Vaporizer
cp1 = Cp (water, T = T1, P = P1) specific heat brine
cp5 = Cp (water, T = T5, P = P5) specific heat brine
cp3 = Cp (Fluid$, T = T3, P = P3) specific heat n-pentane
cp4 = Cp (Fluid$, T = T4, P = P4) specific heat n-pentane
QVaporizerModif = m3 · (h4 – h3) Heat Transfer di Vaporizer
UVaporizerModif = 1.471 [kW/m2*K] Overall Heat Transfer Coeficient - dari Datasheet Aservice Vaporizer
UVaporizer,service = 1.8 [kW/m2*K] Overall Heat Transfer Coeficient - dengan asumsi sama dengan luas area Vaporizer 1218 m2
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Preheater Modifikasi

P_5; T_5 = inlet brine ke Preheater

Suhu & Tekanan inlet Preheater (brine) sama dengan suhu dan tekanan brine outlet Vaporizer T_5, P_5

P_3; T_3 = outlet pentane dari Preheater

Suhu & Tekanan outlet Preheater (pentane) sama dengan Suhu dan Tekanan inlet Vaporizer pentane T_3, P_3

$T_{19} = T_{26}$ Suhu outlet n-Pentane Preheater tambahan sama dengan suhu inlet preheater eksisting

$P_{19} = P_{26}$ Tekanan outlet n-Pentane Preheater tambahan sama dengan tekanan inlet preheater eksisting

$T_2 = \mathbf{ConvertTemp}(C, K, 156)$ Suhu Brine outlet Preheater eksisting menuju ke inlet preheater tambahan

$P_2 = 2000$ [kPa] Tekanan Brine outlet Preheater eksisting menuju ke inlet preheater tambahan

$m_{19} = m_{14}$ laju alir Pentane yang masuk ke Preheater sama dengan outlet Feed Pump

$m_2 = m_5$ Laju alir brine inlet preheater eksisting sama dengan laju alir brine outlet Preheater ekisting menuju preheater tambahn

$h_{19} = \mathbf{h}(\text{Fluid\$}, T = T_{19}, P = P_{19})$ enthalpi pentane inlet preheater

$s_{19} = \mathbf{s}(\text{Fluid\$}, T = T_{19}, P = P_{19})$ entropy pentane inlet preheater

$cp_{19} = \mathbf{Cp}(\text{Fluid\$}, T = T_{19}, P = P_{19})$ specific heat n-pentane

$h_2 = \mathbf{h}(\text{water}, T = T_2, P = P_2)$ enthalpi brine oulet preheater

$s_2 = \mathbf{s}(\text{water}, T = T_2, P = P_2)$ entropy brine outlet preheater

$cp_2 = \mathbf{Cp}(\text{water}, T = T_2, P = P_2)$ specific heat brine

$Q_{preheaterModif} = m_{19} \cdot (h_3 - h_{19})$ Heat transfer di Preheater eksisting

$U_{preheaterModif} = 1.165$ [kW/m^2*K] Overall Heat Transfer Coeficient - dari Datasheet $A_{service}$ Preheater

$U_{preheater,service} = 1.756$ [kW/m^2*K] Overall Heat Transfer Coeficient - dengan asumsi sama dengan luas area Preheater 1218 m2

$U_{preheater,clean} = 1.791$ [kW/m^2*K] Overall Heat Transfer Coeficient - dengan asumsi A_{clean} Preheater

$$LMTD_{preheaterModif2} = \frac{T_5 - T_3 - (T_2 - T_{19})}{\ln\left[\frac{T_5 - T_3}{T_2 - T_{19}}\right]}$$ LMTD preheater

$LMTD_{preheaterModif} = 39.6$ K

LMTD preheater

$Q_{preheaterModif} = U_{preheaterModif} \cdot A_{preheaterModif} \cdot LMTD_{preheaterModif2}$ $A_{preheater}$

$Q_{preheaterModif} = U_{preheater,service} \cdot A_{preheater,service} \cdot LMTD_{preheaterModif2}$ $A_{preheater,service}$

$Q_{preheaterModif} = U_{preheater,clean} \cdot A_{preheater,clean} \cdot LMTD_{preheaterModif2}$ $A_{preheater,clean}$

Additional Preheater Modifikasi

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$Q_{preheaterModif} = U_{preheater,service} \cdot A_{preheater,service} \cdot LMTD_{preheaterModif2}$ $A_{preheater,service}$

$Q_{preheaterModif} = U_{preheater,clean} \cdot A_{preheater,clean} \cdot LMTD_{preheaterModif2}$ $A_{preheater,clean}$

Additional Preheater Modifikasi

$T_{25} = T_{17}$ Suhu n-pentane inlet Preheater tambahan sama dengan suhu n-pentane outlet recuperator;assume $T_{17}=T_{18}=T_{25}$

T_{26} = **ConvertTemp** (C, K, 120) Suhu n-pentane outlet Preheater tambahan

$T_{27} = T_2$ Suhu Brine inlet preheater tambahan

T_{28} = **ConvertTemp** (C, K, 128) Suhu Brine outlet preheater ke Reinjection well

$P_{25} = P_{14}$ Suhu n-pentane inlet Preheater tambahan = suhu n-pentane outlet recuperator,assume no pressure drop

$P_{26} = P_{14}$ Tekanan n-pentane outlet Preheater tambahan, assume no pressure drop

$P_{27} = P_2$ Tekanan Brine inlet preheater tambahan

$P_{28} = 1700$ [kPa] Tekanan Brine outlet preheater ke Reinjection well

$m_{25} = m_{14}$ laju alir Pentane

$m_{25} = m_{26}$ laju alir pentane

h_{25} = **h** (Fluid\$, $T = T_{25}$, $P = P_{25}$) enthalpi pentane inlet preheater tambahan

s_{25} = **s** (Fluid\$, $T = T_{25}$, $P = P_{25}$) entropy pentane inlet preheater tambahan

Cp_{25} = **Cp** (Fluid\$, $T = T_{25}$, $P = P_{25}$) specific heat n-pentane inlet preheater tambahan

h_{26} = **h** (Fluid\$, $T = T_{26}$, $P = P_{26}$) enthalpi n-pentane outlet Preheater tambahan

s_{26} = **s** (Fluid\$, $T = T_{26}$, $P = P_{26}$) entropy n-pentane outlet Preheater tambahan

Cp_{26} = **Cp** (Fluid\$, $T = T_{26}$, $P = P_{26}$) specific heat n-pentane outlet Preheater tambahan

h_{27} = **h** (water, $T = T_{27}$, $P = P_{27}$) enthalpi Brine inlet preheater tambahan

s_{27} = **s** (water, $T = T_{27}$, $P = P_{27}$) entropy Brine inlet preheater tambahan

cp_{27} = **Cp** (water, $T = T_{27}$, $P = P_{27}$) specific heat brine inlet preheater tambahan

h_{28} = **h** (water, $T = T_{28}$, $P = P_{28}$) enthalpi Brine outlet preheater ke Reinjection well

s_{28} = **s** (water, $T = T_{28}$, $P = P_{28}$) entropy Brine outlet preheater ke Reinjection well

cp_{28} = **Cp** (water, $T = T_{28}$, $P = P_{28}$) specific heat brine

$m_{27} = m_1$

$$LMTD_{preheater,addModif2} = \left[\frac{T_{27} - T_{26} - (T_{28} - T_{25})}{\ln \left[\frac{T_{27} - T_{26}}{T_{28} - T_{25}} \right]} \right] \cdot 0.875$$ LMTD preheater

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$Q_{preheater,addModif} = U_{preheater,addModif,clean} \cdot A_{preheater,addModif,clean} \cdot LMTD_{preheater,addModif2}$ $A_{preheaterModif}$

RECUPERATOR CW Modif

$P_8;T_8$

Hot side suhu dan tekanan inlet n-Pentane Recuperator CW sama dengan Suhu dan Tekanan outlet Turbine CW

$T_{10} = \mathbf{ConvertTemp}(C, K, 85)$ Hot side - Suhu outlet n-Pentane Recuperator CW to ACHE

$P_8=172_{kPa}$

Hot side tekanan intlet Recuperator asumsi tidak ada pressure drop

$P_{10} = 172$ [kPa] Hot side tekanan outlet Recuperator asumsi tidak ada pressure drop

$m_{10} = m_8$ Laju alir pentane

$T_{16} = T_{14}$ Cold side- Suhu keluar n-Pentane dari Feed Pump atau inlet Recuperatr (kenaikan suhu Pompa Feed Pump 1.8-2 C)

$T_{17} = \mathbf{ConvertTemp}(C, K, 60)$ Cold side- Suhu outlet n-Pentane Recuperator CW to Preheater

$m_{16} = \frac{m_{14}}{2}$ Laju alir n-Pentane dari outlet pompa feed pump atau inlet recuperator CW

$m_{17} = m_{16}$ Laju alir n-Pentane dari outlet recuperator CW ke Preheater

$P_{16} = P_{14}$ Cold side Pressure intlet Recuperator asumsi tidak ada pressure drop

$P_{17} = P_{16}$ Cold side outlet pressure Recuperator asumsi tidak ada pressure drop

h_8=enthalpy(Fluid\$,T=T_8,P=P_8)

Entalphi hot side inlet Recuperator

s_8=entropy(Fluid\$,T=T_8,P=P_8)

Entropy hot side inlet Recuperator

$h_{10} = \mathbf{h}(Fluid\$, T = T_{10}, P = P_{10})$ Entalphi hot side outlet Recuperator

$s_{10} = \mathbf{s}(Fluid\$, T = T_{10}, P = P_{10})$ Entropy hot side outlet Recuperator

Cp_8=cp(Fluid\$,T=T_8,P=P_8)

Specific heat n-pentane

$Cp_{10} = \mathbf{Cp}(Fluid\$, T = T_{10}, P = P_{10})$ Specific heat n-pentane

$h_{16} = \mathbf{h}(Fluid\$, T = T_{16}, P = P_{16})$ Entalphi cold side inlet n-Pentane Recuperator

$s_{16} = \mathbf{s}(Fluid\$, T = T_{16}, P = P_{16})$ Entropy cold side inlet n-Pentane Recuperator

$h_{17} = \mathbf{h}(Fluid\$, T = T_{17}, P = P_{17})$ Entalphi cold side outlet n-Pentane Recuperator

$s_{17} = \mathbf{s}(Fluid\$, T = T_{17}, P = P_{17})$ Entropy cold side outlet n-Pentane Recuperator

$Cp_{16} = \mathbf{Cp}(Fluid\$, T = T_{16}, P = P_{16})$ Specific heat n-pentane

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RECUPERATOR CCW Modif

$P_9;T_9$

Hot side suhu dan tekanan inlet n-Pentane Recuperator CW sama dengan Suhu dan Tekanan outlet Turbine CW

$T_{11} = \mathbf{ConvertTemp}(C, K, 85)$ Hot side - Suhu outlet n-Pentane Recuperator CW to ACHE

$P_9=172_{kPa}$

Hot side tekanan intlet Recuperator asumsi tidak ada pressure drop

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TURBINE Modifikasi CW

$T_6 = T_4$ Temperature Inlet Turbine CW

$T_8 = \textbf{ConvertTemp}(C, K, 101.7)$ Temperature outlet Turbine CW dan atau inlet hot side Recuperator

$P_6 = P_4$ Tekanan Inlet Turbine CW

$P_8 = 172$ [kPa] Tekanan outlet Turbine CW

$m_6 = \frac{m_4}{2}$ laju alir Pentane inlet turbine CW

$m_8 = \frac{m_4}{2}$ laju alir Pentane outlet turbine CW

$h_6 = \textbf{h}(Fluid\$, T = T_6, x = 1)$ Enthalpi inlet Turbine CW

$s_6 = \textbf{s}(Fluid\$, T = T_6, x = 1)$ Entropy inlet Turbine CW

$cp_6 = \textbf{Cp}(Fluid\$, T = T_6, x = 1)$ specific heat n-pentane

$h_8 = \textbf{h}(Fluid\$, T = T_8, P = P_8)$ Enthalpi outlet turbine CW

$s_8 = \textbf{s}(Fluid\$, T = T_8, P = P_8)$ Entropy outlet Turbine CW

$cp_8 = \textbf{Cp}(Fluid\$, T = T_8, P = P_8)$ specific heat n-pentane

$h_{8s} = h_{14} + (h_8 - h_{14}) \cdot \left[\frac{s_6 - s_{14}}{s_8 - s_{14}}\right]$ ideal outlet entalphi turbine CW

$\eta_{generator} = 0.95 \cdot 100$ Generator efisiensi data sheet 0,95-0,97

$W_{Turbine,ModifCW} = m_6 \cdot (h_6 - h_8)$ Gross Power Turbine Mechanical

$W_{Turbine,gross,ModifCW} = W_{Turbine,ModifCW} \cdot \frac{\eta_{generator}}{100}$ Gross Power Turbine Electrical

TURBINE Modifikasi CCW

$T_7 = T_4$ Temperature Inlet Turbine CCW

$T_9 = \textbf{ConvertTemp}(C, K, 101.7)$ Temperature outlet Turbine CCW atau inlet Reuperator

$P_7 = P_4$ Tekanan Inlet Turbine CCW

$P_9 = 172$ [kPa] Tekanan outlet Turbine CCW

$m_7 = \frac{m_4}{2}$ Mass flow Pentane inlet turbine CCW

$m_9 = m_7$ Mass flow Pentane outlet turbine CCW

$h_7 = \textbf{h}(Fluid\$, T = T_7, x = 1)$ Enthalpi inlet Turbine CCW

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$W_{Turbine,ModifCCW} = m_7 \cdot (h_7 - h_9)$ Gross Power Turbine Mechanical

$W_{Turbine,gross,ModifCCW} = W_{Turbine,ModifCCW} \cdot \frac{\eta_{generator}}{100}$ Gross Power Turbine Electrical

AIR COOLER HEAT EXCHANGER Modifikasi

$T_{12} = T_{10}$ Suhu inlet ACHE atau Hot side - temperature outlet recuperator CW dan CCW

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$W_{Turbine,gross,ModifORC} = W_{Turbine,gross,ModifCW} + W_{Turbine,gross,ModifCCW}$

Specific Exergy

$h_{22} = \mathbf{h}(Air, T = T_0)$ enthalpy - dead state - Air

$s_{22} = \mathbf{s}(Air, T = T_0, P = P_0)$ entropy - dead state - Air

$h_{23} = \mathbf{h}(water, T = T_0, P = P_0)$ enthalpy liquid - dead state - Brine

$s_{23} = \mathbf{s}(water, T = T_0, P = P_0)$ entropy liquid - dead state - Brine

$h_{24} = |\mathbf{h}(n\text{–}pentane, T = T_0, P = P_0)|$ enthalpy liquid - dead state - pentane

$s_{24} = |\mathbf{s}(n\text{–}pentane, T = T_0, P = P_0)|$ entropy liquid - dead state - pentane

Specific Exergy Brine From Well resources and to Reinjection well

$E_1 = h_1 - h_{23} - T_0 \cdot (s_1 - s_{23})$ specific exergy Brine dari wellpad-to ORC Vaporizer

$E_{28} = h_{28} - h_{23} - T_0 \cdot (s_{28} - s_{23})$ specific exergy Brine dari ORC preheater ke reinjection system

Exergetic Power

$Ex = m_1 \cdot E_1$ Potensi Eksergi yang dihasilkan

Exergy Vaporizer

$E_3 = h_3 - h_{24} - T_0 \cdot (s_3 - s_{24})$ specific exergy pentane sebelum vaporizer

$E_4 = h_4 - h_{24} - T_0 \cdot (s_4 - s_{24})$ specific exergy pentane setelah vaporizer

$E_1=(h_1-h_{23})-T_0*(s_1-s_{23})$

specific exergy brine masuk ke Vaporizer sama dengan E_1

$E_5 = h_5 - h_{23} - T_0 \cdot (s_5 - s_{23})$ specific exergy brine setelah vaporizer

Exergy Rate Vaporizer

$E_1 = m_1 \cdot E_1$ Exergy rate enter vaporizer Brine

$E_5 = m_5 \cdot E_5$ Exergy rate outlet vaporizer Brine

$E_3 = m_3 \cdot E_3$ Exergy rate enter vaporizer pentane

$E_4 = m_4 \cdot E_4$ Exergy rate enter vaporizer pentane

Exergy Balance Vaporizer

$m_1 \cdot E_1 + m_3 \cdot E_3 = m_5 \cdot E_5 + m_4 \cdot E_4 + E_{destruction,Vaporizer,2}$

$E_{destruction,vaporizer} = m_4 \cdot (E_3 - E_4) + m_1 \cdot (E_1 - E_5)$

$E_{input,Vaporizer} = m_1 \cdot E_1 + m_3 \cdot E_3$

$E_{output,Vaporizer} = m_5 \cdot E_5 + m_4 \cdot E_4$

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$E_{destruction,vaporizer} = m_4 \cdot (E_3 - E_4) + m_1 \cdot (E_1 - E_5)$

$E_{input,Vaporizer} = m_1 \cdot E_1 + m_3 \cdot E_3$

$E_{output,Vaporizer} = m_5 \cdot E_5 + m_4 \cdot E_4$

Exergy Preheater Eksisting

$E_3=(h_3-h_{24})-T_0*(s_3-s_{24})$

specific exergy keluar dari Preheater E_3

$E_{19} = h_{19} - h_{24} - T_0 \cdot (s_{19} - s_{24})$ specific exergy pentane sebelum Preheater

$E_5=(h_5-h_{23})-T_0*(s_5-s_{23})$

specifi exergy masuk ke Preheater Brine E_5

$E_2 = h_2 - h_{23} - T_0 \cdot (s_2 - s_{23})$ specifi exergy keluar dari Preheater Brine E_2

Exergy Rate Preheater

$E_{19} = m_{19} \cdot E_{19}$ Exergy rate enter Preheater pentane

$E_3=m_3*E_3$

Exergy rate outlet Preheater pentane E_3

$E_5=m_5*E_5$

Exergy rate enter Preheater Brine E_5

$E_2 = m_2 \cdot E_2$ Exergy rate outlet Preheater Brine

Exergy Balance Preheater

$m_{19} \cdot E_{19} + m_5 \cdot E_5 = m_2 \cdot E_2 + m_3 \cdot E_3 + E_{destruction,preheater,Eks}$

$E_{destruction,preheater} = m_{19} \cdot (E_{19} - E_3) + m_5 \cdot (E_5 - E_2)$

$E_{input,preheater} = m_{19} \cdot E_{19} + m_5 \cdot E_5$

$E_{output,preheater} = m_2 \cdot E_2 + m_3 \cdot E_3$

Exergy Preheater Tambahan

specific exergy keluar dari Preheater Pentane E_3

$E_{25} = h_{25} - h_{24} - T_0 \cdot (s_{25} - s_{24})$ specific exergy pentane inlet Preheater

$E_{26} = h_{26} - h_{24} - T_0 \cdot (s_{26} - s_{24})$ specific exergy pentane outlet Preheater

$E_{27} = h_{27} - h_{23} - T_0 \cdot (s_{27} - s_{23})$ specific exergy brine inlet Preheater

$E_{28}=(h_{28}-h_{23})-T_0*(s_{28}-s_{23})$

specific exergy brine outlet Preheater

Exergy Rate Preheater tambahan

$E_{25} = m_{25} \cdot E_{25}$ Exergy rate inlet Preheater tambahan - pentane

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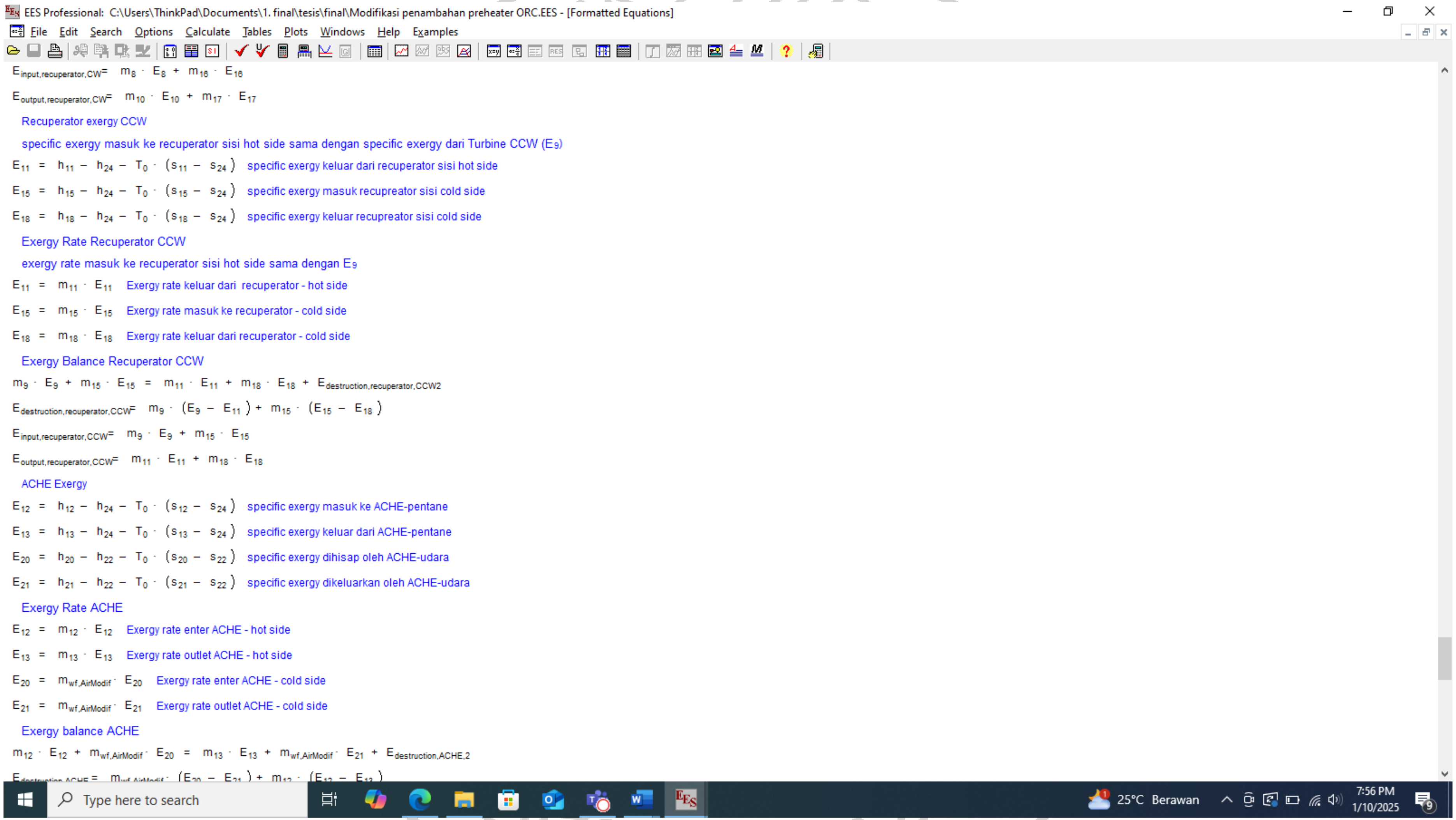

$E_{input,recuperator,CW} = m_8 \cdot E_8 + m_{16} \cdot E_{16}$

$E_{output,recuperator,CW} = m_{10} \cdot E_{10} + m_{17} \cdot E_{17}$

Recuperator exergy CCW

specific exergy masuk ke recuperator sisi hot side sama dengan specific exergy dari Turbine CCW (E_9)

$E_{11} = h_{11} - h_{24} - T_0 \cdot (s_{11} - s_{24})$ specific exergy keluar dari recuperator sisi hot side

$E_{15} = h_{15} - h_{24} - T_0 \cdot (s_{15} - s_{24})$ specific exergy masuk recupreator sisi cold side

$E_{18} = h_{18} - h_{24} - T_0 \cdot (s_{18} - s_{24})$ specific exergy keluar recupreator sisi cold side

Exergy Rate Recuperator CCW

exergy rate masuk ke recuperator sisi hot side sama dengan E_9

$E_{11} = m_{11} \cdot E_{11}$ Exergy rate keluar dari recuperator - hot side

$E_{15} = m_{15} \cdot E_{15}$ Exergy rate masuk ke recuperator - cold side

$E_{18} = m_{18} \cdot E_{18}$ Exergy rate keluar dari recuperator - cold side

Exergy Balance Recuperator CCW

$m_9 \cdot E_9 + m_{15} \cdot E_{15} = m_{11} \cdot E_{11} + m_{18} \cdot E_{18} + E_{destruction,recuperator,CCW2}$

$E_{destruction,recuperator,CCW} = m_9 \cdot (E_9 - E_{11}) + m_{15} \cdot (E_{15} - E_{18})$

$E_{input,recuperator,CCW} = m_9 \cdot E_9 + m_{15} \cdot E_{15}$

$E_{output,recuperator,CCW} = m_{11} \cdot E_{11} + m_{18} \cdot E_{18}$

ACHE Exergy

$E_{12} = h_{12} - h_{24} - T_0 \cdot (s_{12} - s_{24})$ specific exergy masuk ke ACHE-pentane

$E_{13} = h_{13} - h_{24} - T_0 \cdot (s_{13} - s_{24})$ specific exergy keluar dari ACHE-pentane

$E_{20} = h_{20} - h_{22} - T_0 \cdot (s_{20} - s_{22})$ specific exergy dihisap oleh ACHE-udara

$E_{21} = h_{21} - h_{22} - T_0 \cdot (s_{21} - s_{22})$ specific exergy dikeluarkan oleh ACHE-udara

Exergy Rate ACHE

$E_{12} = m_{12} \cdot E_{12}$ Exergy rate enter ACHE - hot side

$E_{13} = m_{13} \cdot E_{13}$ Exergy rate outlet ACHE - hot side

$E_{20} = m_{wf,AirModif} \cdot E_{20}$ Exergy rate enter ACHE - cold side

$E_{21} = m_{wf,AirModif} \cdot E_{21}$ Exergy rate outlet ACHE - cold side

Exergy balance ACHE

$m_{12} \cdot E_{12} + m_{wf,AirModif} \cdot E_{20} = m_{13} \cdot E_{13} + m_{wf,AirModif} \cdot E_{21} + E_{destruction,ACHE,2}$

$E_{destruction,ACHE} = m_{wf,AirModif} \cdot (E_{20} - E_{21}) + m_{12} \cdot (E_{12} - E_{13})$

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$\eta_{Exergi,Turbine,CW} = \left[\frac{W_{Turbine,gross,ModifCW} + E_8}{E_6} \right] \cdot 100$ efisiensi eksergi dari Turbine

Turbine Exergy CCW

$E_7 = h_7 - h_{24} - T_0 \cdot (s_7 - s_{24})$ specific exergy masuk ke Turbine CCW

$E_9 = h_9 - h_{24} - T_0 \cdot (s_9 - s_{24})$ specific exergy keluar dari Turbine CCW

Exergy Rate Turbine CCW

$E_7 = m_7 \cdot E_7$ Exergy rate masuk ke Turbine CCW

$E_9 = m_9 \cdot E_9$ Exergy rate keluar dari Turbine CCW

Exergy Balance Turbine CCW

$m_7 \cdot E_7 = W_{Turbine,gross,ModifCCW} + m_9 \cdot E_9 + E_{destruction,turbine,CCW,2}$

$E_{destruction,Turbine,CCW} = m_7 \cdot (E_7 - E_9) - W_{Turbine,gross,ModifCCW}$

$E_{input,turbine,CCW} = m_7 \cdot E_7$

$E_{output,turbine,CCW} = W_{Turbine,gross,ModifCCW} + m_9 \cdot E_9$

$\eta_{Exergi,Turbine,CCW} = \left[\frac{W_{Turbine,gross,ModifCCW} + E_9}{E_7} \right] \cdot 100$ efisiensi eksergi dari Turbine

Recuperator exergy CW

specific exergy masuk ke recuperator sisi hot side sama dengan specific exergy dari Turbine CW (E_8)

$E_{10} = h_{10} - h_{24} - T_0 \cdot (s_{10} - s_{24})$ specific exergy keluar dari recuperator sisi hot side

$E_{16} = h_{16} - h_{24} - T_0 \cdot (s_{16} - s_{24})$ specific exergy masuk recupreator sisi cold side

$E_{17} = h_{17} - h_{24} - T_0 \cdot (s_{17} - s_{24})$ specific exergy keluar recupreator sisi cold side

Exergy Rate Recuperator CW

exergy rate masuk ke recuperator sisi hot side sama dengan E_8

$E_{10} = m_{10} \cdot E_{10}$ Exergy rate outlet recuperator - hot side

$E_{16} = m_{16} \cdot E_{16}$ Exergy rate enter recuperator - cold side

$E_{17} = m_{17} \cdot E_{17}$ Exergy rate outlet recuperator - cold side

Exergy Balance Recuperator CW

$m_8 \cdot E_8 + m_{16} \cdot E_{16} = m_{10} \cdot E_{10} + m_{17} \cdot E_{17} + E_{destruction,recuperator,CW,2}$

$E_{destruction,recuperator,CW} = m_8 \cdot (E_8 - E_{10}) + m_{16} \cdot (E_{16} - E_{17})$

$E_{input,recuperator,CW} = m_8 \cdot E_8 + m_{16} \cdot E_{16}$

$E_{output,recuperator,CW} = m_{10} \cdot E_{10} + m_{17} \cdot E_{17}$

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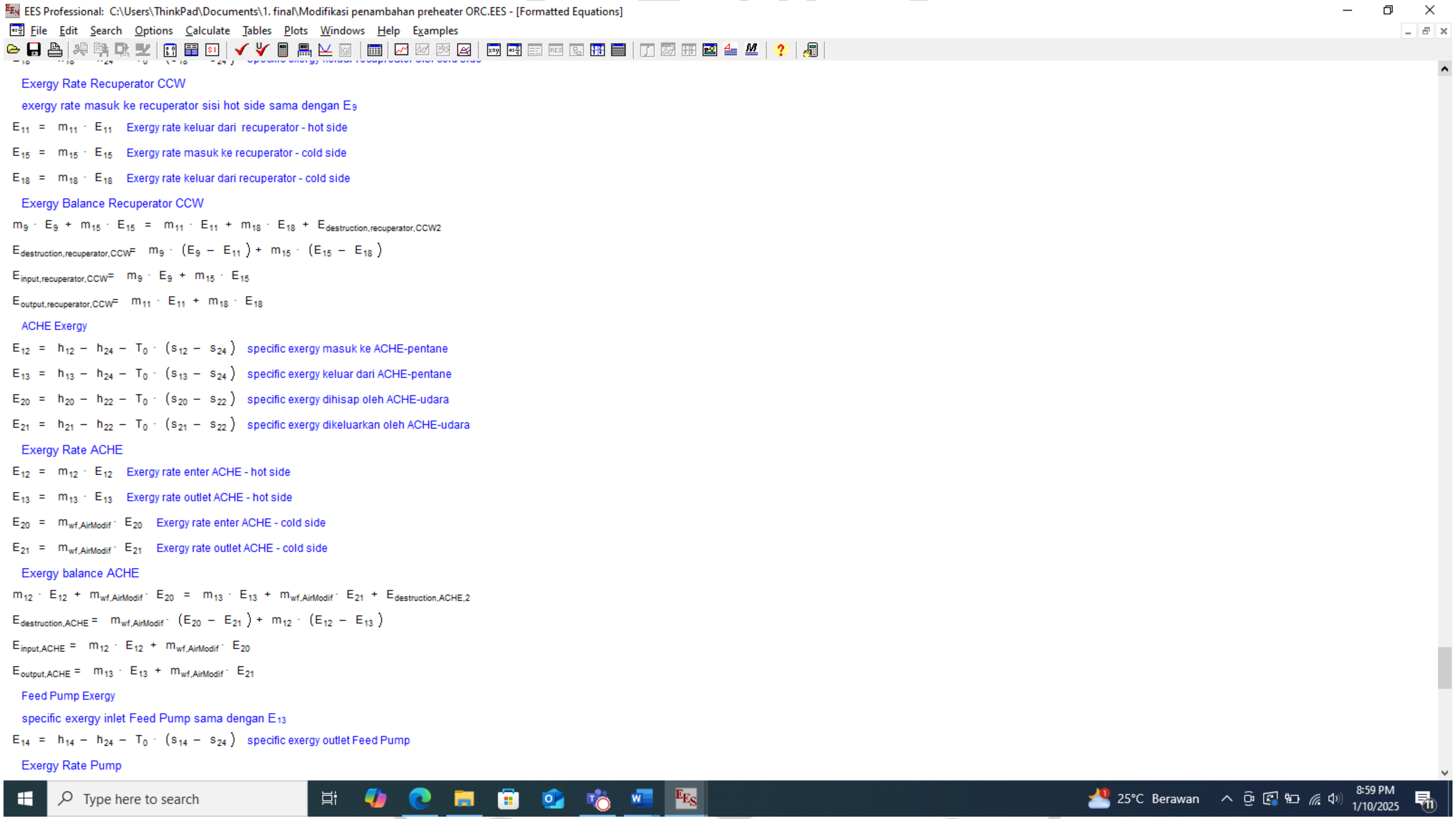

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Exergy Rate Recuperator CCW

exergy rate masuk ke recuperator sisi hot side sama dengan E_9

$E_{11} = m_{11} \cdot E_{11}$ Exergy rate keluar dari recuperator - hot side

$E_{15} = m_{15} \cdot E_{15}$ Exergy rate masuk ke recuperator - cold side

$E_{18} = m_{18} \cdot E_{18}$ Exergy rate keluar dari recuperator - cold side

Exergy Balance Recuperator CCW

$m_9 \cdot E_9 + m_{15} \cdot E_{15} = m_{11} \cdot E_{11} + m_{18} \cdot E_{18} + E_{destruction,recuperator,CCW2}$

$E_{destruction,recuperator,CCW} = m_9 \cdot (E_9 - E_{11}) + m_{15} \cdot (E_{15} - E_{18})$

$E_{input,recuperator,CCW} = m_9 \cdot E_9 + m_{15} \cdot E_{15}$

$E_{output,recuperator,CCW} = m_{11} \cdot E_{11} + m_{18} \cdot E_{18}$

ACHE Exergy

$E_{12} = h_{12} - h_{24} - T_0 \cdot (s_{12} - s_{24})$ specific exergy masuk ke ACHE-pentane

$E_{13} = h_{13} - h_{24} - T_0 \cdot (s_{13} - s_{24})$ specific exergy keluar dari ACHE-pentane

$E_{20} = h_{20} - h_{22} - T_0 \cdot (s_{20} - s_{22})$ specific exergy dihisap oleh ACHE-udara

$E_{21} = h_{21} - h_{22} - T_0 \cdot (s_{21} - s_{22})$ specific exergy dikeluarkan oleh ACHE-udara

Exergy Rate ACHE

$E_{12} = m_{12} \cdot E_{12}$ Exergy rate enter ACHE - hot side

$E_{13} = m_{13} \cdot E_{13}$ Exergy rate outlet ACHE - hot side

$E_{20} = m_{wf,AirModif} \cdot E_{20}$ Exergy rate enter ACHE - cold side

$E_{21} = m_{wf,AirModif} \cdot E_{21}$ Exergy rate outlet ACHE - cold side

Exergy balance ACHE

$m_{12} \cdot E_{12} + m_{wf,AirModif} \cdot E_{20} = m_{13} \cdot E_{13} + m_{wf,AirModif} \cdot E_{21} + E_{destruction,ACHE,2}$

$E_{destruction,ACHE} = m_{wf,AirModif} \cdot (E_{20} - E_{21}) + m_{12} \cdot (E_{12} - E_{13})$

$E_{input,ACHE} = m_{12} \cdot E_{12} + m_{wf,AirModif} \cdot E_{20}$

$E_{output,ACHE} = m_{13} \cdot E_{13} + m_{wf,AirModif} \cdot E_{21}$

Feed Pump Exergy

specific exergy inlet Feed Pump sama dengan E_{13}

$E_{14} = h_{14} - h_{24} - T_0 \cdot (s_{14} - s_{24})$ specific exergy outlet Feed Pump

Exergy Rate Pump

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Exergy balance pump

$m_{13} \cdot E_{13} + W_{pumpModif} = m_{14} \cdot E_{14} + E_{destruction,Feed,Pump,2}$

$E_{destruction,Feed,Pump} = m_{13} \cdot (E_{13} - E_{14}) + W_{pumpModif}$

$E_{input,FP} = m_{13} \cdot E_{13} + W_{pumpModif}$

$E_{output,FP} = m_{14} \cdot E_{14}$

Potensi Brine

$Q_{Potensi,brine} = m_1 \cdot cp_1 \cdot (T_1 - T_{28})$ Heat Estimate pada kondisi HMB

$Q_{potensi,brine2} = m_1 \cdot (h_1 - h_{28})$

$n_{eff} = 0.13$

$W_{Power,estimate} = Q_{Potensi,brine} \cdot n_{eff}$ n_{eff}=10-15% based on optimum design

$T_{29} = \textbf{ConvertTemp}(C, K, 80)$

$Q_{buang,reinjection,well} = m_{28} \cdot cp_{28} \cdot (T_{28} - T_{29})$

$W_{Power,estimate,buang} = Q_{buang,reinjection,well} \cdot n_{eff}$ n_{eff}=10-15% based on optimum design

WORK NET ORGANIC RANKINE CYCLE

$W_{netModifORC} = W_{Turbine,gross,ModifORC} - W_{pumpModif} - W_{motor,FanModif}$

EFISIENSI

$\eta_{Turbine,CW} = \left[\frac{h_6 - h_8}{h_6 - h_{8s}}\right] \cdot 100$ isentropic Turbine efficiency

$\eta_{Turbine,CCW} = \left[\frac{h_7 - h_9}{h_7 - h_{9s}}\right] \cdot 100$ isentropic Turbine efficiency

$\eta_{Plant,ORC} = \frac{W_{netModifORC}}{Q_{potensi,brine2}} \cdot 100$ design and off-design optimization procedure for low-temperature geothermal organic rankine cycle hal 7

atau

$\eta_{Plant,ORC,2} = \left[\frac{W_{netModifORC}}{m_1 \cdot (h_1 - h_5) + m_5 \cdot (h_5 - h_2)}\right] \cdot 100$

$\eta_{Plant,ORC,22} = \frac{W_{netModifORC}}{m_1 \cdot (h_1 - h_{23})} \cdot 100$

$\eta_{Thermal,effisiensi,ORC} = \frac{W_{netModifORC}}{m_1 \cdot (h_1 - h_2)} \cdot 100$ dippipo hal 174

$\eta_{utilisasi,effisiensi,ORC} = \frac{W_{netModifORC}}{E_1} \cdot 100$ design and off-design optimization procedure for low-temperature geothermal organic rankine cycle hal 7

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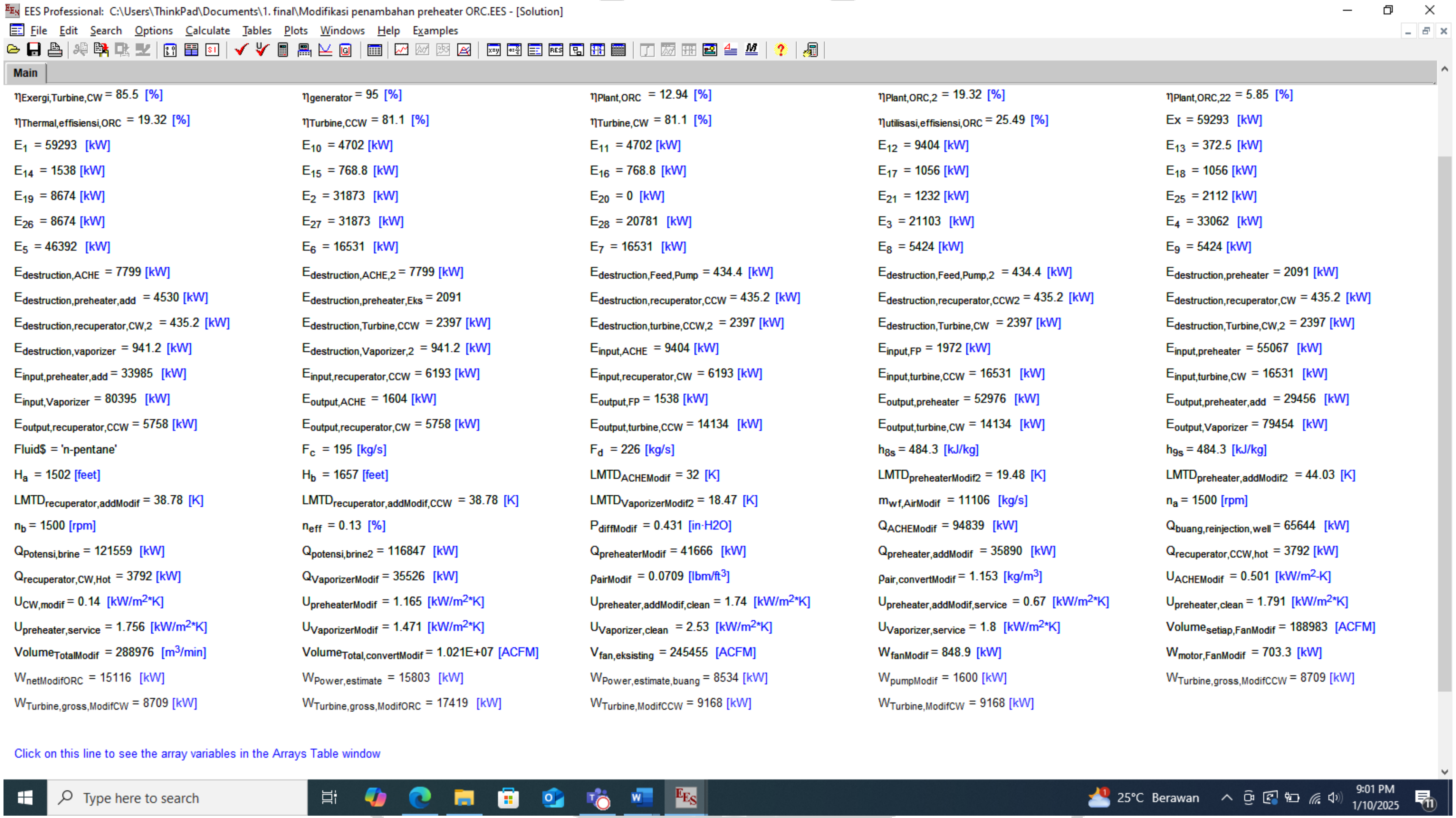
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File Edit Search Options Calculate Tables Plots Windows Help Examples
Main
$\eta_{Exergi,Turbine,CW}$ = 85.5 [%]
$\eta_{generator}$ = 95 [%]
$\eta_{Plant,ORC}$ = 12.94 [%]
$\eta_{Plant,ORC,2}$ = 19.32 [%]
$\eta_{Plant,ORC,22}$ = 5.85 [%]
$\eta_{Thermal,effisiensi,ORC}$ = 19.32 [%]
$\eta_{Turbine,CCW}$ = 81.1 [%]
$\eta_{Turbine,CW}$ = 81.1 [%]
$\eta_{utilisasi,effisiensi,ORC}$ = 25.49 [%]
Ex = 59293 [kW]
E_1 = 59293 [kW]
E_{10} = 4702 [kW]
E_{11} = 4702 [kW]
E_{12} = 9404 [kW]
E_{13} = 372.5 [kW]
E_{14} = 1538 [kW]
E_{15} = 768.8 [kW]
E_{16} = 768.8 [kW]
E_{17} = 1056 [kW]
E_{18} = 1056 [kW]
E_{19} = 8674 [kW]
E_2 = 31873 [kW]
E_{20} = 0 [kW]
E_{21} = 1232 [kW]
E_{25} = 2112 [kW]
E_{26} = 8674 [kW]
E_{27} = 31873 [kW]
E_{28} = 20781 [kW]
E_3 = 21103 [kW]
E_4 = 33062 [kW]
E_5 = 46392 [kW]
E_6 = 16531 [kW]
E_7 = 16531 [kW]
E_8 = 5424 [kW]
E_9 = 5424 [kW]
$E_{destruction,ACHE}$ = 7799 [kW]
$E_{destruction,ACHE,2}$ = 7799 [kW]
$E_{destruction,Feed,Pump}$ = 434.4 [kW]
$E_{destruction,Feed,Pump,2}$ = 434.4 [kW]
$E_{destruction,preheater}$ = 2091 [kW]
$E_{destruction,preheater,add}$ = 4530 [kW]
$E_{destruction,preheater,Eks}$ = 2091
$E_{destruction,recuperator,CCW}$ = 435.2 [kW]
$E_{destruction,recuperator,CCW2}$ = 435.2 [kW]
$E_{destruction,recuperator,CW}$ = 435.2 [kW]
$E_{destruction,recuperator,CW,2}$ = 435.2 [kW]
$E_{destruction,Turbine,CCW}$ = 2397 [kW]
$E_{destruction,turbine,CCW,2}$ = 2397 [kW]
$E_{destruction,Turbine,CW}$ = 2397 [kW]
$E_{destruction,Turbine,CW,2}$ = 2397 [kW]
$E_{destruction,vaporizer}$ = 941.2 [kW]
$E_{destruction,Vaporizer,2}$ = 941.2 [kW]
$E_{input,ACHE}$ = 9404 [kW]
$E_{input,FP}$ = 1972 [kW]
$E_{input,preheater}$ = 55067 [kW]
$E_{input,preheater,add}$ = 33985 [kW]
$E_{input,recuperator,CCW}$ = 6193 [kW]
$E_{input,recuperator,CW}$ = 6193 [kW]
$E_{input,turbine,CCW}$ = 16531 [kW]
$E_{input,turbine,CW}$ = 16531 [kW]
$E_{input,Vaporizer}$ = 80395 [kW]
$E_{output,ACHE}$ = 1604 [kW]
$E_{output,FP}$ = 1538 [kW]
$E_{output,preheater}$ = 52976 [kW]
$E_{output,preheater,add}$ = 29456 [kW]
$E_{output,recuperator,CCW}$ = 5758 [kW]
$E_{output,recuperator,CW}$ = 5758 [kW]
$E_{output,turbine,CCW}$ = 14134 [kW]
$E_{output,turbine,CW}$ = 14134 [kW]
$E_{output,Vaporizer}$ = 79454 [kW]
Fluid$ = 'n-pentane'
F_c = 195 [kg/s]
F_d = 226 [kg/s]
h_{8s} = 484.3 [kJ/kg]
h_{9s} = 484.3 [kJ/kg]
H_a = 1502 [feet]
H_b = 1657 [feet]
$LMTD_{ACHEModif}$ = 32 [K]
$LMTD_{preheaterModif2}$ = 19.48 [K]
$LMTD_{preheater,addModif2}$ = 44.03 [K]
$LMTD_{recuperator,addModif}$ = 38.78 [K]
$LMTD_{recuperator,addModif,CCW}$ = 38.78 [K]
$LMTD_{VaporizerModif2}$ = 18.47 [K]
$m_{wf,AirModif}$ = 11106 [kg/s]
n_a = 1500 [rpm]
n_b = 1500 [rpm]
n_{eff} = 0.13 [%]
$P_{diffModif}$ = 0.431 [in·H2O]
$Q_{ACHEModif}$ = 94839 [kW]
$Q_{buang,reinjection,well}$ = 65644 [kW]
$Q_{Potensi,brine}$ = 121559 [kW]
$Q_{potensi,brine2}$ = 116847 [kW]
$Q_{preheaterModif}$ = 41666 [kW]
$Q_{preheater,addModif}$ = 35890 [kW]
$Q_{recuperator,CCW,hot}$ = 3792 [kW]
$Q_{recuperator,CW,Hot}$ = 3792 [kW]
$Q_{VaporizerModif}$ = 35526 [kW]
$\rho_{airModif}$ = 0.0709 [lbm/ft^3]
$\rho_{air,convertModif}$ = 1.153 [kg/m^3]
$U_{ACHEModif}$ = 0.501 [kW/m^2-K]
$U_{CW,modif}$ = 0.14 [kW/m^2*K]
$U_{preheaterModif}$ = 1.165 [kW/m^2*K]
$U_{preheater,addModif,clean}$ = 1.74 [kW/m^2*K]
$U_{preheater,addModif,service}$ = 0.67 [kW/m^2*K]
$U_{preheater,clean}$ = 1.791 [kW/m^2*K]
$U_{preheater,service}$ = 1.756 [kW/m^2*K]
$U_{VaporizerModif}$ = 1.471 [kW/m^2*K]
$U_{Vaporizer,clean}$ = 2.53 [kW/m^2*K]
$U_{Vaporizer,service}$ = 1.8 [kW/m^2*K]
$Volume_{setiap,FanModif}$ = 188983 [ACFM]
$Volume_{TotalModif}$ = 288976 [m^3/min]
$Volume_{Total,convertModif}$ = 1.021E+07 [ACFM]
$V_{fan,eksisting}$ = 245455 [ACFM]
$W_{fanModif}$ = 848.9 [kW]
$W_{motor,FanModif}$ = 703.3 [kW]
$W_{netModifORC}$ = 15116 [kW]
$W_{Power,estimate}$ = 15803 [kW]
$W_{Power,estimate,buang}$ = 8534 [kW]
$W_{pumpModif}$ = 1600 [kW]
$W_{Turbine,gross,ModifCCW}$ = 8709 [kW]
$W_{Turbine,gross,ModifCW}$ = 8709 [kW]
$W_{Turbine,gross,ModifORC}$ = 17419 [kW]
$W_{Turbine,ModifCCW}$ = 9168 [kW]
$W_{Turbine,ModifCW}$ = 9168 [kW]
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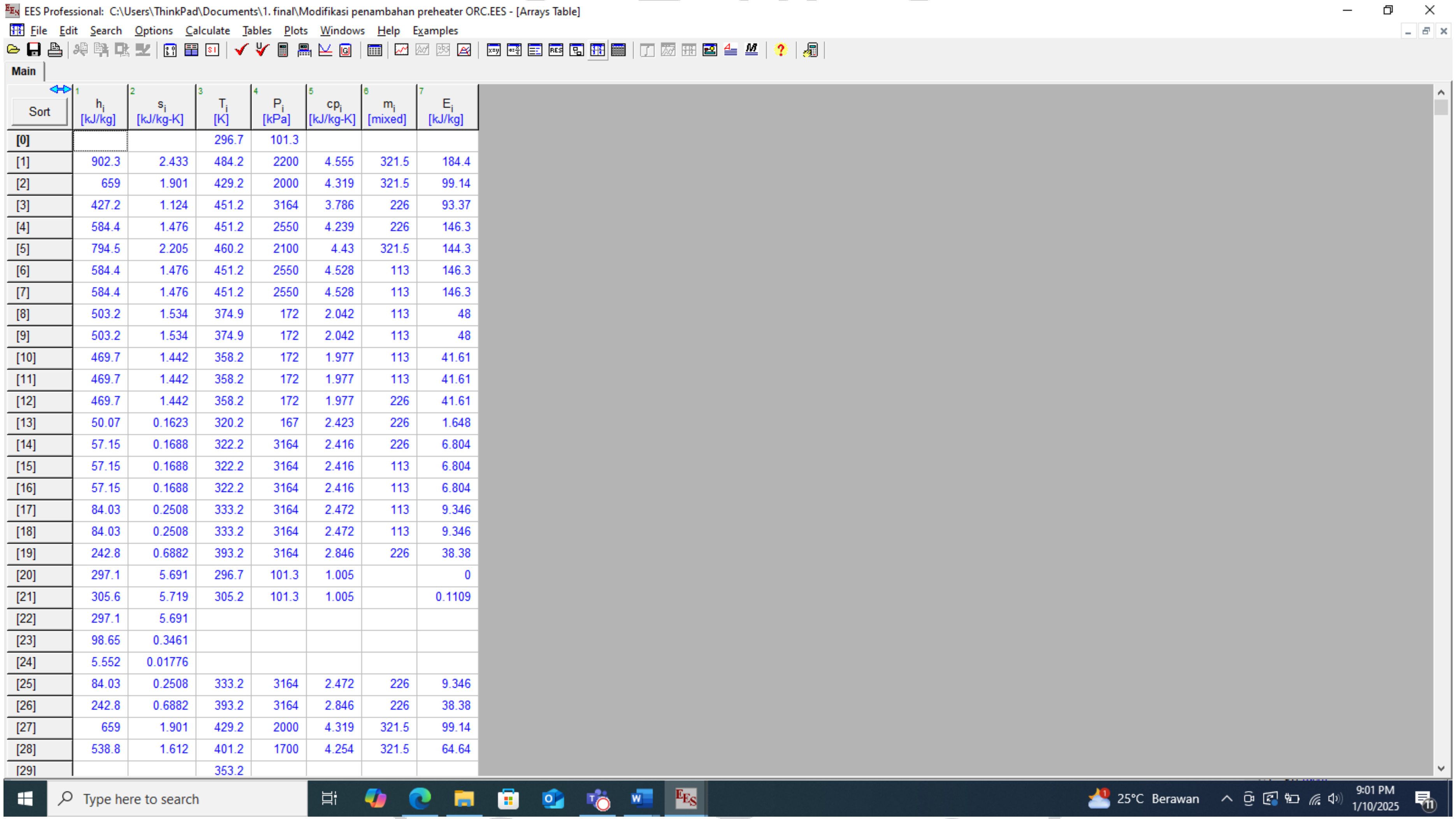

Sort	h_i [kJ/kg]	s_i [kJ/kg-K]	T_i [K]	P_i [kPa]	cp_i [kJ/kg-K]	m_i [mixed]	E_i [kJ/kg]
[0]			296.7	101.3			
[1]	902.3	2.433	484.2	2200	4.555	321.5	184.4
[2]	659	1.901	429.2	2000	4.319	321.5	99.14
[3]	427.2	1.124	451.2	3164	3.786	226	93.37
[4]	584.4	1.476	451.2	2550	4.239	226	146.3
[5]	794.5	2.205	460.2	2100	4.43	321.5	144.3
[6]	584.4	1.476	451.2	2550	4.528	113	146.3
[7]	584.4	1.476	451.2	2550	4.528	113	146.3
[8]	503.2	1.534	374.9	172	2.042	113	48
[9]	503.2	1.534	374.9	172	2.042	113	48
[10]	469.7	1.442	358.2	172	1.977	113	41.61
[11]	469.7	1.442	358.2	172	1.977	113	41.61
[12]	469.7	1.442	358.2	172	1.977	226	41.61
[13]	50.07	0.1623	320.2	167	2.423	226	1.648
[14]	57.15	0.1688	322.2	3164	2.416	226	6.804
[15]	57.15	0.1688	322.2	3164	2.416	113	6.804
[16]	57.15	0.1688	322.2	3164	2.416	113	6.804
[17]	84.03	0.2508	333.2	3164	2.472	113	9.346
[18]	84.03	0.2508	333.2	3164	2.472	113	9.346
[19]	242.8	0.6882	393.2	3164	2.846	226	38.38
[20]	297.1	5.691	296.7	101.3	1.005		0
[21]	305.6	5.719	305.2	101.3	1.005		0.1109
[22]	297.1	5.691					
[23]	98.65	0.3461					
[24]	5.552	0.01776					
[25]	84.03	0.2508	333.2	3164	2.472	226	9.346
[26]	242.8	0.6882	393.2	3164	2.846	226	38.38
[27]	659	1.901	429.2	2000	4.319	321.5	99.14
[28]	538.8	1.612	401.2	1700	4.254	321.5	64.64
[29]			353.2				