

LAMPIRAN



ISTILAH

- Load gross : load yang dikeluarkan oleh generator
- Load net : load generator dikurangi auxiliary power
- Auxiliary power : daya yang dipakai untuk konsumsi unit itu sendiri
- Eksitasi : untuk membangkitkan daya magnet dalam generator
- Heat rate : energy thermal yang dibutuhkan tiap 1 kWh
- Heat Loss : Rugi-rugi panas
- Main steam : uap utama untuk memutar turbin di sisi HP Turbin
- CRH : Cold reheat steam yaitu steam yang keluar dari HP turbin sebelum dipanaskan di reheater
- HRH : Hot Reheat steam yaitu steam yang sudah dipanaskan dari reheater masuk IP Turbin
- Reheater : pemanas ulang steam yang keluar dari HP turbin
- Feed water : air umpan boiler
- Spray water : untuk mendinginkan uap dalam superheater dan reheater agar tidak terlalu panas
- NPHR : Net Plant Heat rate, Heat rate dari keseluruhan unit berdasarkan load net
- Flow : jumlah aliran massa per jam
- Pressure : tekanan
- Coal Feeder : alat untuk mengatur flow batu bara
- Degradasi : penurunan performa pada alat
- Komparasi : suatu perbandingan
- HHV : Higher heating value
- Auxiliary steam : uap untuk kebutuhan peralatan-peralatan
- Sootblow : alat untuk membersihkan kerak dari kotoran batu bara menggunakan steam
- Venting : untuk membuang udara yang terkandung dalam air / uap
- Blow down : untuk membuang air dalam boiler agar kualitas air terjaga

Data Entalpi Menggunakan Software Steam Table

The image displays four screenshots of the ChemicalLogic SteamTab Companion software, each showing a different set of input conditions and resulting steam properties. The software interface includes input fields for Temperature and Pressure, unit selection (Metric/SI or English), and a table of properties such as Temperature, Pressure, Steam quality, Volume, Density, Compressibility factor, Enthalpy, Entropy, Helmholtz free energy, Internal energy, Gibbs free energy, Heat capacity at constant volume, Heat capacity at constant pressure, Speed of sound, and Coefficient of thermal expansion.

Top Left Screenshot: Input: Temperature = 537.4, Pressure = 166.4. Units: Metric/SI. Steam quality is Indeterminate.

Property	Value	Unit
Temperature	537.4	°C
Pressure	166.4	bar
Steam quality	Indeterminate	%
Volume	0.0199519	m³/kg
Density	50.1205	kg/m³
Compressibility factor	0.887503	dimensionless
Enthalpy	3397.53	kJ/kg
Entropy	6.41533	kJ/(kg·°C)
Helmholtz free energy	-2134.42	kJ/kg
Internal energy	3065.53	kJ/kg
Gibbs free energy	-1802.42	kJ/kg
Heat capacity at constant volume	1.93962	kJ/(kg·°C)
Heat capacity at constant pressure	2.82985	kJ/(kg·°C)
Speed of sound	653.186	m/s
Coefficient of thermal expansion	0.00193797	1/°C

Top Right Screenshot: Input: Temperature = 335, Pressure = 38.4. Units: Metric/SI. Steam quality is Superheated.

Property	Value	Unit
Temperature	335	°C
Pressure	38.4	bar
Steam quality	Superheated	%
Volume	0.0672291	m³/kg
Density	14.8745	kg/m³
Compressibility factor	0.919791	dimensionless
Enthalpy	3059.5	kJ/kg
Entropy	6.54671	kJ/(kg·°C)
Helmholtz free energy	-1180.04	kJ/kg
Internal energy	2801.34	kJ/kg
Gibbs free energy	-921.885	kJ/kg
Heat capacity at constant volume	1.7969	kJ/(kg·°C)
Heat capacity at constant pressure	2.53541	kJ/(kg·°C)
Speed of sound	576.551	m/s
Coefficient of thermal expansion	0.00227037	1/°C

Bottom Left Screenshot: Input: Temperature = 540, Pressure = 36.4. Units: Metric/SI. Steam quality is Indeterminate.

Property	Value	Unit
Temperature	540	°C
Pressure	36.4	bar
Steam quality	Indeterminate	%
Volume	0.10074	m³/kg
Density	9.92651	kg/m³
Compressibility factor	0.977115	dimensionless
Enthalpy	3540.98	kJ/kg
Entropy	7.2543	kJ/(kg·°C)
Helmholtz free energy	-2724.55	kJ/kg
Internal energy	3174.28	kJ/kg
Gibbs free energy	-2357.86	kJ/kg
Heat capacity at constant volume	1.74418	kJ/(kg·°C)
Heat capacity at constant pressure	2.27363	kJ/(kg·°C)
Speed of sound	683.282	m/s
Coefficient of thermal expansion	0.00134831	1/°C

Bottom Right Screenshot: Input: Temperature = 286, Pressure = 189. Units: Metric/SI. Steam quality is Subcooled.

Property	Value	Unit
Temperature	286	°C
Pressure	189	bar
Steam quality	Subcooled	%
Volume	0.00131798	m³/kg
Density	758.736	kg/m³
Compressibility factor	0.0965282	dimensionless
Enthalpy	1262.12	kJ/kg
Entropy	3.08409	kJ/(kg·°C)
Helmholtz free energy	-487.268	kJ/kg
Internal energy	1237.21	kJ/kg
Gibbs free energy	-462.348	kJ/kg
Heat capacity at constant volume	3.05797	kJ/(kg·°C)
Heat capacity at constant pressure	5.09895	kJ/(kg·°C)
Speed of sound	1066.73	m/s
Coefficient of thermal expansion	0.00231241	1/°C

Certificate No. 07888/EOBOAK
Date: November 27, 2017



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REPORT OF ANALYSIS

CLIENT : **PT. TJB POWER SERVICES**
Tanjung Jati B Power Plant Desa Tubanan, Kec. Kembang
Kab. Jepara – Jawa Tengah 59453.

THE FOLLOWING SAMPLE (S) WAS/ WERE SUBMITTED AND IDENTIFIED BY CLIENT AS :

TYPE OF SAMPLE : **COAL FEEDER A**
DATE OF RECEIVED : November 15, 2017
DATE OF ANALYSIS : November 16 up to 27, 2017
TEST REQUIRED : Proximate Analysis, Ultimate Analysis
DESCRIPTION OF SAMPLE : Form : Coal
Weight / Volume : ± 4 Kg
Packing : Unsealed plastic bag.
SAMPLE IDENTIFICATION (STATED BY CLIENT) : Code : **CF – A U1**
Date : **24 – 10 – 2017**

We have tested the sample (s) submitted and the following results were obtained :

Parameters	Unit	AR (As Received)	ADB (Air Dried Basis)	Test Method
Total Moisture	% wt	18.76	---	ASTM D 3302 – 17
Moisture In the Analysis Sample	% wt	---	9.10	ASTM D 3173 – 17
Ash Content	% wt	3.30	3.69	ASTM D 3174 – 12
Volatile Matter	% wt	37.50	41.96	ASTM D 3175 – 17
Fixed Carbon	% wt	40.44	45.25	ASTM D 3172 – 13
Total Sulfur	% wt	0.61	0.68	PO – BB – 11
Gross Calorific Value	Kcal/Kg	5794	6483	ASTM D 5865 – 13

The Attachment available is an integral part of this certificate.

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Dept. of Commercial 3 - Coal and Minerals



7103051701430,06



Certificate No. 07894/EOBOAK
Date: November 27, 2017



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REPORT OF ANALYSIS

CLIENT : **PT. TJB POWER SERVICES**
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Kab. Jepara – Jawa Tengah 59453.

THE FOLLOWING SAMPLE (S) WAS/ WERE SUBMITTED AND IDENTIFIED BY CLIENT AS :

TYPE OF SAMPLE : **COAL FEEDER E**
DATE OF RECEIVED : November 15, 2017
DATE OF ANALYSIS : November 16 up to 27, 2017
TEST REQUIRED : Proximate Analysis, Ultimate Analysis.
DESCRIPTION OF SAMPLE : Form : Coal
Weight / Volume : ± 4 Kg
Packing : Unsealed plastic bag
SAMPLE IDENTIFICATION (STATED BY CLIENT) : Code : CF – E U1
Date : 24 – 10 – 2017

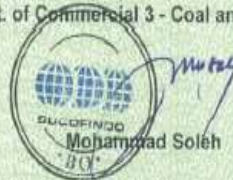
We have tested the sample (s) submitted and the following results were obtained :

Parameters	Unit	AR (As Received)	ADB (Air Dried Basis)	Test Method
Total Moisture	% wt	17.62	---	ASTM D 3302 – 17
Moisture in the Analysis Sample	% wt	---	8.32	ASTM D 3173 – 17
Ash Content	% wt	2.74	3.05	ASTM D 3174 – 12
Volatile Matter	% wt	37.63	41.88	ASTM D 3175 – 17
Fixed Carbon	% wt	42.01	46.75	ASTM D 3172 – 13
Total Sulfur	% wt	0.51	0.57	PO – BB – 11
Gross Calorific Value	Kcal/Kg	5957	6629	ASTM D 5865 – 13

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7103051701430.09

Certificate No. 07890/EOBOAK
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REPORT OF ANALYSIS

CLIENT : PT. TJB POWER SERVICES
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Kab. Jepará - Jawa Tengah 59453.

THE FOLLOWING SAMPLE (S) WAS/WERE SUBMITTED AND IDENTIFIED BY CLIENT AS :

TYPE OF SAMPLE : COAL FEEDER C
DATE OF RECEIVED : November 15, 2017
DATE OF ANALYSIS : November 16 up to 27, 2017
TEST REQUIRED : Proximate Analysis, Ultimate Analysis
DESCRIPTION OF SAMPLE : Form : Coal
Weight / Volume : ± 4 Kg
Packing : Unsealed plastic bag
SAMPLE IDENTIFICATION (STATED BY CLIENT) : Code : CF - C U1
Date : 24 - 10 - 2017

We have tested the sample (s) submitted and the following results were obtained :

Parameters	Unit	AR (As Received)	ADB (Air Dried Basis)	Test Method
Total Moisture	% wt	17.33	---	ASTM D 3302 - 17
Moisture in the Analysis Sample	% wt	---	8.63	ASTM D 3173 - 17
Ash Content	% wt	2.58	2.85	ASTM D 3174 - 12
Volatile Matter	% wt	37.79	41.77	ASTM D 3175 - 17
Fixed Carbon	% wt	42.30	46.75	ASTM D 3172 - 13
Total Sulfur	% wt	0.54	0.60	PO - BB - 11
Gross Calorific Value	Kcal/Kg	5979	6608	ASTM D 5865 - 13

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Dept. of Commercial 3 - Coal and Minerals

7103051701430,08



Certificate No. 07889/EOBOAK
Date: November 27, 2017



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REPORT OF ANALYSIS

CLIENT : **PT. TJB POWER SERVICES**
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Kab. Jepara – Jawa Tengah 59453.

THE FOLLOWING SAMPLE (S) WAS/ WERE SUBMITTED AND IDENTIFIED BY CLIENT AS :

TYPE OF SAMPLE : **COAL FEEDER B**
DATE OF RECEIVED : **November 15, 2017**
DATE OF ANALYSIS : **November 16 up to 27, 2017**
TEST REQUIRED : **Proximate Analysis, Ultimate Analysis.**
DESCRIPTION OF SAMPLE : **Form : Coal**
Weight / Volume : ± 4 kg
Packing : Unsealed plastic bag.
SAMPLE IDENTIFICATION (STATED BY CLIENT) : **Code : CF – B U1**
Date : 24 – 10 – 2017

We have tested the sample (s) submitted and the following results were obtained :

Parameters	Unit	AR (As Received)	ADB (Air Dried Basis)	Test Method
Total Moisture	% wt	20.15	---	ASTM D 3302 – 17
Moisture In the Analysis Sample	% wt	---	9.83	ASTM D 3173 – 17
Ash Content	% wt	3.23	3.65	ASTM D 3174 – 12
Volatile Matter	% wt	35.92	40.56	ASTM D 3175 – 17
Fixed Carbon	% wt	40.70	45.98	ASTM D 3172 – 13
Total Sulfur	% wt	0.57	0.64	PO – BB – 11
Gross Calorific Value	Kcal/kg	5688	6423	ASTM D 5865 – 13

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Dept. of Commercial 3 - Coal and Minerals

7103051701430.07



Certificate No. 07895/EOBOAK
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REPORT OF ANALYSIS

CLIENT

PT. TJB POWER SERVICES

Tanjung Jati B Power Plant Desa Tubanan, Kec. Kembang
Kab. Jepara – Jawa Tengah 59453

THE FOLLOWING SAMPLE (S) WAS/WERE SUBMITTED AND IDENTIFIED BY CLIENT AS :

TYPE OF SAMPLE : COAL FEEDER F
DATE OF RECEIVED : November 15, 2017
DATE OF ANALYSIS : November 16 up to 27, 2017
TEST REQUIRED : Proximate Analysis, Ultimate Analysis
DESCRIPTION OF SAMPLE : Form : Coal
Weight / Volume : ± 4 Kg
Packing : Unsealed plastic bag
SAMPLE IDENTIFICATION (STATED BY CLIENT) : Code : CF – F U 1
Date : 24 – 10 – 2017

We have tested the sample (s) submitted and the following results were obtained :

Parameters	Unit	AR (As Received)	ADB (Air Dried Basis)	Test Method
Total Moisture	% wt	17.13	---	ASTM D 3302 – 17
Moisture in the Analysis Sample	% wt	---	8.17	ASTM D 3173 – 17
Ash Content	% wt	3.00	3.32	ASTM D 3174 – 12
Volatile Matter	% wt	37.57	41.83	ASTM D 3175 – 17
Fixed Carbon	% wt	42.30	46.88	ASTM D 3172 – 13
Total Sulfur	% wt	0.50	0.55	PO – BB – 11
Gross Calorific Value	Kcal/Kg	5996	6644	ASTM D 5865 – 13

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Dept. of Commercial 3 - Coal and Minerals



7103051701430,10

HASIL SIMULASI HEAT RATE DAN EFISIENSI

TCPI - [Report]

File Help

Report -> Configurasi Graphics Exit

Tempat: Group: [General] Name: [Heat again]

Start time: 10/24/2017 09:30 End time: 10/24/2017 11:30 Calculator Step: [minute] Directory: [General folder] [Unit]

	1BLEFF	1TBHEATRATEGRC	1TBOUTGROEFF	1GENTRANSEFF	1UNHEATRATENET	1UNNETEPP	1GNOJ001DG	1
	Boiler Efficiency	Turbine Heat Rate	Turbine Output	Generator	Unit Heat Rate Net	Unit Net Efficiency	GEN OUT MW	U
	%	Kcal/kwh	Gross (HRg)	Gross Efficiency	(HRn)	%	MW	M
	Time	avg	avg	avg	avg	avg	avg	
6	10/24/2017 09:30	89.0	2010.3	42.8	89.77	2438.3	35.3	701.919
7	10/24/2017 10:00	89.0	2011.5	42.7	89.77	2438.0	35.3	701.884
8	10/24/2017 10:30	89.0	2011.7	42.7	89.77	2438.9	35.3	701.588
9	10/24/2017 11:00	89.0	2011.5	42.7	89.77	2439.9	35.2	699.203
10								
11	Average	89.0	2011.3	42.8	89.77	2438.3	35.3	701.149
12	Sum							
13	Maximum							
14	Minimum							
15	Validity	100%	100%	100%	100%	100%	100%	100%
16								
17								



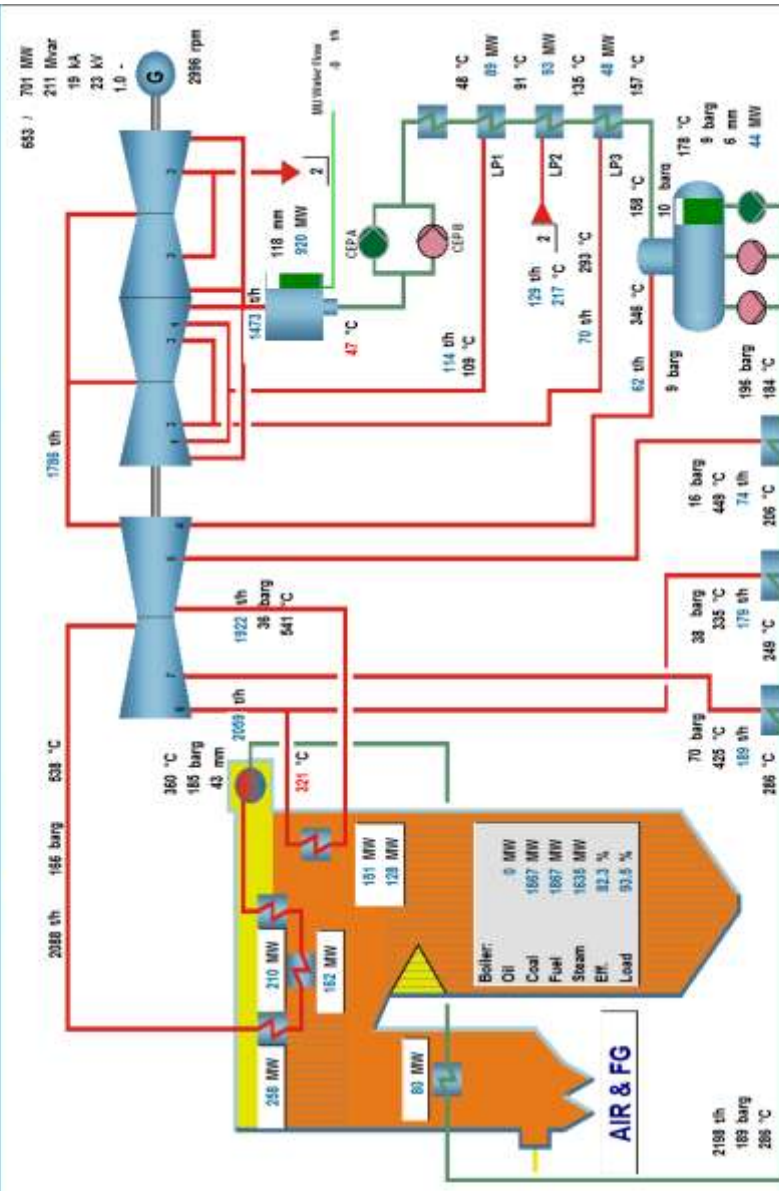


Unit 1 STATISTIC

Energy/Unit Mass Comp	21767.00	kJ/kg
Fuel Heating Value	23841.38	kJ/kg
Coal Flow	275.09	th
Loss of Ignition	41.20	kJ/kg
Radiation Loss	36.80	kJ/kg
Total Loss	3018.07	kJ/kg
Unmeasured Loss	25.67	kJ/kg
Boiler Output	5903.01	GWh
Boiler EF	81.06	%

Heat Consumed	5055.13	GWh
Main Steam Entalpy	3395.64	kJ/kg
HRH Steam Entalpy	3502.89	kJ/kg
Aux Steam Flow	0.00	th
Aux Steam Loss	15.71	GWh
Spillflow Loss	0.34	GWh
Blowdown Loss	0.65	GWh
Desaerator Vent Loss	2012.13	kcal/MWh
Gross Heat Rate	2154.32	kcal/MWh
Net Heat Rate	42.73	%
Gross EF	20.31	%
Net EF		

Aux Power Consumption	47.50	MW
Heat Input	14055.17	GWh
Heat Output	8593.03	GWh
Gen. Trained EF	95.77	%
Net Heat Rate	2459.08	kcal/MWh
Gross EF	30.03	%
Net EF	31.25	%



Slab Level (%)	A	B	C	D	E	F
50 Storage	69	78	79	77	51	85

