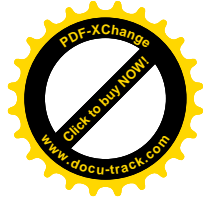
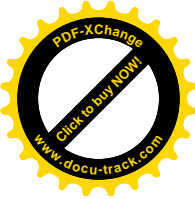


LAMPIRAN 3

HASIL PERHITUNGAN *HEAT RATE* DAN EFISIENSI

PLTGU TAMBAK LOROK BLOK 1 DAN BLOK 2



Unit : PLTGU Tambak Lorok GT 1.1
Test Condition : OPEN CYCLE
Date : 27 Juni 2013
Duration : 60 Menit

GAS TURBINE PERFORMANCE**1. GAS TURBINE HEAT RATE**

Item	Code	Calculation Formula	Unit	Result (MW)			
				30	50	75	90
Gas turbine gross heat rate	HR _{GTG}	$(GF_{oil} \times HHV_{oil}) / (GTKWG \times 1000)$	kCal/kWh	4,861.52	3,726.04	3,206.18	3,094.02
Gas turbine net heat rate	HR _{GTN}	$(GF_{oil} \times HHV_{oil}) / (GTKWN \times 1000)$	kCal/kWh	4,915.95	3,750.90	3,220.23	3,105.61
Fuel Oil flow rate	GF _{oil}	measured	kg/h	12,987.77	16,919.11	22,054.89	25,272.34
Fuel Oil higher heating value	HHV _{oil}	measured	kJ/kg	45,452.37	45,452.37	45,452.37	45,452.37
Gas turbine gross power output	GTKWG	measured	MW	29.02	49.33	74.73	88.73
Gas turbine net power output	GTKWN	measured	MW	28.70	49.00	74.40	88.40
Specific Fuel Consumption	SFC	GF _c /GTKWG	l/kWh	0.53	0.40	0.35	0.33
Frequency	F	measured	Hz	49.96	49.97	50.00	50.02
Efisiensi GT	η _{GT}	$(3600/4,1868 \times HRGTG) \times 100$	%	17.69	23.08	26.82	27.79

2. GAS TURBINE COMPRESSOR EFFICIENCY

Item	Code	Calculation Formula	Unit	Result (MW)			
				30	50	75	90
GT compressor efficiency	η _c	$((T1C - 273.15) / (T2C - T1C)) \times ((PCS) / P_a)^{(1/\eta_c - 1)} \times 100$	%	82.66	84.21	85.27	85.68
GT compressor inlet air temperature	T1C	measured	°C	27.00	27.54	28.90	28.80
GT compressor outlet air temperature	T2C	measured	°C	305.44	322.78	336.33	341.22
GT compressor outlet air pressure	PCS	measured	kg/cm ² (A)	7.52	8.45	9.13	9.45
Ambien pressure	P _a	measured	kg/cm ² (A)	1.03	1.03	1.02	1.02
Specific heat ratio	K	constant		1.40	1.40	1.40	1.40
Air Inlet Differential Pressure	ΔP	measured	mbar	1.05	1.05	1.05	1.05

3. POWER OUTPUT CORRECTED

Item	Code	Calculation Formula	Unit	Correction Factor			
Power Output			MW	28.68	48.58	73.63	87.38
Power Output Correction Factor							
Speed	FN	----	----	0.0000	0.0000	0.0000	0.0000
Fired Hour	FH	----	----	0.0000	0.0000	0.0000	0.0000
Barometer	FB	$1 + 0.7 \times (BP/14.692 - 1)$	----	0.9946	0.9945	0.9943	0.9942
Inlet Temperature (Guar)	F (2a)	----	----	0.9257	0.9257	0.9257	0.9257
Inlet Temperature (Test)	F (2b)	----	----	0.9257	0.9224	0.9140	0.9146
Ambient Humidity (Guar)	F (3a)	----	----	0.9983	0.9983	0.9983	0.9983
Ambient Humidity (Test)	F (3b)	----	----	0.9980	0.9982	0.9981	0.9980
Power Factor	F5	----	----	0.8969	1.0024	1.0045	1.0023
Total Correction	-----	$FN \times F(2a) \times F(3a) / F(B) \times F(2b) \times F(3b) \times F(5)$	----	1.1213	1.0069	1.0143	1.0161
Power Output After Correction			MW	32.15	48.91	74.68	88.78

4. HEAT RATE CORRECTED

Item	Code	Calculation Formula	Unit	Correction Factor			
Heat Rate			kCal/kWh	4,861.52	3,726.04	3,206.18	3,094.02
Heat Rate Correction Factor							
Speed	HN	----	----	0.0000	0.0000	0.0000	0.0000
Fired Hour	HH	----	----	0.0000	0.0000	0.0000	0.0000
Inlet Temperature (Guar)	F (2c)	Constant	----	1.0167	1.0167	1.0167	1.0167
Inlet Temperature (Test)	F (2d)	Calculate	----	1.0167	1.0175	1.0196	1.0195
Ambient Humidity (Guar)	F (3c)	Constant	----	1.0046	1.0046	1.0046	1.0046
Ambient Humidity (Test)	F (3d)	Calculate	----	1.0055	1.0051	1.0053	1.0057
Total Correction	-----	-----	----	0.9991	0.9987	0.9964	0.9962
Heat Rate After Correction			kCal/kWh	4,857.17	3,721.07	3,194.66	3,082.35

GAS TURBINE PERFORMANCE TEST CALCULATION

Unit : PLTGU Tambak Lorok GT 2.1
Test Condition : OPEN CYCLE
Date : 28 Juni 2013
Duration : 60 Menit

GAS TURBINE PERFORMANCE

1. GAS TURBINE HEAT RATE

Item	Code	Calculation Formula	Unit	Result (MW)			
				30	50	75	100
Gas turbine gross heat rate	HR _{GTG}	$(GF_{oil} \times HHV_{oil}) / (GTKWG \times 1000)$	kCal/kWh	5,358.81	4,184.56	3,658.62	3,423.91
Gas turbine net heat rate	HR _{GTN}	$(GF_{oil} \times HHV_{oil}) / (GTKWN \times 1000)$	kCal/kWh	5,509.22	4,203.89	3,671.23	3,435.96
Fuel Oil flow rate	GF _{OIL}	measured	kg/h	14,893.95	19,351.48	25,380.48	31,762.30
Fuel Oil higher heating value	HHV _{OIL}	measured	kJ/kg	45,452.37	45,452.37	45,452.37	45,452.37
Gas turbine gross power output	GTKWG	measured	MW	30.19	50.24	75.36	100.77
Gas turbine net power output	GTKWN	measured	MW	29.37	50.01	75.10	100.42
Specific Fuel Consumption	SFC	GFc/GTKWG	l/kWh	0.58	0.45	0.40	0.37
Frequency	F	measured	Hz	50.06	49.98	50.06	50.03
Efisiensi GT	η_{GT}	$(3600 / (4,1868 \times HRGTC)) \times 100$	%	16.05	20.55	23.50	25.11

2. GAS TURBINE COMPRESSOR EFFICIENCY

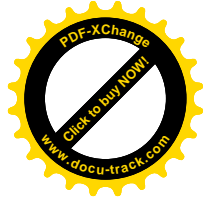
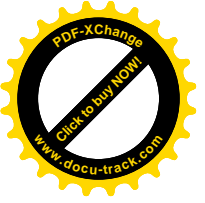
Item	Code	Calculation Formula	Unit	Result (MW)			
				30	50	75	100
GT compressor efficiency	η_c	$((T1C + 273.15) / (T2C - T1C)) \times (((PCS) / Pa)^{K-1} - 1) \times 100$	%	82.96	84.72	85.52	86.07
GT compressor inlet air temperature	T1C	measured	°C	26.40	30.12	26.70	26.80
GT compressor outlet air temperature	T2C	measured	°C	301.20	337.00	340.20	352.40
GT compressor outlet air pressure	PCS	measured	kg/cm ² (A)	7.43	8.95	9.59	10.32
Ambien pressure	Pa	measured	kg/cm ² (A)	1.03	1.02	1.03	1.03
Specific heat ratio	K	constant		1.40	1.40	1.40	1.40
Air Inlet Differential Pressure	ΔP	measured	mbar	0.75	0.75	0.75	0.75

3. POWER OUTPUT CORRECTED

Item	Code	Calculation Formula	Unit	Correction Factor			
Power Output			MW	30.19	50.24	75.36	100.77
Power Output Correction Factor							
Speed	FN	----	----	0.0000	0.0000	0.0000	0.0000
Fired Hour	FH	----	----	0.0000	0.0000	0.0000	0.0000
Barometer	FB	$1 + 0.7 \times (BP / 14.692 - 1)$	----	0.9945	0.9943	0.9947	0.9947
Inlet Temperature (Guar)	F (2a)	----	----	0.93	0.93	0.93	0.93
Inlet Temperature (Test)	F (2b)	----	----	0.9295	0.9064	0.9276	0.9270
Ambient Humidity (Guar)	F (3a)	----	----	0.9983	0.9983	0.9983	0.9983
Ambient Humidity (Test)	F (3b)	----	----	0.9980	0.9983	0.9980	0.9982
Power Factor	FS	----	----	1.0023	1.0015	1.0029	1.0025
Total Correction	-----	$FN \times F(2a) \times F(3a) / F(2b) \times F(3b) \times F(5)$	----	0.9995	1.0256	1.0007	1.0016
Power Output After Correction			MW	30.18	51.52	75.41	100.93

4. HEAT RATE CORRECTED

Item	Code	Calculation Formula	Unit	Correction Factor			
Heat Rate			kCal/kWh	5,358.81	4,184.56	3,658.62	3,423.91
Heat Rate Correction Factor							
Speed	HN	----	----	0.0000	0.0000	0.0000	0.0000
Fired Hour	HH	----	----	0.0000	0.0000	0.0000	0.0000
Inlet Temperature (Guar)	F (2c)	Constant	----	1.0167	1.0167	1.0167	1.0167
Inlet Temperature (Test)	F (2d)	Calculate	----	1.0158	1.0216	1.0162	1.0164
Ambient Humidity (Guar)	F (3c)	Constant	----	1.0046	1.0046	1.0046	1.0046
Ambient Humidity (Test)	F (3d)	Calculate	----	1.0055	1.0048	1.0057	1.0049
Total Correction	-----	----	----	1.0000	0.9951	0.9994	1.0000
Heat Rate After Correction			kCal/kWh	5,358.83	4,163.99	3,656.31	3,423.79



LAMPIRAN 4

DATA HASIL PENGUKURAN NILAI KALOR

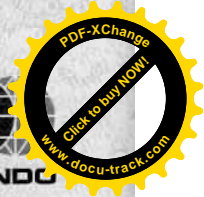
BAHAN BAKAR



Certificate No. 15640/DBBPAG
Date: July 15, 2013



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Email: jum.cbt@sucofindo.co.id



REPORT OF ANALYSIS

The following sample (s) was submitted and identified by the client as :

CLIENT : PLN (PERSERO).
PUSLITBANG KETENAGALISTRIKAN, PT.
Jl. Duren Tiga No. 102,
Jakarta Selatan 12760

TYPE OF SAMPLE : HSD

DATE RECEIVED : July 8, 2013

DATE OF ANALYSIS : July 8 – 11, 2013

TESTED FOR : Density at 15°C, Sulfur Content and Gross Heating Value

DESCRIPTION OF SAMPLE : Form : Liquid
Volume : 500 ml
Packing : Unsealed Bottle
1 (One) sample

SAMPLE IDENTIFICATION : " GT 1.1 PLTGU TAMBAK LOROK "

YOUR REFERENCE : -

Parameters	Units	Results	Methods
- Density at 15°C	kg/m ³	850.6	ASTM D. 4052-09
- Sulfur Content	% wt	0.217	ASTM D. 4294-10
- Gross Heating Value	BTU/lb	19541	ASTM D. 4868-00 (Reapproved 2011)

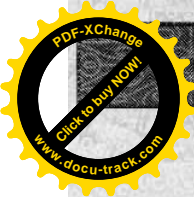
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1328585

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Certificate No. 15642/DBBPAG
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Email: jum.cbt@sucofindo.co.id

REPORT OF ANALYSIS

The following sample (s) was submitted and identified by the client as :

CLIENT : PLN (PERSERO).
PUSLITBANG KETENAGALISTRIKAN, PT.
Jl. Duren Tiga No. 102,
Jakarta Selatan 12760

TYPE OF SAMPLE : HSD

DATE RECEIVED : July 8, 2013

DATE OF ANALYSIS : July 8 – 11, 2013

TESTED FOR : Density at 15°C, Sulfur Content and Gross Heating Value

DESCRIPTION OF SAMPLE : Form : Liquid
Volume : 500 ml
Packing : Unsealed Bottle
1 (One) sample

SAMPLE IDENTIFICATION : " GT 2.1 PLTGU TAMBAK LOROK "

YOUR REFERENCE : -

Parameters	Units	Results	Methods
- Density at 15°C	kg/m ³	851.0	ASTM D. 4052-09
- Sulfur Content	% wt	0.202	ASTM D. 4294-10
- Gross Heating Value	BTU/lb	19541	ASTM D. 4868-00 (Reapproved 2011)

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