

**Shanghai Minghua Power Technology
Engineering Co., Ltd**

**The performance acceptance test report for Phase I
on LFO after conversion of Malta Delimara 3 plant**

Shanghai Minghua Power Technology Engineering Co.,Ltd

2800 Yangshupu Road, Shanghai, China

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Abstract:

Under the witness of independent engineer, Shanghai Minghua Power Technology Engineering Co., Ltd takes charge of carrying out the performance acceptance test of Phase I on LFO of Malta Delimara 3 power plant. In this test, performance parameters of Phase I DF engines in combined cycle are measured with light fuel oil (LFO) as fuel. And this performance test report describes in detail the test procedure and calculation method, and provides the corresponding conclusions on heat rate ,output power, emissions and noise of combined cycle test.

Key words:

Performance acceptance test; Combined cycle; Heat rate; Output power; Emission; Noise

Main results of the performance acceptance formal test for Phase 1 on LFO after conversion

Item	Symbol	Unit	Value
DE45-DE48 plus STG combined cycle (100% load, 2016/9/29 16:30-18:30)			
Gross power of DE45	P_{45}	kW	16662.00
Gross power of DE46	P_{46}	kW	16622.00
Gross power of DE47	P_{47}	kW	16641.50
Gross power of DE48	P_{48}	kW	16588.00
Gross power of STG Corr. to reference condition	$P_{\text{STG-corr}}$	kW	5867.17
Gross power of combined cycle Corr. to reference condition (4 DF engines plus STG)	$P_{\text{Gross-corr}}$	kW	72380.67
DE45 engine gross heat rate Corr. to the reference condition	$\text{HRDE45}_{\text{gross-corr}}$	kJ/kWh	8206.58
DE46 engine gross heat rate Corr. to the reference condition	$\text{HRDE46}_{\text{gross-corr}}$	kJ/kWh	8198.52
DE47 engine gross heat rate Corr. to the reference condition	$\text{HRDE47}_{\text{gross-corr}}$	kJ/kWh	8247.83
DE48 engine gross heat rate Corr. to the reference condition	$\text{HRDE48}_{\text{gross-corr}}$	kJ/kWh	8202.19
Gross heat rate of combined cycle Corr. to reference condition (4 DF engines plus STG)	HR_{corr}	kJ/kWh	7547.98
Engine noise and external noise (100% load, 2016/9/29 16:30-18:30)			

Inside of the enclosure of DE45	L _{45-in}	dB	104.8
Outside of the enclosure of DE45	L _{45-out}	dB	76.8
Inside of the enclosure of DE46	L _{46-in}	dB	105.4
Outside of the enclosure of DE46	L _{46-out}	dB	77.9
Inside of the enclosure of DE47	L _{47-in}	dB	105.4
Outside of the enclosure of DE47	L _{47-out}	dB	78.4
Inside of the enclosure of DE48	L _{48-in}	dB	105.5
Outside of the enclosure of DE48	L _{48-out}	dB	79.2
External noise at plant boundary	L _g	dB	66.35
Emission of DE45-DE48 plus STG combined cycle (100% load, 2016/9/29 16:30-18:30)			
O ₂ —Stack 3 (DE45- 46) O ₂ —Stack 4 (DE47- 48)	O ₂	Vol. %	12.09 12.03
NO _x —Stack 3 (DE45- 46) NO _x —Stack 4 (DE47- 48)	NO _x	mg/Nm ³ @ 15% O ₂	95.8 49.2
SO _x —Stack 3 (DE45- 46) SO _x —Stack 4 (DE47- 48)	SO _x	mg/Nm ³ @ 15% O ₂	21.2 19.1
CO—Stack 3 (DE45- 46) CO—Stack 4 (DE47- 48)	CO	mg/Nm ³ @ 15% O ₂	58.6 58.9
Particulate matter—Stack 3 (DE45- 46) Particulate matter—Stack 4 (DE47- 48)	PM	mg/Nm ³ @ 15% O ₂	5.1 6.8

Note:

1. During the test of DE45-DE48 plus STG combined cycle, DE41-DE44 were shut down.
2. The calculation of engine heat rate takes into account of the 1% pilot fuel consumption. As requested by plant owner, waste gate opening of Phase I DF engines have been adjusted (from 14% to 31% at full load) to increase the exhaust outlet temperature after turbo so as to improve SCR efficiency and STG output, which slightly affected the heat rate of DF engines on LFO.
3. During the 100% load test, STG output had some fluctuations (approx. $\pm 1170\text{kW}$) in an orderly manner due to STG governor problem, which accounted to only 1.6% of the total Phase I combined cycle output. All parties agreed to continue the test and recognize the final performance results.
4. For emission test, all measurement instrument have been compared to testing gas in China before transferred to Malta and provided with calibration certificate. Emission values are converted to normalized conditions at 0 °C, one atmospheric pressure, dry and 15% O₂. NO_x level of Stack 4 is lower due to the larger amount of ammonia injection for DE47 and DE48.

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I The objective of test

Under the witness of independent engineer, Shanghai Minghua Power Technology Engineering Co., Ltd takes charge of carrying out the performance acceptance test of Phase I on LFO of Malta Delimara 3 power plant.

The objective of these tests is to measure the heat rate, power output, noise and emission (including NO_x, SO_x, CO and PM) of the converted Phase I DF engines combined cycle on LFO at various loads, thus providing the performance basis of Phase I engines on LFO after the conversion.

II Test condition

Table 2-1 Test condition and time of the test

NO.	Test condition	Contents of the test	Time and Date
1	90% load for DE45-DE48 engines (4+1 formal test)	Test the output power, heat rate and noise of DF engine on the condition that the generating power of each engine reaches 90% load.	10:45—12:45 2016/09/29
2	90% load for combined cycle test of DE45-DE48 (4+1 formal test)	Test the output power, heat rate, noise and emission of combined cycle on the condition that the generating power of each engine reaches 90% load.	10:45—12:45 2016/09/29
3	80% load for DE45-DE48 engines (4+1 formal test)	Test the output power, heat rate and noise of DF engine on the condition that the generating	13:30—15:00 2016/09/29

		power of each engine reaches 80% load.	
4	80% load for combined cycle test of DE45-DE48 (4+1 formal test)	Test the output power, heat rate, noise and emission of combined cycle on the condition that the generating power of each engine reaches 80% load.	13:30—15:00 2016/09/29
5	100% load for DE45-DE48 engines (4+1 preliminary test)	Test the output power, heat rate and noise of DF engine on the condition that the generating power of each engine reaches 100% load.	15:30—16:30 2016/09/29
6	100% load for combined cycle test of DE45-DE48 (4+1 preliminary test)	Test the output power, heat rate, noise and emission of combined cycle on the condition that the generating power of each engine reaches 100% load.	15:30—16:30 2016/09/29
7	100% load for DE45-DE48 engines (4+1 formal test)	Test the output power, heat rate and noise of DF engine on the condition that the generating power of each engine reaches 100% load.	16:30—18:30 2016/09/29
8	100% load for combined cycle test of DE45-DE48 (4+1 formal test)	Test the output power, heat rate, noise and emission of combined cycle on the condition that the generating power of each engine reaches 100% load.	16:30—18:30 2016/09/29

Note: (1) The test of DE45-DE48 engines and combined cycle are performed

simultaneously at various load.(e.g. test NO. 1 and NO. 2 are done at the same time)
(2) 100% load is required to test the guaranteed performance values in EPC contract.
Test at 90% load and 80% load is required to establish the fundamental data for
Dispatching System of D3 plant.

III Test standard

3.1 Reciprocating internal combustion engines; Performance; Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods-additional requirements for engines for general use. **ISO 3046**

3.2 Rating industrial noise affecting mixed residential and industrial areas. **BS 4142**

3.3 Alternating generating units which are driven by the reciprocating internal combustion engine Part 10: noise measurement (surface method). **ISO 8528.1**

3.4 Stationary source emissions-determination of mass concentration of particulate matter at low concentrations-manual gravimetric method. **ISO 12141-2002**

IV Test instrument and measurement point

4.1 The measurement instrument of atmospheric pressure and ambient temperature are from Minghua Company. Pressure is measured by aneroid barometer and temperature is measured by digital thermo-hygrometer. Test data are recorded at every 5 minutes and calibration certificate of all those test instruments are attached in this report.

4.2 The fuel flow rate of engine is measured by the Vortex Flow meter installed by power plant. Fuel consumption can be calculated by the accumulative data recordings at the beginning and end of test. Meter diagram on site is as follows:



Diagram 4-1 Fuel flow measurement

4.3 The power output of engine and steam turbine is measured by power meter installed by power plant. The power of engine and steam turbine can be calculated by the data accumulative recordings at the beginning and end of test. Meter diagram on site is as follows:



Diagram 4-2 Power output measurement

4.4 Noise is measured by noise analysis system (B&K 2260 type). The layout principle of noise measurement points: 1 meter away from engine shell and 1.2 meter high from ground level. Noise measurement includes inside the engine enclosure,

outside the engine enclosure and external plant boundary.

4.5 The emission measurement adopts Testo 350 type Flue Gas Analyzer and Automatic Dust (flue gas) Tester, whose calibration certificates are shown in attachment. The flue gas firstly goes through a electric-heated sampling gun, to Automatic (flue gas) Dust Tester to collect the PM samples and then to a pretreatment device for the flue gas extraction (by built-in pump), filter and cooling, finally reach the Flue Gas Analyzer. Emission measurement system is shown as follows:



Diagram 4-3 Emission measurement

4.6 Other data used in the calculation is from plant DCS system, including the inlet fuel temperature of engine, charge air coolant temperature, cooling seawater temperature. The measurement points on DCS are shown as follows:

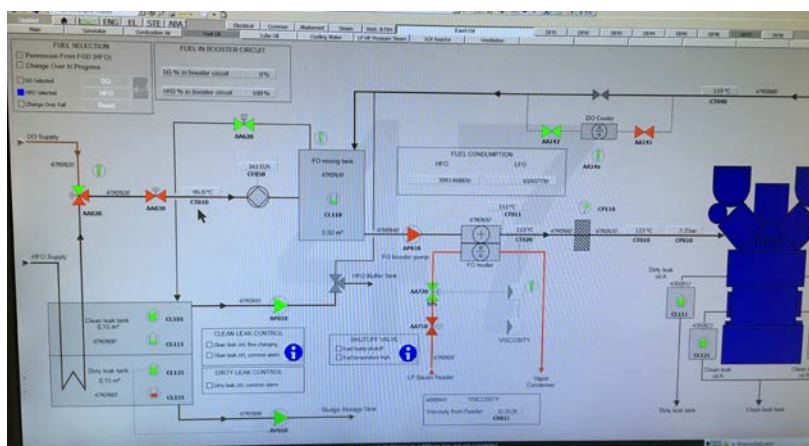


Diagram 4-4 Inlet fuel temperature of engine on DCS

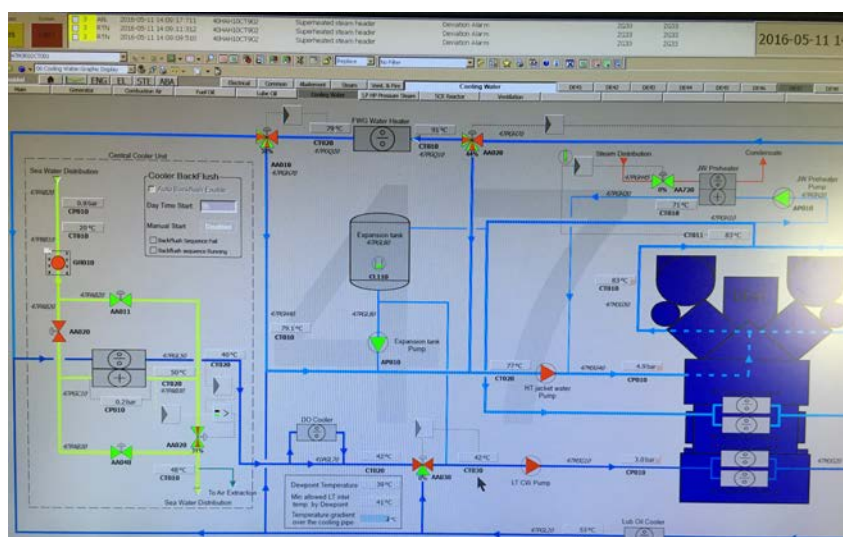


Diagram 4-5 Charge air coolant temperature on DCS

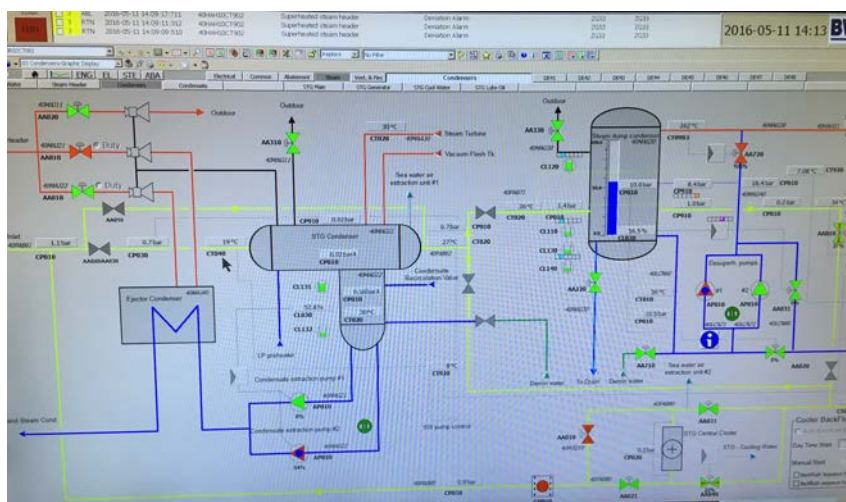


Diagram 4-6 Cooling seawater temperature on DCS

V Test procedure

5.1 Preliminary test

Preliminary test is an indispensable test step before the formal test, which aims at checking the operating condition of the system equipment, the measuring status of the testing meter and instrument and the isolation effect of the system. There should be enough time for calculation and analysis during the preliminary test. The formal test can be conducted only if the preliminary test is qualified.

5.2 Formal test

After the preliminary test meets the test condition requirement, the formal test can be conducted. And the formal test can begin only when the required test condition is stabilized. For details of test condition arrangements, please refer to Table 2-1.

5.3 Test procedure of measuring heat rate and output power

5.3.1 Adjust the load to ensure that the unit operates steadily under the required condition

5.3.2 Make sure the engines are operated in DO(diesel oil, or LFO) mode when testing the output power and heat rate of the combined cycle unit and diesel engine. Record enough measurement data to calculate the system performance. Correct the parameters of the diesel engines to the reference condition which is in accordance with related ISO correction equations. The correction method of the steam turbine output to reference conditions is based on correction formula from manufacturer.

5.3.3 Collect three fuel samples during each test. One sample to be sent to laboratory for analysis, one sample to be kept by testing company and the other one to be kept by the power plant.

5.3.4 After the test is finished, signatures from representatives of all parties involved in the test are needed on every data recording paper of the test.

5.4 Test procedure of noise measurement

The noise measurement will be carried out when the engines are operating at 100% load. Internal and external noise measurement location are indicated in the layout drawing in attachment 8.2.

5.5 Test procedure of emission measurement

The emission measurement will be carried out when the engines are operating at 100% load. The emission measurement point is located at the middle platform of stack. Components under measurement include NO_x, SO_x, CO, O₂ and PM.

VI Calculation of test results

6.1 Gross power of combined cycle unit

The performance calculation of combined cycle unit is based on the measured data of combined cycle test under stable operating conditions. The output power and heat rate of the units are calculated based on the following formula:

$$P_{Gross-corr1} = P_{45} + P_{46} + P_{47} + P_{48} + P_{STG-corr} \quad (1)$$

Where:

$P_{Gross-corr1}$: Gross power of combined cycle (4+1) corrected to the reference condition (kW).

P_{45} : Gross power of DE45 (kW)

P_{46} : Gross power of DE46 (kW)

P_{47} : Gross power of DE47(kW)

P_{48} : Gross power of DE48(kW)

$P_{STG-corr}$: Gross power of steam turbine corrected to the reference condition (kW)

6.2 Total heat rate of combined cycle unit

$$HR_{corr1} = \frac{(Q_{45-corr} + Q_{46-corr} + Q_{47-corr} + Q_{48-corr}) \times Q_r}{P_{Gross-corr1}} \quad (2)$$

Where:

HR_{corr1} : Heat rate of combined cycle (4+1) corrected to the reference condition (kJ/kWh)

$Q_{45-corr}$: Fuel flow rate of engine DE45 corrected to reference condition.

$Q_{46-corr}$: Fuel flow rate of engine DE46 corrected to reference condition.

$Q_{47-corr}$: Fuel flow rate of engine DE47 corrected to reference condition.

$Q_{48-corr}$: Fuel flow rate of engine DE48 corrected to reference condition.

Q_r : the referred lower calorific value of fuel (42700 kJ/kg).

6.3 The calculation of corrected fuel consumption

The following calculation formula of corrected fuel consumption takes engine DE45 as example:

$$Q_{45-corr} = \frac{\alpha}{\kappa} \times Q_{45} \times \frac{Q_x}{Q_r} \quad (3)$$

$$\alpha = \kappa - 0.7(1 - \kappa) \left(\frac{1}{\eta_m} - 1 \right) \quad (4)$$

$$\kappa = \left(\frac{P_x}{P_r} \right)^m \times \left(\frac{T_r}{T_x} \right)^n \times \left(\frac{T_{cr}}{T_{cx}} \right)^s \quad (5)$$

$Q_{45-corr}$: Fuel flow rate of DE45 corrected to the reference condition

Q_{45} : The measured fuel flow rate of DE45

κ : Correction factor of power

P_x : Atmospheric pressure during the test (mbar)

P_r : Atmospheric pressure of reference (1012mbar)

T_x : Ambient temperature during the test

T_r : Ambient temperature of reference (297.15K)

T_{cx} : Charge air coolant temperature during the test (K)

T_{cr} : Charge air coolant temperature of reference (315.25K)

M: 0.7

N: 1.2

s: 1

η_m : 0.9

Q_x : The tested lower calorific value of fuel

Q_r : The referred lower calorific value of fuel (42700 kJ/kg)

6.4 The correction of fuel density

Fuel density is corrected according to ASTM1250-80, the correction formula is as follows (taking DE45 as example):

$$\begin{aligned}\rho_{45-\text{act}} &= \rho_{15} \times \text{VCF} \\ \text{VCF} &= \exp\left(-\alpha_{15} \times (T_{\text{act}} - 15) \times (1 + \alpha_{15} \times 0.8 \times (T_{\text{act}} - 15))\right) \quad (6) \\ \alpha_{15} &= K_0 / (\rho_{15} \times \rho_{15}) + (K_1 / \rho_{15})\end{aligned}$$

$$K_0 = 186.9696$$

$$K_1 = 0.4862$$

VCF: Correction factor of volume

$\rho_{45-\text{act}}$: Actual fuel density

ρ_{15} : Fuel density measured at 15 °C by fuel analysis

T_{act} : Actual fuel temperature recorded from the flow meter of DCS

6.5 The correction of steam turbine output power

The correction applicable to the steam turbine gross power output to reference conditions will be calculated according to the following equation:

$$P_{\text{STG-corr}} = P_{\text{STG}} - \Delta P_{\text{STG}} \quad (7)$$

$$\Delta P_{\text{STG}} = -62.5 \times (T_{\text{amb}} - T_{\text{amb-ref}}) + 92.5 \times (T_{\text{sea-act}} - T_{\text{sea-ref}}) \quad (8)$$

$P_{\text{STG-corr}}$: Steam turbine power corrected to the reference condition

P_{STG} : Steam turbine gross power

ΔP_{STG} : Applicable correction value in kW

T_{amb} : Actual ambient air temperature during the test in °C

$T_{amb-ref}$: Reference ambient air temperature (24°C)

$T_{sea-ref}$: Reference sea water temperature (21°C)

$T_{sea-act}$: Measured sea water temperature at steam turbine condenser inlet.

VII Calculation result of the performance test

7.1 DE45-DE48 plus STG combined cycle test result at 100% load

For the formal test of DE45-DE48 plus STG combined cycle at 100% load, gross power of DE45 is 16662.00kW, gross power of DE46 is 16622.00kW, gross power of DE47 is 16641.50kW , gross power of DE48 is 16588.00kW and STG gross output corrected to reference conditions is 5867.17 kW. In total, the gross output power of DE45-DE48 plus STG combined cycle is 72380.67 kW.

For the formal test of DE47-DE48 plus STG combined cycle, DE45 engine gross heat rate corr. to reference condition is 8206.58 kJ/kWh, DE46 engine gross heat rate corr. to reference condition is 8198.52 kJ/kWh, DE47 engine gross heat rate corr. to reference condition is 8247.83 kJ/kWh, DE48 engine gross heat rate corr. to reference condition is 8202.19 kJ/kWh and heat rate of DE45-DE48 plus STG combined cycle is 7547.98 kJ/kWh.

Table 7-1 Calculation data of DE45-DE48 plus STG combined cycle at 100% load

Item	Symbol	Unit	Value
------	--------	------	-------

Net heat value	LHV	kJ/kg	42910.00
Density@15℃	ρ_{15}	kg/m ³	834.70
DE45 actual fuel oil density	ρ_{DE45}	kg/m ³	824.90
DE46 actual fuel oil density	ρ_{DE46}	kg/m ³	825.44
DE47 actual fuel oil density	ρ_{DE47}	kg/m ³	825.44
DE48 actual fuel oil density	ρ_{DE48}	kg/m ³	825.26
Fuel oil temperature into flow meter DE45	T _{45-act}	℃	28.75
Fuel oil temperature into flow meter DE46	T _{46-act}	℃	28.00
Fuel oil temperature into flow meter DE47	T _{47-act}	℃	28.00
Fuel oil temperature into flow meter DE48	T _{48-act}	℃	28.25
Fuel oil consumption DE45	Q ₄₁	l/h	3823.05
Fuel oil consumption DE46	Q ₄₂	l/h	3808.20

Fuel oil consumption DE47	Q_{43}	l/h	3835.60
Fuel oil consumption DE48	Q_{44}	l/h	3803.40
Fuel oil quality consumption DE45	Q_{fg41}	kg/h	3153.64
Fuel oil quality consumption DE46	Q_{fg42}	kg/h	3143.43
Fuel oil quality consumption DE47	Q_{fg43}	kg/h	3166.05
Fuel oil quality consumption DE48	Q_{fg44}	kg/h	3138.79
Ambient pressure	p_{-amb}	mbar	1024.46
Ambient temperature	T_{-amb}	°C	26.33
Charge air coolant temperature DE45	T_{45-cha}	°C	40.00
Charge air coolant temperature DE46	T_{46-cha}	°C	40.58
Charge air coolant temperature DE47	T_{47-cha}	°C	40.58
Charge air coolant temperature DE48	T_{48-cha}	°C	41.08

Reference ambient pressure	$p_{\text{amb-ref}}$	mbar	1012.00
Reference ambient temperature	$T_{\text{amb-ref}}$	°C	24.00
Reference charge air coolant temperature	$T_{\text{cha-ref}}$	°C	42.1
Ratio of indicated power DE45 κ	κ_{45}	/	1.01
Ratio of indicated power DE46 κ	κ_{46}	/	1.00
Ratio of indicated power DE47 κ	κ_{47}	/	1.00
Ratio of indicated power DE48 κ	κ_{48}	/	1.00
Power adjustment factor DE45 α	α_{45}	/	1.01
Power adjustment factor DE46 α	α_{46}	/	1.00
Power adjustment factor DE47 α	α_{47}	/	1.00
Power adjustment factor DE48 α	α_{48}	/	1.00
Fuel oil consumption DE45 Corr. to amb Ref. condition	$Q_{45\text{amb-corr}}$	kg/h	3155.07

Fuel oil consumption DE46 Corr. to amb Ref. condition	$Q_{46amb-corr}$	kg/h	3144.41
Fuel oil consumption DE47 Corr. to amb Ref. condition	$Q_{47amb-corr}$	kg/h	3167.03
Fuel oil consumption DE48 Corr. to amb Ref. condition	$Q_{48amb-corr}$	kg/h	3139.38
Fuel oil consumption DE45 Corr. to Ref.Net Heat Value	$Q_{45lhv-corr}$	kg/h	3170.59
Fuel oil consumption DE46 Corr. to Ref.Net Heat Value	$Q_{46lhv-corr}$	kg/h	3159.87
Fuel oil consumption DE47 Corr. to Ref.Net Heat Value	$Q_{47lhv-corr}$	kg/h	3182.61
Fuel oil consumption DE48 Corr. to Ref.Net Heat Value	$Q_{48lhv-corr}$	kg/h	3154.82
Fuel oil consumption DE45-DE48	Q_{total}	kg/h	12601.91
Fuel oil consumption DE45-DE48 Corr.	$Q_{total-corr}$	kg/h	12667.88
The gross power of DE45	P_{45}	kW	16662.00
The gross power of DE46	P_{46}	kW	16622.00
The gross power of DE47	P_{47}	kW	16641.50

The gross power of DE48	P_{48}	kW	16588.00
The gross power of STG	P_{STG}	kW	5828.00
The gross power of DE45-DE48 plus STG	$P_{total-gross}$	kW	72341.50
The reference sea water temperature	$T_{sea-ref}$	°C	21.00
The measured sea water temperature	$T_{sea-act}$	°C	23.00
STG power correction	ΔP_{STG}	kW	-39.17
The STG power Corr. to the reference condition	$P_{STG-corr}$	kW	5867.17
The gross power of DE45-DE48 plus STG Corr. to the reference condition	$P_{total-gross-corr}$	kW	72380.67
DE45 engine gross heat rate corr. to reference condition	$HR_{DE45-gross-corr}$	kJ/kWh	8206.58
DE46 engine gross heat rate corr. to reference condition	$HR_{DE46-gross-corr}$	kJ/kWh	8198.52
DE47 engine gross heat rate corr. to reference condition	$HR_{DE47-gross-corr}$	kJ/kWh	8247.83
DE48 engine gross heat rate corr. to reference condition	$HR_{DE48-gross-corr}$	kJ/kWh	8202.19

Diesel engine gross heat rate	$HR_{DE-gross}$	kJ/kWh	8090.11
DE45-DE48 plus STG combined cycle gross heat rate	HR_{gross}	kJ/kWh	7438.35
Diesel engine gross heat rate Corr. to the reference condition	$HR_{DE-gross-corr}$	kJ/kWh	8213.79
Combined cycle gross heat rate of DE45-DE48 plus STG Corr. to the reference condition	$HR_{gross-corr}$	kJ/kWh	7547.98

7.2 DE45-DE48 plus STG combined cycle test result at 90% load

For the DE45-DE48 plus STG combined cycle test at 90% load, gross power of DE45 is 14957.50kW, gross power of DE46 is 14916.00kW, gross power of DE47 is 14935.00kW, gross power of DE48 is 14907.00kW and STG gross output corrected to reference conditions is 5029.97 kW. In total, the gross output power of DE45-DE48 plus STG combined cycle is 64745.47 kW.

For the DE45-DE48 plus STG combined cycle test at 90% load, DE45 engine gross heat rate corr. to reference condition is 8215.56 kJ/kWh, DE46 engine gross heat rate corr. to reference condition is 8199.27 kJ/kWh, DE47 engine gross heat rate corr. to reference condition is 8267.10 kJ/kWh, DE48 engine gross heat rate corr. to reference condition is 8200.28 kJ/kWh and heat rate of DE45-DE48 plus STG combined cycle is 7581.93 kJ/kWh.

Table 7-2 Calculation results of DE45-DE48 plus STG combined cycle at 90% load

Item	Symbol	Unit	Value
The gross power of DE45	P_{45}	kW	14957.50

The gross power of DE46	P_{46}	kW	14916.00
The gross power of DE47	P_{47}	kW	14935.00
The gross power of DE48	P_{48}	kW	14907.00
The gross power of STG	P_{STG}	kW	5020.00
The gross power of DE45-DE48 plus STG	$P_{total-gross}$	kW	64735.50
STG power correction	ΔP_{STG}	kW	-9.97
The STG power Corr. to the reference condition	$P_{STG-corr}$	kW	5029.97
The gross power of DE45-DE48 plus STG Corr. to the reference condition	$P_{total-gross-corr}$	kW	64745.47
DE45 engine gross heat rate corr. to reference condition	$HR_{DE45-gross-corr}$	kJ/kWh	8215.56
DE46 engine gross heat rate corr. to reference condition	$HR_{DE46-gross-corr}$	kJ/kWh	8199.27
DE47 engine gross heat rate corr. to reference condition	$HR_{DE47-gross-corr}$	kJ/kWh	8267.10
DE48 engine gross heat rate corr. to reference condition	$HR_{DE48-gross-corr}$	kJ/kWh	8200.28

Diesel engine gross heat rate	$HR_{DE-gross}$	kJ/kWh	8097.04
DE45-DE48 plus STG combined cycle gross heat rate	HR_{gross}	kJ/kWh	7469.15
Diesel engine gross heat rate Corr. to the reference condition	$HR_{DE-gross-corr}$	kJ/kWh	8220.57
Combined cycle gross heat rate of DE45-DE48 plus STG Corr. to the reference condition	$HR_{gross-corr}$	kJ/kWh	7581.93

7.3 DE45-DE48 plus STG combined cycle test result at 80% load

For the DE45-DE48 plus STG combined cycle test at 80% load, gross power of DE45 is 13359.00kW, gross power of DE46 is 13315.00kW, gross power of DE47 is 13337.00kW, gross power of DE48 is 13309.00kW and STG gross output corrected to reference conditions is 4461.42 kW. In total, the gross output power of DE45-DE48 plus STG combined cycle is 57781.42 kW.

For the DE45-DE48 plus STG combined cycle test at 80% load, DE45 engine gross heat rate corr. to reference condition is 8252.99 kJ/kWh, DE46 engine gross heat rate corr. to reference condition is 8228.04 kJ/kWh, DE47 engine gross heat rate corr. to reference condition is 8286.66 kJ/kWh, DE48 engine gross heat rate corr. to reference condition is 8235.80 kJ/kWh and heat rate of DE45-DE48 plus STG combined cycle is 7615.54 kJ/kWh.

Table 7-2 Calculation results of DE45-DE48 plus STG combined cycle at 80% load

Item	Symbol	Unit	Value
------	--------	------	-------



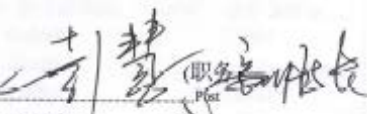
The gross power of DE45	P_{45}	kW	13359.00
The gross power of DE46	P_{46}	kW	13315.00
The gross power of DE47	P_{47}	kW	13337.00
The gross power of DE48	P_{48}	kW	13309.00
The gross power of STG	P_{STG}	kW	4484.00
The gross power of DE45-DE48 plus STG	$P_{total-gross}$	kW	57804.00
STG power correction	ΔP_{STG}	kW	22.58
The STG power Corr. to the reference condition	$P_{STG-corr}$	kW	4461.42
The gross power of DE45-DE48 plus STG Corr. to the reference condition	$P_{total-gross-corr}$	kW	57781.42
DE45 engine gross heat rate corr. to reference condition	$HR_{DE45-gross-corr}$	kJ/kWh	8252.99
DE46 engine gross heat rate corr. to reference condition	$HR_{DE46-gross-corr}$	kJ/kWh	8228.04
DE47 engine gross heat rate corr. to reference condition	$HR_{DE47-gross-corr}$	kJ/kWh	8286.66

DE48 engine gross heat rate corr. to reference condition	$HR_{DE48-gross-corr}$	kJ/kWh	8235.80
Diesel engine gross heat rate	$HR_{DE-gross}$	kJ/kWh	8133.29
DE45-DE48 plus STG combined cycle gross heat rate	HR_{gross}	kJ/kWh	7502.80
Diesel engine gross heat rate Corr. to the reference condition	$HR_{DE-gross-corr}$	kJ/kWh	8250.89
Combined cycle gross heat rate of DE45-DE48 plus STG Corr. to the reference condition	$HR_{gross-corr}$	kJ/kWh	7615.54

VIII Appendix

8.1 Calibration certificate

Calibration certificate -- aneroid barometer




		
上海市气象信息与技术服务中心 气象计量所 SHANGHAI METEOROLOGICAL IT SERVICE CENTER METEOROLOGICAL METROLOGY STATION		
<h1>校准证书</h1>		
CALIBRATION CERTIFICATE		
该报告/证书已确认，准予____用。		
证书编号 Certificate No.	DP2-2015739 年__月__日 确认人：____	
委 托 者 Customer	上海明华电力技术工程有限公司	
委托者地址 Address of customer	/	
器具名称 Name of instrument	空盒气压表	
制 造 厂 Manufacturer	上海软品仪器仪表有限公司	
型号/规格 Model/Specification	DYM3	
器具编号 No. of instrument	02883	
	证书批准人 Approved by	
	核 验 员 Checked by	
	校 准 员 Calibrated by	
校准日期 Date for calibrated	2015 年 12 月 03 日 Year Month Day	
地址：徐家汇蒲西路166号1号楼10楼 Address No.166 Puxi Road Xujiahui No.1 building tenth floor 电话：021-64383886 Tel 邮政编码：201615 Post code 传真：021-67697092 Fax		
未获本中心批准，部分采用本证书内容无效。 Partly using this certificate will not be admitted unless allowed by SMMS		
第 1 页 共 2 页 Page of total page		

实验室认可证书号: SJ034 The number of the certificate accredited is		证书编号: DP2-2015739 Certificate No	
本次校准所依据的技术规范(代号、名称): JJG272-2007 空盒气压表和空盒气压计检定规程 Reference document for the calibration(code, name)			
本次校准所使用的主要标准器具: Main measurement standards used in this calibration			
名称/型号: 数字压力计 Name/Model		器具编号: 110734 No. of instrument	
测量范围: (800~1050) hPa measuring range		证书编号/有效期限: GQJ(V)QY2015-0733 Certificate No./Due date	
不确定度或准确度等级或最大允许误差: 0.01 级 Uncertainty accuracy class/maximum permissible error		2016 年 02 月 01 日 发证机构: 国家气象计量站 Issuing body	
以上计量标准器具的量值溯源至国家基准。 Quantity values of above measurement standards used in this calibration are traced to those of the national primary standards in the P.R.China			
校准地点及环境条件: Location and environmental condition for the calibration			
地点: 松江九亭涞坊路 2030 号 Location		温度: 15.8 °C Ambient temperature	
湿度: / %RH Relative humidity		其它: / Others	
本次校准结果的扩展不确定度: $U=0.4\text{hPa}$, $k=2$ Expanded uncertainty			
校准结果/说明: Results of calibration and additional explanation			
根据国家计量检定规程 JJG272-2007 进行校准。校准结果如下: 根据国家计量检定规程 JJG272-2007 进行校准。校准结果如下:			
1. 温度系数: $\pm 0.02 \text{ hPa/}^\circ\text{C}$			
2. 标准表示值 (hPa)	被测表示值 (hPa)	气 压	修正值
1050.0	1050.0	1050	-0.1
1030.0	1030.0	1040	-0.1
1010.0	1009.9	1030	-0.1
990.0	990.0	1020	-0.1
960.0	959.2	1010	0.0
960.0	960.4	1000	0.0
990.0	989.7	990	-0.1
1010.0	1009.7	980	-0.1
1030.0	1029.9	970	0.0
1050.0	1049.8	960	0.0
3. 补充修正值: -0.5 hPa 。 如果希望在技术规范规定的范围内使用本校准结果, 则建设在 2016 年 12 月 02 日之前复校。 以下空白。			
本证书提供的结果仅对本次被校的器具有效。 The data are valid only for the instrument(s)			

Calibration certificate—digital thermo-hygrometer


  		校准证书编号: 2015E13-10-016346 Calibrated certificate serial no.:	
SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA		 * 3 4 6 5 5 2 *	
CALIBRATION CERTIFICATE		该报告/证书已确认, 准予使用。 2015年12月15日 确认人: 	
上海市计量测试技术研究院 华东国家计量测试中心 校准证书			
委 托 者 Customer	上海明华电力技术工程有限公司		
委托者地址 Address of customer	/		
器 具 名 称 Name of instrument	简易数字温湿度计		
制 造 厂 Manufacturer	/		
型号/规格 Model/Specification	/		
器 具 编 号 No. of instrument	M-00-84-0012		
器具准确度 Instrument accuracy	/		
批准人/ 职务 Approved by / Functions		任学弟	副所长
(机构校准专用章)		核 验 员 Checked by	崔体运
		校 准 员 Calibrated by	张勇
校准日期 2015 年 12 月 09 日 Date for calibrated Year Month Day			
地址: 上海市张衡路 1500 号(总部) Address No.1500 Zhangheng Road, Shanghai(headquarters)		电话: 021-38839800 Tel	传真: 021-50798390 Fax
客户咨询电话: 800-920-5172 Inquire line		邮编: 201203 Post Code	
投诉电话: 021-50798262 Tel. for complaint			
未经本院/中心批准, 部分采用本证书内容无效。 Party using this report will not be admitted unless allowed by SIMT.			
第 1 页 共 3 页 Page 01/003 pages			

  		校准证书编号: 2015E13-10-016346 Calibrated certificate series No.	
SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA		 * 3 4 6 5 5 2 *	
国家法定计量检定机构计量授权证书号(中心/院): (国)法计(2012)01039号/(2012)01019号 The number of the Certificate of Metrological Authorization to The Legal Metrological Verification Institution is No. / (2012) 01039/ No. (2012) 01019			
中国合格评定国家认可委员会实验室认可证书号: No. CNAS L0134 The number of the certificate accredited by CNAS is No. L0134			
本次校准所依据的技术规范(代号、名称): Reference documents for the calibration (code : name)			
JJF1076-2001 湿度传感器校准规范 JJG874 2007 温度指示控制仪检定规程			
本次校准所使用的主要计量标准器具: Main measurement standards used in this calibration			
名称/型号 Name/Model	编号 Number	证书编号/有效期限 Certificate No./Due date	测量范围/准确度等级或 最大允差或不确定度 Measurement range/accuracy class or maximum permissible errors or uncertainty of measurement
精密温湿度校准箱 EC30	1254-06	2015E13-30-000026 2016.07.29	(30~95)%RH, (5~50) °C 波动度: ±0.2%RH, ±0.10 °C 均匀度: 1.0%RH, 0.22 °C
精密露点仪 DEW PRIME II	26485/2396X	2015E13-20-002154 2016.07.28	(-15~45) °C DP/±0.1 °C DP
精密露点仪(温度) DEW PRIME II	26485	2015E11-10-001806 2016.03.03	(0~50) °C/±0.1 °C
以上计量标准器具的量值溯源至国家基准。 Quantity values of above measurement standards used in this calibration are traced to those of the national primary standards in the P.R. China.			
校准地点及环境条件: Location and environmental condition for the calibration			
地点: Location	院总部机械楼 314 室		
温度: Ambient temperature	(20~22) °C	湿度: Relative humidity	(40~45) %RH; 其它: /
本次校准结果的扩展不确定度: Expanded uncertainty			
见续页 See continued pages			
校准结果/说明: Results of calibration and additional explanation			
见续页 See continued pages			
本证书提供的结果仅对本次被校的器具有效。 The data are valid only for the instruments.			
校准证书续页专用 Continued page of calibration certificate		第 2 页 共 3 页 Page 2 of total 3 pages	

SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

校准证书编号: 2015E13-10-016346
Calibrated certificate series No.



* 3 4 6 5 5 2 *

校准结果/说明 (续页):
Results of calibration and additional explanation (continued page)

湿度/%RH(20℃)				温度/℃			
标准值	被测仪器示值	扩展不确定度 ($k=2$)	技术要求	标准值	被测仪器示值	扩展不确定度 ($k=2$)	技术要求
40.0	39	2	MPE: ± 5	15.0	15.0	0.3	MPE: ± 1.0
60.0	59			20.0	19.9		
80.0	83			30.0	29.9		





结论: 温度示值误差符合 JJG874-2007 第 4.1.1.2 条的要求。
湿度示值误差符合 JJF1076-2001 第 8.3 条的要求。
如果希望在制造商指定的技术指标范围内, 或者在技术法规规定的范围内使用本校准结果, 则建议在 2016 年 12 月 09 日之前进行复校。
校准结果内容结束

校准证书续页专用
Continued page of calibration certificate

第 3 页 共 3 页
Page 3 of total pages

Calibration certificate---flue gas analyzer

  		校准证书编号: 2015H15-10-029583 Calibrated certificate series No.	
SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA		 * 3 5 1 4 3 6 5 *	
CALIBRATION CERTIFICATE			
该报告/证书已确认, 准予_____ 2016年1月7日 确认人: 张昕			
上海市计量测试技术研究院 华东国家计量测试中心			
校 准 证 书			
委 托 者 Customer	上海明华电力技术工程有限公司		
委托者地址 Address of customer	/		
器具名称 Name of instrument	烟气分析仪		
制 造 厂 Manufacturer	Testo		
型号/规格 Model/Specification	testo 350		
器具编号 No. of instrument	M-07-04-0430(02625029)		
器具准确度 Instrument accuracy	/		
批准人/ 职务 Approved by / Functions		任淑贞	所长
(机构校准专用章)		核 验 员 Checked by	叶泓
		校 准 员 Calibrated by	张昕
校准日期 Date for calibrated	2015	年	12 月 31 日 Day
地址: 上海市张衡路 1500 号(总部) Address No.1500 Zhangheng Road, Shanghai(headquarters)	电话: 021-38839800 Tel.	传真: 021-50798390 Fax	邮编: 201203 Post Code
客户咨询电话: 800-820-5172 Inquire line	投诉电话: 021-50798262 Tel. for complaint		
未经本院/中心批准, 部分采用本证书内容无效。 Partly using this report will not be admitted unless allowed by SIMT.			
第 1 页		共 3 页	
Page		of total pages	

  		校准证书编号: 2015H15-10-029583 Calibrated certificate series No.	
SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA		 * 3 5 1 4 3 6 5 *	
国家法定计量检定机构计量授权证书号(中心/院): (国)法计(2012)01039号/(2012)01019号 The number of the Certificate of Metrological Authorization to The Legal Metrological Verification Institution is No. (2012) 01039/ No. (2012) 01019			
中国合格评定国家认可委员会实验室认可证书号: No. CNAS L0134 The number of the certificate accredited by CNAS is No. L0134			
本次校准所依据的技术规范(代号、名称): Reference documents for the calibration (code, name) 参照 JJG968-2002 烟气分析仪检定规程 参照 JCJ/001017.1-2015 烟气分析仪校准作业指导书			
本次校准所使用的主要计量标准器具: Main measurement standards used in this calibration			
名称/型号 Name/Model	编号 Number	证书编号/有效期限 Certificate No./Due date	测量范围/准确度等级或 最大允差或不确定度 Measurement range/accuracy class or maximum permissible error or uncertainty of measurement
氮气中一氧化氮气体 标准物质	951067	2016.01	98μ mol/mol 1.0%
氮气中二氧化硫气体 标准物质	L00507040	2016.01	100μ mol/mol 1.0%
氮气中一氧化碳气体 标准物质	L00107132	2016.08	100μ mol/mol 1.0%
氮气中氧气标准物质	211730	2016.08	5.00% 1.0%
以上计量标准器具的量值溯源至国家基准。 Quantity values of above measurement standards used in this calibration are traced to those of the national primary standards in the P.R. China.			
校准地点及环境条件: Location and environmental condition for the calibration			
地点: Location	张衡路 1500 号 (理化东楼 128)		
温度: Ambient temperature	21	℃;	湿度: 55 %RH; 其它: 无
本次校准结果的扩展不确定度: Expanded uncertainty $U_{rel}(O_2) = 2.3\%(k=2)$, $U_{rel}(NO) = 2.6\%(k=2)$, $U_{rel}(CO) = 2.8\%(k=2)$, $U_{rel}(SO_2) = 2.6\%(k=2)$			
校准结果/说明: Results of calibration and additional explanation 见续页			
本证书提供的结果仅对本次被校的器具有效。 The data are valid only for the instrument(s).			
校准证书续页专用 Continued page of calibration certificate		第 2 页 共 3 页 Page 2 of total 3 pages	





SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

校准证书编号: 2015H15-10-029583
Calibrated certificate series No.



* 3 5 1 4 3 6 5 *

校准结果/说明 (续页):
Results of calibration and additional explanation (continued page)


O ₂		SO ₂	
仪器用空气校至 20.95%		仪器用氮气校至零	
响应时间: 20s		响应时间: 35s	
校准气浓度值 (%)	仪器显示值 (%)	校准气浓度值 (μ mol/mol)	仪器显示值 (μ mol/mol)
5.00	5.08	100	97
NO		CO	
仪器用氮气校至零		仪器用氮气校至零	
响应时间: 20s		响应时间: 19s	
校准气浓度值 (μ mol/mol)	仪器显示值 (μ mol/mol)	校准气浓度值 (μ mol/mol)	仪器显示值 (μ mol/mol)
98	100.6	100	99

校准结果内容结束

校准证书续页专用
Continued page of calibration certificate

第 3 页 共 3 页
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Calibration certificate—automatic (flue gas) dust tester

 SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

该报告/证书已确认，准予使用。
2015年11月9日 确认人：陈皓

上海市计量测试技术研究院
华东国家计量测试中心

检定证书
Verification Certificate

证书编号：2015120-20-060347 号
Certificate No.

送检单位：上海明华电力技术工程有限公司
Applicant

计量器具名称：自动烟尘（气）测试仪
Name of Instrument

型号/规格：3012H
Type/Specification

出厂编号：A08167672X
Series No.

制造单位：青岛崂山应用技术研究所
Manufacturer

检定依据：JJG680-2007 烟尘采样器国家计量检定规程
Verification Regulation

检定结论：合格
Conclusion

批准人：刘悦
Approved by

核验员：张爱亮
Checked by

检定员：李平
Verified by

检定日期：2015 年 10 月 27 日
Date for Verification Year Month Day

有效期至：2016 年 10 月 26 日
Valid until Year Month Day

计量检定机构授权证书号：（国）法计（2012）01019号/01039号
Authorization Certificate No.

地址：上海市张衡路 1500 号（总部）
Address No. 1500 Zhangheng Road, Shanghai (headquarters)


传真：021-50798390
Fax

电话：021-38839800
Telephone

邮编：201203
Post Code

网址：www.simt.com.cn
Web site

第 1 页 共 3 页
Page of total pages

 SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA		证书编号: 2015I20-20-060347 Certificate No.	
本次检定所使用的计量(基)标准/主要计量器具: Measurement standards / Measuring instrument used in this verification			
名称/型号 Name/Model	编号 Number	证书编号/有效期限 Certificate No./Due date	测量范围/准确度等级或 最大允差或不确定度 Measurement range/accuracy class or maximum permissible errors or uncertainty of measurement
玻璃转子流量计 /LZB-15	5	2015E31-20-002558/ 2017.04.22	(10.0~70.0) L/min/1.0 级
U 型压力计 /BY	2001-10151	2015E21-20-001892/ 2016.04.23	(0~10) kPa/2.5 级
以上计量标准器具的量值溯源至国家基准。 The value of a quantity of measurement standard used in this verification is traced to those of the national primary standards in the P.R. China.			
检定地点及环境条件: Location and environmental condition for the verification			
地点: Location	院宜山路分部 23 号楼 504 室		
温度: Ambient temperature	20.5 °C	湿度: Humidity	55 %RH
		其它: Others	1014.5hPa
检定结果/说明: Results of verification and additional explanation 见续页。			
本证书提供的结果仅对本次被检的器具有效。 未经本院/中心批准, 部分采用本证书内容无效。 The data are valid only for the instrument(s). Partly using this certificate will not be admitted unless allowed by SIMT.			
检定证书续页专用 Continued page of verification certificate		第 2 页 共 3 页 Page of total pages	



SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

证书编号: 2015I20-20-060347
Certificate No.

检定结果/说明 (续页):
Results of verification and additional explanation (continued page):

序号	检定项目名称及单位	技术要求	检定结果
1	外 观	铭牌上应有仪器名称、型号、制造厂名、计量标志、出厂编号、制造日期和主要技术指标 各零部件应齐全并连接可靠, 不应有影响使用的损伤和变形; 各紧固件和开关无损坏和卡死现象 测试件中配备的温度计、压力计、流量计和真空表的数值和刻度应清晰, 颜色牢固, 不得有影响读数的缺陷	符合
2	绝 缘 电 阻 (MΩ)	≥20	200
3	气 密 性 (Pa)	≤120	50
4	抽 气 能 力 (kPa)	≥20	40
5	流量稳定性 (%)	≤5	2
6	流量示值误差 (% F.S)	不超过 ±5	-1.0
7	计 时 误 差 (s)	不超过 ±2s	1
8	温度示值误差 (℃)	不超过 2.5 ℃	0.8
9	计前压力示值误差 (% F.S)	不超过 ±2.5	/
10	静压力示值误差 (% F.S)	不超过 ±4	-2
11	动压力示值误差 (% F.S)	不超过 ±2	1
12	压力零点漂移 (Pa)	在 1h 内, 零点漂移不大于 4Pa	2
13	等速跟踪相应时间 (s)	不大于 20 s	10

检定结果内容结束

检定证书续页专用
Continued page of verification certificate

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Calibration certificate—(B&K 2260 type) noise measurement

 SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA		 该报告/证书已确认, 准 3-5 级 313 2016 年 1 月 15 日 确认人: 
上海市计量测试技术研究院 华东国家计量测试中心		
检定证书 Verification Certificate		
证书编号: 2015D51-20-003191 号 Certificate No. 上海明华电力技术工程有限公司		
送检单位 Applicant	上海明华电力技术工程有限公司	
计量器具名称 Name of instrument	声级计	
型号 / 规格 Type/ Specification	2238	
出厂编号 Serial No.	2231691/M-07-04-0016	
制造单位 Manufacturer	丹麦B&K公司	
检定依据 Verification Requirement	JJG 188-2002	
检定结论 Conclusion	1级合格	
批准人 Approved by	马建敏 	
核定专用章 Stamp	核验员 邓峰 	
	检定员 安兆亮 	
检定日期 Date for verification	2015 年 12 月 31 日	
有效期至 Due to	2016 年 12 月 30 日	
计量检定机构授权证书号: (国) 法计 (2012) 01019号/01039号 Authorization Certificate No. 地址: 上海市张衡路1500号(总部) Address: No.1500 Zhangheng Road, Shanghai(Main Office) 传真: 021-50798390 Fax		电话: 021-38839800 Telephone 邮编: 201203 PostCode 网址: www.simt.com.cn Web site
第 1 页 共 4 页 Page 1 of 4		

名称/型号 Name/Model		编号 Number	证书编号/有效期限 Certificate No./Valid Date	测量范围/准确度等级或 最大允差或不确定度 Measurement range/accuracy class or maximum permissible error or uncertainty in measurement
多通道分析仪 /3560c		2491440	2015D51-10-001318 /2016年04月29日	10Hz-20kHz /频率 MPE: $\pm 0.2\text{dB}$
传声器前置放大器 /2669		2490349	LSae2015-1522 /2016年04月13日	频率: 2Hz-200kHz /频率 MPE: $\pm 0.2\text{dB}$
声校准器 /4220		2463395	LSae2015-1523 /2016年04月13日	250Hz, 124.0dB /LS级

本次检定所使用的计量(基)标准/主要计量器具:
Measurement standards/Measuring instrument used in this verification.

以上计量标准器具的量值溯源至国家基准。
The value of a quantity of measurement standard used in this verification is traced to those of the national primary standards in the P. R. China.

检定地点及环境条件:
Location and environmental condition for the verification

地点:
Location 张衡路1500号机械楼202室

温度:
Ambient temperature 24.0 °C 湿度:
Humidity 31.3 %RH 其它: 101.7 kPa
Others

检定结果/说明:
Results of verification and additional explanation
见续页

本证书提供的结果仅对本次接检的器具有效。 未经本院/中心批准, 部分采用本证书内容无效。
This data are valid only for the instrument /s/. Partly Using this certificate will not be without prior approval by SIMT.

第 2 页 共 4 页
Page of total pages

检定证书续页专用

证书编号: 2015D51-20-003191
Certificate No.


* 3 5 1 4 3 1 3 *

 **SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY**
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

检定结果/说明 (续页):
Results of verification and additional explanation (continued page):

一、外观检查:
外观检查: 完好

二、指示声级调整:
传声器编号: 2231262
标准值: 94.0 dB
声级计声级: 94.0 dB

三、频率计权:
频率计权: 符合1级标准

四、级线性:

4.1 参考级量程	
起始点指示声级	90.0 dB
起始点以上间隔1dB点的最大误差	0.1 dB
起始点以下间隔1dB点的最大误差	0.1 dB
4.2 其他级量程	
起始点指示声级	90.0 dB
起始点以上间隔10dB点的最大误差	0.2 dB
上限以下5dB内的1dB点的最大误差	0.1 dB
起始点以下间隔10dB点的最大误差	0.2 dB
下限以上5dB内的1dB点的最大误差	0.1 dB
4.3 最大误差	
相对参考级量程的级量程控制器最大误差	0.0 dB

五、本机噪声:
A₁: 20.2 dB
C₁: / dB
Z/FLAT: / dB

六、F和S时间计权:
衰减速率F: 30.1 dB/s
衰减速率S: 4.6 dB/s
F和S差值: 0.0 dB

证书编号: 2015051-20-003181
Certificate No. 
* 3 5 1 4 3 1 3 *

 SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

检定结果/说明 (续页):
Results of verification and additional explanation (continued page):

七、猝发音响应 (A计权):

单个猝发音 持续时间(ms)	猝发音响应 $L_{Amax}-L_A$ (dB)	猝发音响应 $L_{A5max}-L_A$ (dB)	猝发音响应 $L_{AE}-L_A$ (dB)
500	-0.2	-4.2	/
200	-1.3	-7.6	/
50	-4.8	-13.4	/
10	-11.1	-20.0	/

八、重复猝发音响应 (A计权):

单个猝发音 持续时间(ms)	相邻单个猝发音之间 间隔时间(ms)	猝发音响应 $L_{AeqT}-L_A$ (dB)
500	2000	-7.0
200	800	-7.0
50	200	-7.0
10	40	-7.0

九、过载指示:
过载指示误差: / dB

检定结果内容结束

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Page 4 of total 04Page

检定证书续页专用

Noise measurement point at plant boundary



2016/09/29—100% load—LFO fuel of DE47



INSPECTORATE



Inspectorate Malta Ltd
Inspectorate House, Spencer Hill, Marsa
MRS 1959, Malta
Tel: +356 2246 9700
Fax: +356 2123 7788
Email: operations.malta@inspectorate.com

Client: Shanghai Minghua Power Technology Engineering Co Ltd

Page 1 of 1

ANALYTICAL REPORT NO: MLA005900.3

Operation:	Supplied Sample Received 30th September 2016	Job Number:	MLA005900
Product:	Gas Oil	Sample Number:	31672
Location:	Inspectorate Laboratory, Marsa	Date Received:	30-Sep-16
Sample Origin:	Labelled 'DE 47, Sample 1, 929'	Date Testing Complete:	03-Oct-16

Test	Method	Units	Result	Spec
Density @ 15°C	• ISO 12185:01	kg/l	0.8347	TBR
Low Heating Value	• ASTM D4868:10	KJ/kg	42910	TBR

The latest issue of the test methods have been used unless stated otherwise
Please refer to ASTM D3244-97 and IP method 367 Appendix E for utilisation of test data for conformance with specifications
Inspectorate Malta accepts no liability with respect to supplied samples

TBR = To Be Reported
This analysis certificate may not be reproduced other than in full except with the written permission of the laboratory
Results relate only to the sample tested

Chemist
Natasa Matis
Wayne Zammit
Pierre Duca

Justyn Hill - Laboratory Manager
Authorised Signatory for Inspectorate Malta Ltd



2016/09/29—100% load—LFO fuel of DE48



Inspectorate Malta Ltd
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MRS 1959, Malta
Tel: +356 2248 9700
Fax: +356 2123 7788
Email: operations.malta@inspectorate.com

Client: Shanghai Minghua Power Technology Engineering Co Ltd

Page 1 of 1

ANALYTICAL REPORT NO: MLA005900.4

Operation:	Supplied Sample Received 30th September 2016	Job Number:	MLA005900
Product:	Gas Oil	Sample Number:	31873
Location:	Inspectorate Laboratory, Marsa	Date Received:	30-Sep-16
Sample Origin:	Labeled 'DE 48, Sample 1'	Date Testing Complete:	03-Oct-16

Test	Method	Units	Result	Spec
Density @ 15°C	* ISO 12185:01	kg/l	0.8347	TBR
Low Heating Value	* ASTM D4868:10	KJ/kg	42910	TBR

The latest issue of the test methods have been used unless stated otherwise
Please refer to ASTM D3244-97 and IP method 367 Appendix E for utilisation of test data for conformance with specifications
Inspectorate Malta accepts no liability with respect to supplied samples

TBR = To Be Reported
This analysis certificate may not be reproduced other than in full except with the written permission of the laboratory
Results relate only to the sample tested

Chemist: Natasa Matis
Wayne Zammit
Pierre Duca

Justyn Hill - Laboratory Manager
Authorised Signatory for Inspectorate Malta Ltd



2016/9/29—100% load—Power meter recordings

Original Recording Table 100%

Project: Malta Delimara 3 Power Plant
Test Condition: DE45-DE48 plus STG

Test: Performance test
Test date:

Engine Number	DE45		DE46		DE47		DE48		STG
Name of measuring point	Power		Power		Power		Power		Power
Unit	MWh		MWh		MWh		MWh		MWh
Time		Time		Time		Time		Time	
15:20:00	233987.764	15:31:00	265351.236	15:32:00	344916.729	15:33:00	35343.934	15:24:00	208639.736
16:30:00	234004.429	16:31:00	265361.956	16:32:00	345013.397	16:33:00	353420.528	16:34:00	208645.395
17:30:00	234021.091	17:31:00	265384.580	17:32:00	345030.017	17:33:00	353447.239	17:34:00	208651.420
18:30:00	234037.753	18:31:00	265401.220	18:32:00	345046.660	18:33:00	353463.714	18:34:00	208657.251
18:50:00	234043.302	18:51:00	265406.739	18:52:00	345052.026	18:53:00	353469.277	18:54:00	208659.857
Remarks	Note: 1. All test instruments have been verified as effective and under the usage period.								

Recorder: [Signature]

Inspector: [Signature]

Independent Engineer: [Signature]
30/09/16

2016/9/29—100% load—Recordings from DCS

Original Recording Table

Project: Malta Delimara 3 Power Plant

Test: Performance test

Test Condition: DE45-DE48 plus STG

Test date: 29/09/2016

Load: 100%

Name Time	#45 Fuel oil temperature	#46 Fuel oil temperature	#45 Charge air coolant temperature	#46 Charge air coolant temperature	Sea Water temperature
15:30	29	28	40	41	23.35
15:40	29	28	40	40	23.48
15:50	29	28	40	40	23.42
16:00	29	28	40	41	23.42
16:10	28	28	40	40	23.39
16:20	29	28	40	41	23.36
16:30	29	28	40	40	23.42
16:40	29	28	40	41	23.45
16:50	29	28	40	40	23.45
17:00	29	28	40	41	23.45
17:10	29	28	40	41	23.48
17:20	29	28	40	40	23.48
17:30	29	28	40	40	23.45
17:40	29	28	40	41	23.45
17:50	29	28	40	41	23.42
18:00	29	28	40	41	23.42
18:10	28	28	40	40	23.39
18:20	28	28	40	40	23.39
18:30	28	28	40	41	23.42
18:40	28	28	40	41	23.42
18:50	28	28	40	41	23.45
Note: 1. All test instruments have been verified as effective and under the usage period.					

Recorder: 宋涛

Inspector: 薛明华

Independent Engineer: ASIN
30/09/16

Original Recording Table

Project: Malta Delimara 3 Power Plant

Test: Performance test

Test Condition: DE45-DE48 plus STG

Test date: 29/09/2016

Load: 100%

Name Time	#47 Fuel oil temperature	#48 Fuel oil temperature	#47 Charge air coolant temperature	#48 Charge air coolant temperature	Sea Water temperature
15:30	28	28	41	41	
15:40	28	28	39	41	
15:50	28	28	39	41	
16:00	28	28	41	41	
16:10	28	28	41	41	
16:20	28	28	41	41	
16:30	28	28	42	41	
16:40	28	28	39	41	
16:50	28	28	40	41	
17:00	28	28	39	41	
17:10	28	29	39	41	
17:20	28	29	41	41	
17:30	28	29	42	41	
17:40	28	28	40	41	
17:50	28	28	41	42	
18:00	28	28	42	41	
18:10	28	28	42	41	
18:20	28	28	40	41	
18:30	28	28	42	41	
18:40	28	28	41	42	
18:50	28	28	41	42	

Note: 1. All test instruments have been verified as effective and under the usage period.

Recorder: 陈伟

Inspector: 薛明华

Independent Engineer: ASD

30/09/16

2016/9/29—100% load—Recordings of ambient conditions

Original Recording Table

Project: Malta Delimara 3 Power Plant
Test Condition: DE45-DE48 plus STG

Test: Performance test (100%)
Test date: 29/09/2016

Time	P	T	H		
Unit	kpa	°C	%		
15:30	102.53	27.1	53		
15:40	102.56	26.8	53		
15:50	102.57	26.8	53		
16:00	102.50	26.8	54		
16:10	102.49	27.0	53		
16:20	102.50	26.8	54		
16:30	102.49	26.8	54		
16:40	102.49	26.5	54		
16:50	102.50	26.5	54		
17:00	102.46	26.3	55		
17:10	102.43	26.2	56		
17:20	102.49	26.3	54		
17:30	102.49	26.4	55		
17:40	102.48	26.3	56		
17:50	102.42	26.3	56		
18:10	102.40	26.2	55		
18:20	102.39	26.3	55		
18:30	102.40	26.4	57		
Remarks	Note: 1. All test instruments have been verified as effective and under the usage period.				

Recorder: Dai Kunpeng

Inspector: [Signature]

Independent Engineer: ATX
30/09/16

2016/9/29—100% load—Noise recordings

Original Recording Table

Project: Malta Delimara 3 Power Plant
Test Condition: DE45-DE48 plus STG

Test: Performance test
Test date: 29/09/2016

(100%)

Engine Number	DE45		DE46		DE47		DE48
Name of measuring point	Noise		Noise		Noise		Noise
Unit	dB		dB		dB		dB
Time	17:50	Time	17:55	Time	18:00	Time	18:10
Inside enclosure							
P1	103.5		104.3	1	104.6		105.3
P2	106.7		107.1		107.1		107.5
P3	105.8		106.6		105.7		107.0
P4	105.4		105.8		105.8		106.2
P5	105.0		105.9		105.8		105.6
P6	106.7		106.3		106.6		106.7
P7	108.2		108.6		108.6		108.5
P8	101.4		102.6		102.7		101.8
P9	100.9		101.4		101.7		101.2
Outside enclosure							
P10	77.6		77.4	77.4	77.7		78.8
P11	76.1		78.3		79.1		79.5
External noise							
P12	67.3						
P13	65.4						
Remarks	Note: 1. All test instruments have been verified as effective and under the usage period.						

Recorder: [Signature]

Inspector: [Signature]

Independent Engineer: [Signature]
30/09/16

2016/9/29—100% load—Emission recordings

Original Recording Table

Project: Malta Delimara 3 Power Plant
Test Condition: DE45-DE48 plus STG

Test: Performance test
Test date: 2016. 9. 29.

100%

Name of measuring point	SO ₂ ppm	CO ppm	NO ₂ ppm	NO ppm	O ₂ %
Unit	45, 46				
Time					
15:30	10	70.6	0.1	69.0	12.09
15:35	11	69.2	0.2	69.1	12.08
15:40	11	69.0	0.2	68.7	12.10
15:45	11	70.6	0.3	65.3	12.08
15:50	11	68.5	0.3	67.6	12.09
15:55	11	69.3	0.4	69.1	12.10
16:00	12	69.7	0.4	75.0	12.11
Remarks	Note: 1. All test instruments have been verified as effective and under the usage period.				

Recorder: 陈睿

Inspector: 黄明华

Independent Engineer: ATD
30/09/16

