BEFORE THE NATIONAL ELECTRIC
POWER REGULATORY AUTHORITY

PEITION FOR TARIFF DETERMINATION

ON BEHALF OF

MEKOTEX (PRIVATE) LIMITED

FOR A POWER PROJECT OF APPROXIMATELY 5.0 MW

AT

PLOT NO. D-15, S. I. T. E., KOTRI, DISTRICT JAMSHORO
SINDH

Submitted on:
December 26, 2014

MEKOTEX (PRIVATE) LIMITED
495-DEH LANDHI
MAIN NATIONAL HIGHWAY
LANDHI, KARACHI.
TEL: 021-3501 6357, 3501 5592
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LIST OF DOCUMENTS

Part I

Application and Basic Accompanying Documents

1. Application for Tariff Determination
2. Tariff Petition Fee
3. Affidavit
4. Resolution of Board of Directors

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Part III

Correspondence between Mekotex, NEPRA and the Power Purchaser and a copy of Schedule 1 to the PPA.

PART II – PROPOSED TARIFF SUMMARY

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A. **Glossary**

CEO	Chief Executive Officer
CPPA	Central Power Purchase Agency of NTDC
FSA	Fuel Supply Agreement
SPP	Small Power Producer
IRR	Internal Rate of Return
ISO	International Standards Organization
KIBOR	Karachi Inter-Bank Offered Rates
KV	Kilovolt
KW	Kilowatt
KWh	Kilotwatt per Hour
L/C	Letter of Credit
LHV	Lower Heating Value
LOI	Letter of Intent
MW	Megawatt
MWh	Megawatt per Hour
NEPRA	National Electric Power Regulatory Authority
NTDC	National Transmission & Dispatch Company Limited
O&M	Operation & Maintenance
PKR	Pakistani Rupee
PPA	Power Purchase Agreement
Project	MEKOTEX proposed small power product of approximately 9.8 MW capacity based on reciprocating engine single fuel natural gas fired technology at Plot: D-15, S.I.T.E., Kotri, District Jamshoro, Sindh.
ROE	Return on Equity
US$	United States Dollar
WAPDA	Water & Power Development Authority
HESCO	Hyderabad Electric Supply Company Limited
MPL	Mekotex (Private) Limited

F/I

B. **Introductory Remarks**

- This tariff petition is being filed before NEPRA pursuant to Rule 6(1)(a) of the NEPRA Licensing (Generation) Rules, 2000, and Rule 3 of the NEPRA (Tariff Standards & Procedure) Rules, 1998, read with Paragraph 1.3 of Guidelines for Determination of Tariff for Power Producers issued by the Government of Pakistan in November 2005.

- Since there has been change in specification of our power plant, the petition is filed as per the new power plant. Modification in the generation license would be applied after the determination of tariff, with consideration to economically viable tariff.

- The LOI issued under the SPP policy and it is an enhancement of PPA which was signed between HESCO and MPL on 10.06.2011 for 4.0 MW from MPL, S.I.T.E., Kotri.

- The determination of tariff by the Authority vide its determination under interim power procurement (Procedures & Standards) Regulations 2005 (NO: NEPRA/PAR-85) dated March 22, 2013, the Authority revised the tariff downward from the original PPA.

- A grieved by the tariff MPL discontinued its supply to HESCO as the determined tariff was not viable to supply electricity hence did not further enhanced agreement tenure.

- In response to the reconsideration the detail of the tariff along with OEM recommendation for the O&M are submitted hereby in the subsequent pages of this tariff petition.

- The petition is divided into 3 parts:

    - Fuel Cost Components
    - Operation & Maintenance (O&M)
    - Return on Equity / IRR

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C. Particulars of Petition

1. DETAILS OF THE PETITIONER

Name & Registered Office

MEKOTEX (PRIVATE) LIMITED
495-DEH LANDHI
MAIN NATIONAL HIGHWAY
LANDHI, KARACHI.
TEL: 021-3501 6357, 3501 5592
FAX: 021-3501 6649
E-MAIL: info@mekotex.com

Representatives of MEKOTEX (PRIVATE) LIMITED

i.	Mr. Muhammad Shoaib	Director
ii.	Mr. S. Tariq Aziz	Technical Director
iii.	Mr. M. Tariq Zafar	Technical Manager

2. BACKGROUND

2.1 Under the Regulation of Generation, Transmission and Distribution of Electric Power Act (Act No. XL) of 1997 (the "NEPRA ACT"), NEPRA is the authority *inter alia* competent to determine tariff's and other terms and conditions of the supply of electricity through generation, transmission and distribution. NEPRA is also the competent authority for determining the process and procedures for reviewing tariffs and recommending tariff adjustments.

2.2 MPL is a private limited company incorporated and existing under the Companies Ordinance, 1984.

2.3 In accordance with the requirements of NEPRA Act and the rules and regulations made thereunder, MPL hereby submits this Petition under the NEPRA (Tariff Standards and Procedure) Rules 1998, for tariff determination in respect of its power generation facility situated at Plot No. D-15, S.I.T.E., Kotri, District Jamshoro, in the Sindh province.

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3. INTRODUCTION

3.1 Pursuant to LOI, MPL requested HESCO several times to file a review petition against the tariff determined by the NEPRA for MPL against the PPA signed dated 10.06.2011 but HESCO refused to file a review petition as it was a beneficiary in the tariff determined by NEPRA and it was against their interest to file a review petition.

3.2 The Petition is divided into 3 parts:

3.2.1 Fuel Cost Components
3.2.2 Operation & Maintenance (O&M)
3.2.3 Return on Equiry / IRR

4. PLANT DETAIL

GE JENBACHER JMS-620 GS-n.l =04= UNITS
Gas Fired Engine
Each 3.3 MW

5. TARIFF

The petition is divided into 3 parts:

5.1 Fuel Cost Components
5.2 Operation & Maintenance (O&M)
5.3 Return on Equity / IRR

5.1.1 Fuel cost is a major cost component constituent of a thermal power plant. In the tariff determined by NEPRA, the Authority had thoroughly investigated the plants in order to assess the actual efficiency of the power plant. Based thereon NEPRA's technical professional suggested the following efficiency levels:

- GE Jenbacher 620F GS. NL F01 43% on Combined Cycle
- GE Jenbacher 620F GS. NL F01 37.5% on Simple Cycle

5.4 Having considered the above recommendation, the Authority has decided to determine the reference fuel cost component in the instant case. Accordingly on the basis of HHV gas price of Rs. 238.38/MMBtu, LHV-HH Factor of 1.1076 and 37.5% thermal efficiency (HR 9.101 Btu/KWh), the reference fuel cost component works out Rs. 2.4030/KWh on simple cycle. On the basis of current applicable gas price of Rs. 573.28/MMBtu, the fuel cost component will be Rs. 6.896/KWh.

5.5 In future the reference fuel cost component will be subject to adjustment for gas price variation as notified by OGRA or any other competent authority from time to time according to the following mechanism:

GCC (Rev)	=	GCC(Ref) x GP(Rev) / GP(Ref)
Where:		
GCC(Ref)	=	Revised gas cost component amount applicable for the billing cycle
GCC(Ref)	=	Reference gas cost component
GP(Rev)	=	Revised gas price, excluding General Sales Tax applicable for the billing cycle as notified by OGRA for new captive power producers
GP(Ref)	=	Reference gas price i.e. Rs. 238.38/MMBtu(HHV)

5.6 Degradation will be allowed as per manufacturer's degradation curves. Degradation curve is attached herewith for the approval of the Authority.

5.7 It is pertinent to point out that the uniformity of the gas supplied by SSGC is a factor, which needs reconsideration. The subject is not entertained by SSGC hence thermal efficiency of the plant is always in question and the Authority requested to give cushion to the power producers for such irregularity of the SSGC.

5.8 The petitioner accepts the efficiency worked out by the Authority provided the degradation curve and the authenticity of the gas supplied is scattered for.

O & M

5.2.1 In its determination dated 22.03.2013, on non-availability of the data, the authority had imposed O&M of Liberty Powertec Ltd., which is a RFO based reciprocating plant of over 200 MW and cannot be made based for the O&M of a gas based power plant.

It is divided into three component i.e. fixed cost component, variable cost component and insurance.

Fixed Cost Component

Fixed Cost Component comprises of:

a) Salaries & Wages
b) Administration Cost

Variable Cost Component

Variable Cost Component consists of the following:

a) Electric Duty
b) Oil & Lubricants
c) Scheduled Maintenance advised by OEM
d) Water
e) Auxiliary Maintenance

Fixed Cost Component			
Salaries & Wages	Annexure 'A'		0.20
Administration Cost	Annexure 'B'		0.17
Variable Cost Component			
Electric Duty			0.03
Oil & Lubricant	Annexure 'C'		0.15
Scheduled Maintenance		2,000 Hrs	0.24
		6,000 Hrs	0.12
		10,000 Hrs	0.06
		20,000 Hrs	0.11
		30,000 Hrs	0.51
		60,000 Hrs	0.26
Water	Annexure 'D'		0.13
Auxiliary Maintenance			0.03
Incidental Maintenance			0.10
Depreciation	Annexure 'E'		0.78
Insurance			0.10
Total...:			**2.99**

Note: The schedule maintenance is as per list attached (Annexure 'F') provided by the OEM. The total OEM cost will have to be subject to adjustment vis-à-vis the dollar – rupee parity for imported portion of the O&M and to the inflation stated by the State Bank of Pakistan.

5.3.1 Return on Equity / ROE

The Authority in the cases of IPP has allowed 15% internal rate of return (IRR) to IPPs, which translate approximately equal to return on equity / ROE of 17%. In the instant case instead of 15% IRR, 17% ROE has been used for ROE component. Approximately US $560 is considered as per KW cost and since no debt servicing is being considered in the said determination therefore 100% equity is considered for the calculation of ROE.

US $560 x PKR 100.00 = PKR 56,000/- x 17% = PKR 9,520/-

Units dispatched during the year 8,760 x 75% = 6,570

PKR 9,520 / 6,570

Return on Equity / ROE = PKR 1.449

PROPOSED TARIFF SUMMARY

Gas Cost Component	6.896
Fixed Cost Component	0.37
Variable Cost Component	1.74
Insurance	0.10
Return on Equity	1.449
Net	10.555

F/B

IT IS PRAYED THAT THE PROPOSED TARIFF (AS BELOW) IN THE PETITION SUBMITTED MAY PLEASE BE APPROVED BY THE AUTHORITY AND AGREEMENT BETWEEN MEKOTEX & HESCO MAY SIGN AND SUPPLY BETWEEN THE PARTIES MAY RESUME AT THE EARLIEST.

Gas Cost Component	6.896	KW H
Fixed Cost Component	0.37	KW H
Variable Cost Component	1.74	KW H
Insurance	0.10	KW H
Return on Equity	1.449	KW H
Net	10.555	KW H

SALARIES & WAGES

Annexure 'A'

SALARIES & WAGES	UNIT	
CHIEF ENGINEER	RS. / MONTH	75,000
SHIFT SUPERVISORS (x 3)	RS. / MONTH	90,000
SHIFT OPERATORS (x 4)	RS. / MONTH	100,000
SHIFT TECHNICIANS (x 8)	RS. / MONTH	120,000
ADDITIONAL BENEFITS	RS. / MONTH	96,250
TOTAL SALARIES & WAGES INCLUDING BENEFITS	**RS. / MONTH**	**481,250**
PER KWH COST	**RS. / KW**	**0.20**

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ADMINISTRATION

Annexure 'B'

ADMINISTRATION	UNIT	
SECURITY		
GUNMEN (x 1)	RS. / MONTH	20,000
SECURITY GUARDS (x 2)	RS. / MONTH	36,000
OFFICE STAFF		
MANAGER	RS. / MONTH	50,000
OFFICE CLERKS	RS. / MONTH	20,000
BENEFITS	RS. / MONTH	31,500
ENTERTAINMENT	RS. / MONTH	75,000
MISCELLEANOUS EXPENSE	RS. / MONTH	100,000
OFFICE EXPENSE (INCL. CONVEYANCE, STATIONERY ETC.)	RS. / MONTH	70,000
ADMINISTRATION COST INCLUDING BENEFITS	**RS. / MONTH**	**402,500**
PER KWH COST	RS. / KW	0.17

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LUBE OIL ANALYSIS

Annexure 'C'

LUBE OIL CHANGE ANALYSIS	UNIT	
LUBE OIL CHANGE INTERVAL (Subject to S. O. S.)	HOURS	1,200
LUBE OIL CAPACITY	LITERS	765
RATE OF OIL PER LITER	LITER	426
TOTAL COST OF OIL ON 2,000 HOURS	RS.	325,890
PER KWH COST	RS. / KWH	0.09
PER HOUR COST	RS. / HR.	271.58
LUBE OIL MAKEUP ANALYSIS	**UNIT**	
LUBE OIL CONSUMPTION IN 24 HOURS	LITERS	10
LUBE OIL CONSUMPTION (Practical)	LITER / HR.	0.4166
PER KWH COST	**RS. / KW**	**0.06**
PER HOUR COST	**RS. / HR**	**177.471**

LUBE OIL CHANGE & MAKEUP TOTAL	RS. / KWH	0.15

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WATER CONSUMPTION ANALYSIS

Annexure 'D'

WATER CONSTUMPTION ANALYSIS	UNIT	
WATER REQUIRED PER MW / PER DAY	GALLONS	5,000
COST PER GALLON	RS. / GALLON	0.45
COST OF WATER FOR EACH MW FOR 24 HOURS	RS. / MW	2,250
PER KWH COST	**RS. / KWH**	**0.093**
WASTAGE & OTHER CONSUMPTION INCLUDES	**RS. / KWH**	**0.10**
COOLING WATER TREATMENT (CHEMICALS)	RS. / KWH	0.03
PER KWH COST	**RS. / KW**	**0.13**

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SCHEDULE OF DEPRECIATION

Annexure 'E'

SCHEDULE OF DEPRECIATION	UNIT	
PER KW INVESTMENT	US $	560
CONVERSION RATE OF PAK RS.	RS.	100
PER KW IN PAK RUPEES	RS.	56,000
DEPRECIATION @ 10% PER ANNUM	RS.	5,600
TOTAL NO. OF WORKING DAY IN AN YEAR	DAYS	300
DEPRECIATION COST PER DAY	RS. / DAY	18.66
DEPRECTIATION PER KWH	**RS. / HR.**	**0.78**

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F/D

Mekotex (Private) Limited

(Textile Spinning, Weaving, Denim, Processing & Printing Mills)

CERTIFIED TRUE COPY OF THE RESOLUTION PASSED ON DECEMBER 24, 2014 BY THE BOARD OF DIRECTORS OF MEKOTEX (PRIVATE) LIMITED

Now, therefore, it is hereby resolved that Mr. M. Shoaib Majeed, Director of the M/s. Mekotex (Private) Limited (herein after referred to as the 'Company'), holding CNIC No. 42201-2122052-3 be and is hereby authorized individually to sign, apply, negotiate, deposit fees and submit documents with the National Electric Power Regulatory Authority in the matter of Tariff Petition filed by the Company.

Further resolved that Mr. M. Shoaib Majeed, Director of the Company is hereby authorized and empowered to do all other things, acts and deeds necessary / incidental and to take any and all steps as he deems expedient for the above said purpose.

Resolved further that certified copy of this Resolution be communicated to whom it may concern and shall remain enforce until notice in writing to the contrary be given.

For MEKOTEX (PRIVATE) LIMITED

MEKOTEX (PRIVATE) LTD. KARACHI

Company Secretary

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HYDERABAD ELECTRIC SUPPLY COMPANY

HESCO OFFICE OF THE CHIEF EXECUTIVE OFFICER HESCO HYDERABAD

No. CEO/HESCO/CE(P&E)/DM(SPP)/ 122-25 Dated 08 01 2013

M/s Mekotex (Pvt) Limited,
Plot No. 495,501 & 504 Deh Landhi,
Main National Highway,
KARACHI.

Subject:- LETTER OF INTENT (LOI) "UNDER SPPs POLICY"- FOR ENHANCEMENT OF POWER PURCHASE FROM 4.00 MW TO 9.8 MW (GAS BASED) AT 11 KV BY HESCO FROM M/S MEKOTEX (PVT) LIMITED SITE KOTRI, SINDH.

Reference:-
i. Your letter No. 002-235-12-13/12 dated 21.12.2012
ii. Policy Framework approved by BOD PEPCO received from MD(PEPCO) No.MD/PEPCO/CPPA/F.22/2573-85 dated 20.06.2009 for purchase of power by DISCO from Small Power Producers (SPPs)

1. In terms of the above referred (SPP) policy, Hyderabad Electricity Supply Company (HESCO) hereby intends to purchase enhanced magnitude of Power from 4.00 MW to 9.8 MW (Gas Based) at 11 KV voltage level at 132 kV Grid Station Kotri Site, from existing Generation facility of M/s Mekotex (Pvt) Limited, site Kotri Sindh. HESCO BOD in its 88th meeting duely approved the proposal for the said enhanced Power purchase, providing following provisions by your firm at your own level

   i. **Modification in Generation License from NEPRA.**
   ii. **NOC from Sui Southern Gas Company Ltd. (SSGCL)**
   iii. **You have to implement the conditions as mentioned in (SSGCL) letter No.SALES/PG-1156/12 dated 16.11.2012.**

2. Enhancement of Power will be signed by HESCO Subject to permission of Power acquisition from NEPRA under SRO 265(1)/ 2005 dated 16.03.2005 & tariff determination from NEPRA .

3 HESCO is issuing this Letter of Intent (LOI) in-order to provide a level of comfort to M/s Mekotex (Pvt) Limited site Kotri, Sindh for Enhancement of power from 4.00 MW to 9.8 MW at 11 KV level, initially for a period two (02) years from COD on take and pay basis.

4. In the mean time, under SPP policy framework power acquisition request will be submitted under Interim Power Procurement (Procedures

Mekotex (Original)

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and Standards) Regulations, 2005, for determination of tariff to NEPRA Subject to the fulfillment of sub point ii & iii of Para 1

6 The Power Enhancement will be finalized in the light of issuance of Power Acquisition permission to HESCO, as per tariff determination by NEPRA.

7 This letter of intent (LOI) has been issued in duplicate on the date hereof and shall come into effect when one copy hereof is received duly signed by M/s Mekotex (Pvt) Limited site Kotri, Sindh Nevertheless this letter of intent (LOI) shall lapse if the copy is not received at HESCO within 15 days.

Chief Executive Officer
M/s Mekotex (Pvt) Limited
Site Kotri, Sindh

Chief Executive Officer
HESCO, Hyderabad

C.C To:-

1. Secretary, Ministry of Water and Power, Government of Pakistan, Islamabad.
2. Managing Director PEPCO, WAPDA House, Lahore.
3. C.O.O. (CPPA) 107-Wapda House, Lahore.
4. Master file.

ANNEXURE F

JENBACHER NATURAL GAS GENERATOR SET
MODEL JGS620 GS.N.L. Version F
MAINTENANCE SCHEDULE
0 - 60000 HOURS SPARE PARTS LIST
ENGINE QTY: 1

S.NO	Part #	Description	QTY	Unit Price (EURO)	2000 hrs	6000 hrs	10000 hrs	20000 hrs	30000 hrs	60000 hrs
		CONSUMABLE								
		IGNITION SYSTEM								
	436782	Spark Plug	28	259.82	7,275					
	102981	Sealing ring	28	1.04	29					
		FILTERS								
		OIL FILTER								
	245488	Filter Cartidge(Oil Filter)	0.5	542.19	271					
	281808	Gasket Set(For Oil Filter 245488)	0.5	161.96	81					
	456718	Oring	0.5	17.34	9					
		AIR FILTERS								
	397000	Air Filter	3	263.61	790.8					
		CRANKCASE VENT								
	9002245	Breather Filter (Blow By Seprator Or Fiter)	1	3,467.68		3,467.7				
	105849	Breather Filter Oring	1	6.79		6.8				
		GAS COMPRESSOR								
	340464	Gas Compressor Intake Gas Filter	1	764.90	764.9					
		GAS PRESSURE CONTROL								
	263174	Filter Cartridge	1	183.06	183.1					
	282800	Gaket set	1	42.09	42.1					
		PRECHMBER VALE								
	389588	Precombustion Chamber Gas Valve	20	546.85		10,937.1				
	211513	protective Cap(Safety Cap)	20	2.75		55.0				
		GAS TRAIN								
	267789	Filter Cartridge	1	455.91			456			
	267793	Gasket Set	1	69.03			69			
		CYLINDER HEAD								
	456736	Cylinder Head Tapet Cover Gasket	20	37.20	743.9					
		INTERCOOLER								
	280486	Sealing/Gasket	2	4.55		9				
	306985	Sealing/Gasket	2	7.80		16				
	362337	Sealing/gasket	3	110.07		330				
	379932	Sealing/gasket	1	21.85		22				
		FLAME PROTECTOR								
	381101	Sealing/Gasket	8	1,233.63						
		SUCTION LINE								
	449408	Pivot Point	1	63.89			64			
	449407	Pivot Point	1	63.89			64			

	456745	Oring	2	2.57			5				
	128604	Bearing (Bushing)	2	46.76				94			
	111841	Bearing (Bushing)	2	12.76				26			
	456745	Oring	2	2.57				5			
		PRECOMBUSTION CHAMBER									
	438604	Pre Combustion Chamber	20	234.37			4,687				
	438603	Pre Combustion Chamber	20	687.84							
		PRECHAMBER SLEEVE									
	319744	Oring	40	16.80			672				
	319743	Oring	20	11.24			225				
	438602	Sealing Ring	20	4.71			94				
	456735	Oring	20	2.10			42				
		TURBOCHARGER (TPS)									
	237224	Sealing/Gasket	2	163.82			328				
	386389	Sealing/Gasket	2	27.04			54				
	456731	Oring	2	11.03			22				
	457375	ORING	4	0.66			3				
	385264	ORING	2	83.02			166				
	400371	Sealing /Gasekt	2	6.52			13				
	456748	Oring	3	31.81			95				
	274661	Gasket	3	3.12			9				
	196526	Oring	12	19.38			233				
	387627	Gaket	12	6.65			80				
	107746	Gasket	8	68.56			548				
	100361	Hexagonal Head Screw	64	1.01				65			
	101855	Hexagonal Nut	64	0.42				27			
	586829	Stud Bolt	24	14.18				340			
	110971	Hexagonal Nut	24	4.70				113			
		STARTER									
	1201866	Starter	3	994.60			2,984				
		CONROD									
	363680	Connecting Rod Bearing(Big end bearing)	20	598.16					11,963	11,963	
	184310	Connecting Rod Bolt	80	13.43					1,075	1,075	
	395986	Connectin Rod Bushing	20	531.70					10,634	10,634	
	9008070	Connecting Rod	20	3,776.67					75,533	75,533	
		JACKET WATER PUMP									
	477003	Sealing Kit	1	945.63			945.6				
	470874	Sealing Kit	1	666.95			667.0				
	101790	GASKET	3	5.17			15.5				
	634478	Bearing Set	2	214.54					429	429	
	545592	Bearing Set	2	256.52					513	513	
		SPARK PLUG EXTENSION									
	319737	Spark Plug Extension Oring	20	23.23			465				
		TORSION VIBRATION DAMPER									
	236761	Vibration Damper	2	1,989.90				3,980			
	304741	Hexagonal Head Screw	12	11.96				144			
		GAS MIXER VALVE									
	342542	Position Indicator	1	313.65				314			
	246184	Servomotor	1	759.07					759	759	
	114530	Hose	2	0.51					1	1	
	235894	Threaded rod	8	11.73					94	94	

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	397978	Nut	8	5.53						44	44
	101895	Washer	8	0.42						3	3
	101330	Screw	8	0.42						3	3
	387308	Flexible coupling	2	135.26						271	271
	195243	Stiffening Plate	2	84.88						170	170
	210930	Cap	2	168.14						336	336
	101337	Clinder Screw	4	0.42						2	2
		ALTERNATOR BEARING									
	457932	Bearing Set for Alternator	1	33,000.00				33,000			
		ALTERNATOR COUPLING									
	285621	Coupling Element	1	4,815.58				4,816			
		MISCELLANEOUS/ELASTOMER PARTS									
	165120	Oring	2	0.82							2
	497554	Oring	20	6.76				135			
	456748	Oring	21	31.81				668			
	221468	oring	2	2.96						6	6
	382009	Hose	2	2.13				4			
	200593	Hose	2	16.67				33			
	106946	Hose	3	45.71				137			
	271618	Hose Pipe	4	74.51				298			
	104215	Hose Pipe	1	20.21				20			
	104233	Hose Pipe	3	33.00				99			
	114530	Hose	2	0.51				1			
	358122	Hose	1	21.09				21			
	287169	Gasket	2	6.37						13	13
	402169	Gasket	1	31.95						32	32
	405221	Gasket	1	8.58						9	9
	237510	Gasket	1	43.73						44	44
	104137	Gasket	6	2.71						16	16
	103143	Gasket	6	1.53						9	9
	100606	Gasket	23	2.70						62	62
	469675	Gasket Set	1	101.33						101	101
	240792	Gasket	4	13.64						55	55
	240789	Gasket	5	5.98						30	30
	240531	Gasket	20	30.13							603
	100822	Sealing Ring	1	0.42							0
	105829	Oring	2	3.82							8
	103012	Cylinder Pin	2	0.78							2
	100843	Sealing Ring	3	1.04							3
	100829	Sealing Ring	2	1.83							4
	342358	Gasket	2	5.46							11
	101790	Gasket	10	5.17							52
	238066	Oring	1	8.70							9
	236875	Oring	1	33.23							33
	236907	Oring	2	2.39							5
	387625	Gasket	2	19.12							38
	390900	Gasket	1	6.52							7
	397487	Gasket	2	1.06							2
	341813	Gasket	1	46.41							46
	387359	Gasket	2	5.46							11
	294887	Oring	1	21.42							21

	107746	Gasket	2	68.56						137
	101235	Gasket	2	31.95						64
	400371	Gasket	2	6.52						13
	148358	Gasket	1	20.03						20
	326951	Gasket Set	1	127.33						127
	112141	Gasket	1	2.92						3
		OIL PUMP								
	196526	Oring	1	19.38					19	19
	R415097	Gear Wheel Pump	1							
	546037	Bushing	2	40.34					81	81
	100839	Sealing Ring	1	0.66					1	1
		NOZZLE OF PISTON COOLING SYSTEM								
	105777	O-ring	20	2.45					49	49
		PISTON								
	610058	Piston A bank	10	5,630.61					56,306	56,306
	610059	Piston B bank	10	5,630.61					56,306	56,306
	232330	Plain Compression Ring	20	276.34						
	361319	Tapered compression piston ring	20	134.21						
	363977	Scrapper Ring	20	157.64						
	228387	Piston Pin	20	376.62					7,532	7,532
	161438	Snap Ring	20	1.38					28	28
		LINER								
	369114	Liner	20	775.39					15,508	15,508
	311221	Scraper Ring	20	201.48					4,030	4,030
	319742	Liner Orings	60	28.75					1,725	1,725
		CRANKSHAFT								
	373131	Thrust Bearing(Wearing Ring)	2	171.52					343	343
	419414	Main Bearing	11	580.67					6,387	6,387
		CYLINDER HEAD								
	334781	Intake Valve	40	275.15					11,006	11,006
	356699	Intake Valve Seat Ring	40	64.24					2,570	2,570
	100261	Valve Cone Piece	160	6.03					965	965
	119725	Valve Spring Cup(Disk)	80	12.83					1,026	1,026
	456738	Oring	80	1.27					102	102
	174479	Valve Spring	80	10.03					802	802
	174481	Valve Spring	80	13.88					1,110	1,110
	274054	Rotocap	80	162.71					13,017	13,017
	334782	Exhaust Valve	40	317.73					12,709	12,709
	338039	Exhaust Valve seat Ring	40	73.94					2,958	2,958
	274090	Washer	80	3.54					284	284
	102307	Snap Ring	80	1.38					111	111
	184157	Locking Ring	20	1.38					28	28
	174461	Oring	20	1.90			38			
	190299	Value Guide	80	17.83					1,427	1,427
	376475	Oring	20	10.47			209			
	337295	Head Gasket	20	89.55					1,791	1,791
	102988	Cylinder Pin	40	0.42					17	17
		DISMANTLING PARTS								
	460071	Cylinder Head Ehaust Manifold Gasket	20	17.30						
	112197	Cylinder Head Water Gasket	40	2.74						

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	407289	Spacer Sleeve	1	22.56						23
	102317	Snap Ring	1	0.86						1
	128442	Oring	1	0.47						0
	456746	Oring	1	104.71						105
	339618	Gasket	4	1.69						7
	100819	Sealing Ring	1	0.42						0
					10,190	15,245	19,263	22,539	311,521	321,158
				INTERVALS	30	10	6	3	1	1
					305,686	148,433	79,519	133,017	311,521	321,158
					Total Parts Cost upto 60000 hours (euro)					1,299,334

NOTE:- Air Filters/Breather Filters,Alternator Coupling and Alternator Bearing/Piston with accessories/Liner with accessories depends upon respective engine which is actually demanded.
Turbo charger internal parts for e.g. overhauling kits, cartridge replacments are not included. This will be served by ABB directly.
Part numbers may vary which could give an impact of 5% plus minus on the financials.

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SSGC

Sui Southern Gas Company Limited

Sales/NOC-PG-1156/13
3.4.2013

Mr. Muhammad Shoaib
Director
M/s Mekotex (Private) Limited
Head Office, Unit No. 1, Plot Nos. 495,501 &504
Deh Landhi / Main National Highway
Karachi

Subject: NOC / Permission to Sell Surplus Power to HESCO from approved Gas load of 3.9 MMCFD for Captive Power Generation At Plot No. D/15, SITE Kotri (Account No.336585 1000)

Dear Sir,

This is with reference to your letter dated 20.3.2013 and our letter No. Sales/6 & 7/Mekotex dated 8.9.2011 on the noted subject. We are pleased to inform that this NOC is also valid for total approved gas load of 3.9 MMCFD according to terms and conditions mentioned therein. Energy efficiency audit will be conducted during/after commissioning of the plant to assess the actual efficiency.

Assuring you of our best services, we remain,

Yours sincerely,

SHAKIR ALEEM
ACTG GENERAL MANAGER (SALES)

SSGC House, Sir Shah Suleman Road, Gulshan-e-Iqbal, P.O. Box 17589 Karachi-75300
PABX Telephone : 99231000, Fax 92-21-99231560 Website : www.ssgc.com.pk

Attn: Mr. Quddus
Manager SPP

SSGC

Sui Southern Gas Company Limited

Sales/NOC/Mekotex
08 September 2011

Mr. M Shoaib Majeed (Director)
M/s Mekotex (Pvt) Limited
Plot No. 495, 501 & 504 Deh Landhi
Main National Highway
Karachi,
Pakistan.

ABU KALID MOOSA MEMON
NOTARY PUBLIC

Subject: **Transfer of NOC to sell Surplus Power.**

This refers to your request on the subject noted above.

We are pleased to inform that your request for transfer of NOC from M/s Sapphire Textile Mills Limited to M/s Mekotex (Pvt) Ltd has been approved by the management on following conditions:

- If due to any reason / during any audit it is observed that gas is not being used for the purpose for which allocation of gas was made, SSGC reserves the right to withdraw gas allocation / NOC granted for sale of surplus gas.
- This NOC will automatically become invalid if NEPRA / Ministry of Petroleum and Natural Resources withdraws its policy of sale of surplus power to HESCO or Power (Electricity) Distribution Companies.
- That all the terms and conditions governing Allocation of gas for Captive Power generation mentioned in Sui Southern Gas Company Limited's letter bearing reference no. Sales / PG-856/07 dated 25 June 2007 shall apply mutatis mutandis. Copy enclosed for ready reference.

Assuring of our best services, we remain,

Yours sincerely,

Muhammad Ahmed Siddiqui
A/ General Manager (Sales)

ATTESTED
08 SEP 2011
ABU KALID MOOSA MEMON

SSGC

Sui Southern Gas Company Limited

SALES DEPARTMENT : ST-4/D, Block 14, Sir Shah Sulaiman Road, Near Civic Centre, Gulshan-e-Iqbal, Karachi-75300 Tel : 9231600 Fax : 9231680

Sales/NOC-PG-856/2008
May 7, 2008

General Manager
Administration
[illegible] Textile Mills Ltd. (Unit-2)
Plot No. A-17, S.I.T.E., Kotri
District Jamshoro

Subject: NOC/Permission to Sell Surplus Power to HESCO from approved Gas load of 0.905MMCFD for Captive Power Generation Customer No. 2365851000

This is with reference to your letter dated April 21, 2008.

We are pleased to inform that your request to sell surplus power to HESCO from your approved gas based Captive Power Generation has been approved by the management of SSGC under Ministry of Petroleum & Natural Resources directives vide their letter No. NG(I)-2(177)/03 dated April 8, 2008.

NOC is granted subject to following conditions:

1. This NOC will automatically become invalid if NEPRA withdraws its policy of sale of surplus power to HESCO.
2. All other terms and conditions governing Allocation of gas for Captive Power generation will remain same as mention in our letter Sales/PG-856/07 dated June 25, 2007.

Assuring you of our best services, we remain,

Yours sincerely,

Zeeba Alvi
ZEEBA ALVI
GENERAL MANAGER (SALES)

Hanif Tela
Meeko lei 2

A917327

100
Rupees

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روپیہ

F/E

میکوٹیکس پرائیویٹ لمیٹڈ پلاٹ نمبر 11 سائٹ ایریا کراچی

548
25/03

KAMRAN LAIQ
Govt. Stamp Vendor
Session Court
License # 47

AFFIDAVIT

I, MUHAMMAD SHOAIB S/O. ABDUL MAJID, Director, MEKOTEX (PRIVATE) LIMITED, resident of 210-B, Adamjee Nagar, Karachi holding CNIC: 42201-2122052-3 hereby declare that all the information provided in the petition are either received from Original Equipment Manufacturer (OEM) or the leading suppliers of the equipment and auxiliaries.

Information provided in the petition is correct and true to the best of my knowledge.

For MEKOTEX (PRIVATE) LIMITED

Muhammad Shoaib

LAIQ AHMED
NOTARY PUBLIC
HYDERABAD

ATTESTED
LAIQ AHMED
ADVOCATE/NOTARY PUBLIC

Technical Description

Cogeneration Unit

JMS 620 GS-N.L

Mekotex 2x620

Electrical output	3354 kW el.
Thermal output	1966 kW

Emission values

NOx < 500 mg/Nm³ (5% O2)

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0.01 Technical Data (at module)

Data at:				Full load	Part Load	
Fuel gas LHV		kWh/Nm³		8,7		
				100%	75%	50%
Energy input		kW	[2]	7.707	5.941	4.175
Gas volume		Nm³/h	*)	886	683	480
Mechanical output		kW	[1]	3.431	2.573	1.715
Electrical output		kW el.	[4]	3.354	2.508	1.656
Recoverable thermal output						
~ Intercooler 1st stage		kW		1.124		
~ Lube oil		kW		310		
~ Jacket water		kW		532		
~ Exhaust gas cooled to 390 °C		kW		~		
Total recoverable thermal output		kW	[5]	1.966		
Total output generated		kW total		5.320		
Heat to be dissipated						
~ Intercooler 2nd stage		kW		~		
~ Lube oil		kW		~		
~ Surface heat	ca.	kW	[7]	234		
Spec. fuel consumption of engine		kWh/kWh	[2]	2,25		
Lube oil consumption	ca.	kg/h	[3]	1,03		
Electrical efficiency		%		43,5%		
Thermal efficiency		%		25,5%		
Total efficiency		%	[6]	69,0%		
Hot water circuit:						
Forward temperature		°C		85,0		
Return temperature		°C		60,0		
Hot water flow rate		m³/h		68,5		

*) approximate value for pipework dimensioning
[_] Explanations: see 0.10 - Technical parameters

All heat data is based on standard conditions according to attachment 0.10. Deviations from the standard conditions can result in a change of values within the heat balance, and must be taken into consideration in the layout of the cooling circuit/equipment (intercooler; emergency cooling; ...). In the specifications in addition to the general tolerance of +/- 8% on the thermal output a further reserve of 10% is recommended for the dimensioning of the cooling requirements.

Main dimensions and weights (at module)

Length	mm	~ 8.900
Width	mm	~ 2.200
Height	mm	~ 2.800
Weight empty	kg	~ 36.600
Weight filled	kg	~ 37.700

Connections

Hot water inlet and outlet	DN/PN	100/10
Exhaust gas outlet	DN/PN	600/10
Fuel gas (at gas train)	DN/PN	100/16
Fuel Gas (at module)	DN/PN	100/10
Water drain ISO 228	G	½"
Condensate drain	DN/PN	50/10
Safety valve - jacket water ISO 228	DN/PN	2x1½"/2,5
Safety valve - hot water	DN/PN	80/10
Lube oil replenishing (pipe)	mm	28
Lube oil drain (pipe)	mm	28
Jacket water - filling (flex pipe)	mm	13
Intercooler water-Inlet/Outlet 1st stage	DN/PN	100/10
Intercooler water-Inlet/Outlet 2nd stage	DN/PN	65/10

Output / fuel consumption

ISO standard fuel stop power ICFN	kW	3.431
Mean effe. press. at stand. power and nom. speed	bar	22,00
Fuel gas type		Natural gas
Based on methane number|Min. methane number	MZ d)	94|80
Compression ratio	Epsilon	10,50
Min. fuel gas pressure for the pre chamber	bar	4,2
Min./Max. fuel gas pressure at inlet to gas train	mbar	250 - 550 c)
Allowed Fluctuation of fuel gas pressure	%	± 10
Max. rate of gas pressure fluctuation	mbar/sec	10
Maximum Intercooler 2nd stage inlet water temperature	°C	60
Spec. fuel consumption of engine	kWh/kWh	2,25
Specific lube oil consumption	g/kWh	0,30
Max. Oil temperature	°C	80
Jacket-water temperature max.	°C	95
Filling capacity lube oil (refill)	lit	~ 765

c) Lower gas pressures upon inquiry
d) based on methane number calculation software AVL 3.1 (calculated without N2 and CO2)

0.02 Technical data of engine

Manufacturer		GE Jenbacher
Engine type		J 620 GS-F101
Working principle		4-Stroke
Configuration		V 60°
No. of cylinders		20
Bore	mm	190
Stroke	mm	220
Piston displacement	lit	124,75
Nominal speed	rpm	1.500
Mean piston speed	m/s	11,00
Length	mm	5.542
Width	mm	1.900
Height	mm	2.540
Weight dry	kg	15.000
Weight filled	kg	16.000
Moment of inertia	kgm²	69,21
Direction of rotation (from flywheel view)		left
Radio interference level to VDE 0875		N
Starter motor output	kW	20
Starter motor voltage	V	24

Thermal energy balance

Energy input	kW	7.707
Intercooler	kW	1.124
Lube oil	kW	310
Jacket water	kW	532
Exhaust gas total	kW	2.089
Exhaust gas cooled to 180 °C	kW	1.222
Exhaust gas cooled to 100 °C	kW	1.672
Surface heat	kW	157

Exhaust gas data

Exhaust gas temperature at full load	°C [8]	390
Exhaust gas temperature at bmep= 16,5 [bar]	°C	~ 426
Exhaust gas temperature at bmep= 11 [bar]	°C	~ 471
Exhaust gas mass flow rate, wet	kg/h	18.796
Exhaust gas mass flow rate, dry	kg/h	17.551
Exhaust gas volume, wet	Nm³/h	14.827
Exhaust gas volume, dry	Nm³/h	13.332
Max.admissible exhaust back pressure after engine	mbar	50

Combustion air data

Combustion air mass flow rate	kg/h	18.241
Combustion air volume	Nm³/h	14.111
Max. admissible pressure drop at air-intake filter	mbar	10

Sound pressure level

Aggregate b)		dB(A) re 20µPa	101
31,5	Hz	dB	88
63	Hz	dB	95
125	Hz	dB	101
250	Hz	dB	99
500	Hz	dB	94
1000	Hz	dB	93
2000	Hz	dB	92
4000	Hz	dB	94
8000	Hz	dB	95
Exhaust gas a)		dB(A) re 20µPa	123
31,5	Hz	dB	112
63	Hz	dB	121
125	Hz	dB	131
250	Hz	dB	119
500	Hz	dB	117
1000	Hz	dB	118
2000	Hz	dB	117
4000	Hz	dB	112
8000	Hz	dB	98

Sound power level

Aggregate	dB(A) re 1pW	122
Measurement surface	m²	144
Exhaust gas	dB(A) re 1pW	131
Measurement surface	m²	6,28

a) average sound pressure level on measurement surface in a distance of 1m according to DIN 45635, precision class 2.
b) average sound pressure level on measurement surface in a distance of 1m (converted to free field) according to DIN 45635, precision class 3.
The spectra are valid for aggregates up to bmep=20 bar. (for higher bmep add safety margin of 1dB to all values per increase of 1 bar pressure).
For operation with 1200 rpm see above values, for operation with 1800 rpm add 3 dB to the above values.
Engine tolerance ± 3 dB

0.03 Technical data of generator

Manufacturer		AVK (+10%-20%) e)
Type		DIG 142 h/4 e)
Type rating	kVA	5.300
Driving power	kW	3.431
Ratings at p.f. = 1,0	kW	3.354
Ratings at p.f. = 0,8	kW	3.338
Rated output at p.f. = 0,8	kVA	4.173
Rated current at p.f. = 0,8	A	219
Frequency	Hz	50
Voltage	kV	11
Speed	rpm	1.500
Permissible overspeed	rpm	2.250
Power factor lagging		0,8 - 1,0
Efficiency at p.f. = 1,0	%	97,8%
Efficiency at p.f. = 0,8	%	97,3%
Moment of inertia	kgm²	229,00
Mass	kg	12.700
Radio interference level to VDE 0875		N
Construction		IMB 24
Protection Class		IP 23
Insulation class		F
Temperature (rise at driving power)		F
Maximum ambient temperature	°C	45
Total harmonic distortion	%	5,0

Reactance and time constants (saturated)

xd direct axis synchronous reactance	p.u.	1,70
xd' direct axis transient reactance	p.u.	0,15
xd'' direct axis sub transient reactance	p.u.	0,11
Td'' sub transient reactance time constant	ms	20
Ta Time constant direct-current	ms	120
Tdo' open circuit field time constant	s	4,10

e) GE Jenbacher reserves the right to change the generator supplier and the generator type. The contractual data of the generator may thereby change slightly. The contractual produced electrical power will not change.

0.04 Technical data of heat recovery

General data - Hot water circuit

Total recoverable thermal output	kW	1.966
Return temperature	°C	60,0
Forward temperature	°C	85,0
Hot water flow rate	m³/h	68,5
Nominal pressure of hot water / (operating pressure)	PN / (bar)	10 / (6)
Pressure drop hot water circuit	bar	1,30
Maximum Variation in return temperature	°C	+0/-20
Max. rate of return temperature fluctuation	°C/min	10

Mixture Intercooler (1st stage)

Type		gilled pipes
Nominal pressure of hot water / (operating pressure)	PN / (bar)	10 / (6)
Pressure drop hot water circuit	bar	0,50
Hot water connection	DN/PN	100/10

Heat exchanger lube oil

Type		plate heat exchanger
Nominal pressure of hot water / (operating pressure)	PN / (bar)	10 / (6)
Pressure drop hot water circuit	bar	0,40
Hot water connection	DN/PN	100/10

Heat exchanger engine jacket water

Type		plate heat exchanger
Nominal pressure of hot water / (operating pressure)	PN / (bar)	10 / (6)
Pressure drop hot water circuit	bar	0,40
Hot water connection	DN/PN	100/10

connection variant F

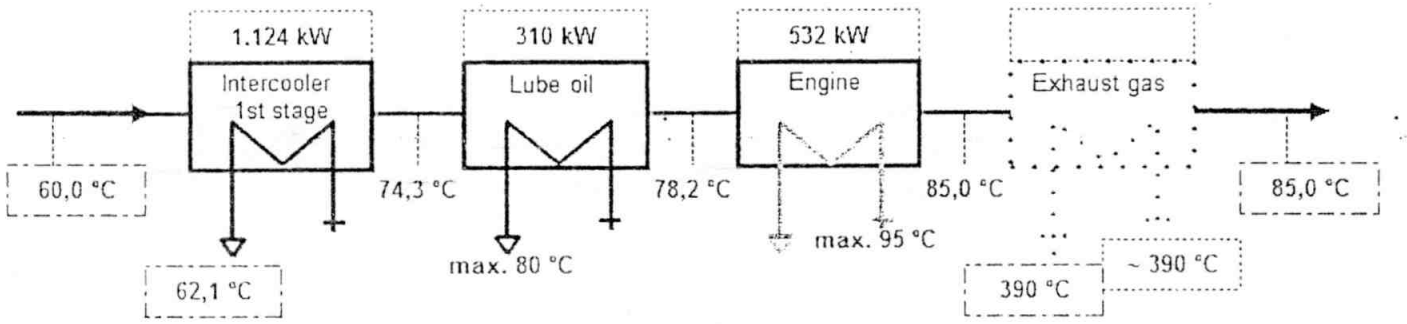
Mekotex 2x620 J 620 GS-F101

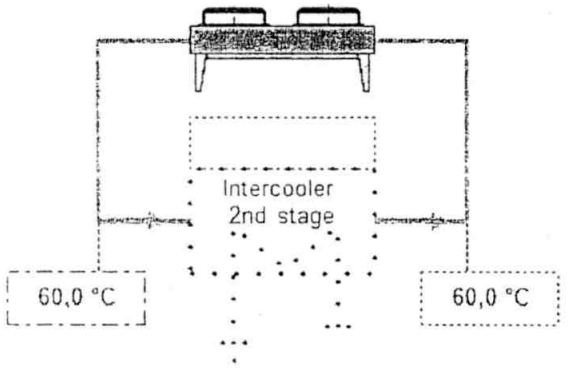
Hot water circuit (calculated with Glykol 5%)

Recoverable thermal output = 1.966 kW

(±8% tolerance +10% reserve for cooling requirements)

Hot water flow rate = 68,5 m³/h





Low temperature circuit (calculated with Glykol 5%)

Heat to be dissipated = 0 kW

(±8% tolerance +10% reserve for cooling requirements)

Cooling water flow rate = 40,0 m³/h

051

0.10 Technical parameters

All data in the technical specification are based on engine full load (unless stated otherwise) at specified temperatures and the methane number and subject to technical development and modifications.

All pressure indications are to be measured and read with pressure gauges (psi.g.).

(1) At nominal speed and standard reference conditions ICFN according to DIN-ISO 3046 and DIN 6271, respectively
(2) According to DIN-ISO 3046 and DIN 6271, respectively, with a tolerance of + 5 %.
Efficiency performance is based on a new unit (immediately upon commissioning).Effects of degradation during normal operation can be mitigated through regular service and maintenance work.
(3) Average value between oil change intervals according to maintenance schedule, without oil change amount
(4) At p. f. = 1.0 according to VDE 0530 REM / IEC 34.1 with relative tolerances
(5) Total output with a tolerance of +/- 8 %
(6) According to above parameters (1) through (5)
(7) Only valid for engine and generator; module and peripheral equipment not considered
(8) Exhaust temperature with a tolerance of +/- 8 %

Radio interference level
The ignition system of the gas engines complies the radio interference levels of CISPR 12 and EN 55011 class B, (30-75 MHz, 75-400 MHz, 400-1000 MHz) and (30-230 MHz, 230-1000 MHz), respectively.

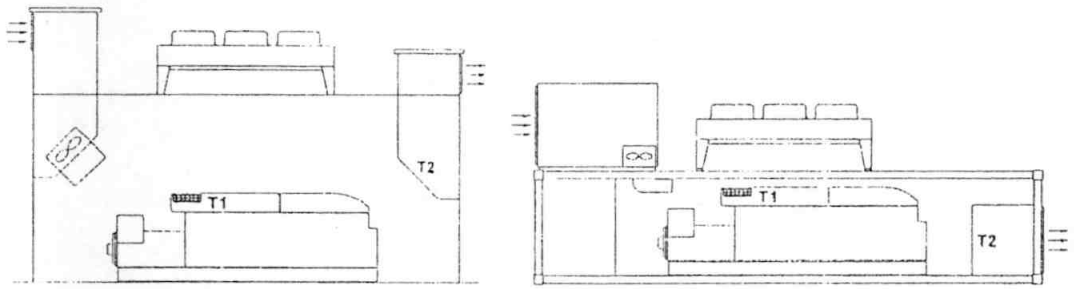
Definition of output
- ISO-ICFN continuous rated power:
  Net break power that the engine manufacturer declares an engine is capable of delivering continuously, at stated speed, between the normal maintenance intervals and overhauls as required by the manufacturer. Power determined under the operating conditions of the manufacturer's test bench and adjusted to the standard reference conditions.
- Standard reference conditions:

Barometric pressure:	1000 mbar (14.5 psi) or 100 m (328 ft) above sea level
Air temperature:	25 °C (77 °F) or 298 K
Relative humidity:	30 %

- Volume values at standard conditions (fuel gas, combustion air, exhaust gas)

Pressure:	1013 mbar (14.7 psi)
Temperature:	0 °C (32 °F) or 273 K

Output adjustment for turbo charged engines
Standard rating of the engines is for an installation at an altitude ≤ **0 m** and an air intake temperature ≤ **45** °C (T1)
Maximum room temperature: **50** °C (T2) -> engine stop



If the actual methane number is lower than the specified, the knock control responds. First the ignition timing is changed at full rated power. Secondly the rated power is reduced. These functions are carried out by the engine management system.
Exceedance of the voltage and frequency limits for generators according to IEC 60034-1 Zone A will lead to a derate in output.

Parameters for the operation of GE Jenbacher gas engines
The genset fulfills the limits for mechanical vibrations according to ISO 8528-9.
If possible, railway trucks must not be used for transport (**TI 1000-0046**).
The following "Technical Instruction of GE JENBACHER" forms an integral part of a contract and must be strictly observed: **TI 1100-0110, TI 1100-0111, and TI 1100-0112.**

Parameters for the operation of control unit and the electrical equipment
Relative humidity 50% by maximum temperature of 40°C.
Altitude up to 2000m above the sea level.

1.00 Scope of supply - module

Design:
The module is built as a compact package. Engine and generator are connected through a coupling and are mounted to the base frame. To provide the best possible isolation from the transmission of vibrations the engine is mounted to the frame by means of anti-vibrational mounts. The remaining vibrations are eliminated by mounting the module on isolating pads (e.g. Sylomer). This, in principle, allows the module to be placed directly on any floor capable of carrying the static load. No special foundation is required. Prevention of sound conducted through solids has to be provided locally.

1.01 Spark ignited gas engine

Four-stroke, air/gas mixture turbocharged, aftercooled, with high performance ignition system and electronically controlled air/gas mixture system.
The engine is equipped with the most advanced

LEANOX® LEAN-BURN COMBUSTION SYSTEM

developed by GE JENBACHER.

1.01.01 Engine design

Engine block
Single-piece crankcase and cylinder block made of special casting; crank case covers for engine inspection, welded steel oil pan.

Crankshaft and main bearings
Drop-forged, precision ground, surface hardened, statically and dynamically balanced; main bearings (upper bearing shell: grooved bearing / lower bearing shell: sputter bearing) arranged between crank pins, drilled oil passages for forced-feed lubrication of connecting rods.

Vibration damper
Maintenance free viscous damper

Flywheel
With ring gear for starter motor and additionally screwed on.

Pistons
Single-piece made of steel, with piston ring carrier and oil passages for cooling; piston rings made of high quality material, main combustion chamber specially designed for lean burn operation.

Connecting rods
Drop-forged, heat-treated, big end diagonally split and toothed. Big end bearings (upper bearing shell: sputter bearing / lower bearing shell: sputter bearing) and connecting rod bushing for piston pin.

Cylinder liner
Chromium alloy gray cast iron, wet, individually replaceable.

Cylinder head
Specially designed and developed for GE JENBACHER-lean burn engines with optimized fuel consumption and emissions; water cooled, made of special casting, individually replaceable; Valve seats, valve guides and spark plug sleeves individually replaceable; exhaust and inlet valves made of high quality material; Pre-chamber with check-valve.

Crankcase breather
Connected to combustion air intake system.

Valve train
Camshaft, with replaceable bushings, driven by crankshaft through intermediate gears, valve lubrication by splash oil through rocker arms.

Combustion air/fuel gas system
Motorized carburetor for automatic adjustment according to fuel gas characteristic. Exhaust driven turbocharger, mixture manifold with bellows, water-cooled intercooler, throttle valve and distribution manifolds to cylinders.

Ignition system
Most advanced, fully electronic high performance ignition system, external ignition control.
MORIS: Automatically, cylinder selective registration and control of the current needed ignition voltage.

Lubricating system
Gear-type lube oil pump to supply all moving parts with filtered lube oil, pressure control valve, pressure relief valve and full-flow filter cartridges. Cooling of the lube oil is arranged by a heat exchanger.

Engine cooling system
Jacket water pump complete with distribution pipework and manifolds.

Exhaust system
Turbocharger and exhaust manifold

Exhaust gas temperature measuring
Thermocouple for each cylinder

Electric actuator
For electronic speed and output control

Electronic speed monitoring for speed and output control
By magnetic inductive pick up over ring gear on flywheel

Starter motor
Engine mounted electric starter motor

1.01.02 Additional equipment for the engine (spares for commissioning)

The initial set of equipment with the essential spare parts for operation after commissioning is included in the scope of supply.

1.01.02 Engine accessories

Insulation of exhaust manifold:
Insulation of exhaust manifold is easily installed and removed

Sensors at the engine:
- Jacket water temperature sensor
- Jacket water pressure sensor
- Lube oil temperature sensor
- Lube oil pressure sensor
- Mixture temperature sensor
- Charge pressure sensor
- Minimum and maximum lube oil level switch
- Exhaust gas thermocouple for each cylinder
- Knock sensors
- Gas mixer / gas dosing valve position reporting.

Actuator at the engine:
- Actuator - throttle valve
- Bypass-valve for turbocharger
- Control of the gas mixer / gas dosing valve

1.01.03 Standard tools (per installation)

The tools required for carrying out the most important maintenance work are included in the scope of supply and delivered in a toolbox.

1.02 Generator-medium voltage

The generator consists of the main generator (built as rotating field machine), the exciter machine (built as rotating armature machine) and the voltage regulator with cos. phi-regulator. The regulator is powered by an auxiliary winding at the main stator.

Main components
- Main stator with frame
- Winding at two layers
- Terminal box includes main terminals plus auxiliary terminals for thermistor connection and control for regulator
- Main rotor with sufficiently sized shaft dynamically balanced as per VDI 2060, Grade Q1
- Drive end bracket with bearing
- Non-drive end bracket with bearing
- Exciter unit
- Power factor controller
- Voltage regulator
- Anti-condensation heater

Electrical data and features
- Voltage adjustment: +/- 10% rated voltage
- Static voltage accuracy: +/- 1% at no load to full load and power factor 0.8-1
- speed variation +/- 3%, cold and hot machine
- Maximum deviation of wave form according to VDE is 5% phase to phase at open circuit
- Generator suitable for parallel operating with mains and other generators
- Sustained short circuit current at 3-pole terminal short circuit: minimum 3 times rated current for 5 seconds.
- Overload capacity according. to IEC 32 - I/VDE 0530

According to VDE 0530 the overspeed test ensues with 1.2 times of rated speed for 2 minutes.

Additional components:
- Electronic voltage regulator
- Electronic power factor regulator
- 3 Pt 100 for winding temperature monitoring
- 2 Pt 100 for bearing temperature monitoring
- Current transformer for protection and measuring uses

1.03 Module accessories

Base frame
Welded structural steel to accommodate engine, generator and heat exchangers.

Flexible coupling
With torque limiter to couple engine with generator. The coupling isolates the major subharmonics of engine firing impulses from the generator.

Bell housing
To connect engine with generator housing. With two ventilation and control windows.

Anti-vibration mounts
Arranged between engine/generator assembly and base frame. Isolating pads (SYLOMER) for placement between base frame and foundation, delivered loose.

Exhaust gas connection
Connection of exhaust gas turbocharger; including flexible connection to compensate for expansions and vibrations.

Combustion air filter
Dry type air filter with replaceable filter cartridges, including flexible connection to carburetor and service indicator.

Interface panel
Totally enclosed sheet steel cubicle with front door, wired to terminals, ready to operate. Cable entry at bottom.

Painting: RAL 7035

Protection: IP 54 external, IP 20 internal (protection against direct contact with live parts)

Design according to IEC 439-1 (EN 60 439-1/1990) and DIN VDE 0660 part 500, respectively.
Ambient temperature: 5 - 40 °C (41 - 104 °F), Relative humidity: 70 %

Dimensions:

- Height: 1300 mm (51 in) **(2100mm bei 624)**
- Width: 1200 mm (47 in) **(1000mm bei 624)**
- Depth: 400 mm (16 in) **(600mm bei 624)**

Power supply from the starter battery charger.

Power distribution to the engine mounted auxiliaries (power input from the supplier of the auxiliaries power supply):
3 x **400/231** V, **50** Hz, 50 A

Essential components installed in interface panel:

- Terminal strip
- Decentralized input and output cards, connected by a data bus interface to the central engine control of the module control panel.

- Speed monitoring
- Relays, contacts, fuses, engine contact switch to control valves and auxiliaries
- Measuring transducer for excitation voltage
- Air conditioning system

Exhaust gas scavenging blower
The exhaust gas scavenging blower is used to scavenge the remaining exhaust gas out of the exhaust gas pipe work, to prevent the appearance of deflagrations.

Function:
Before each start scavenging by blower is done for app. 1 minute (except at black out – start)

Supervisions:
- Scavenging air fan failure
- Scavenging air flap failure

Consisting of:
- Fan
- Exhaust gas flap
- Temperature switch
- Compensator and pipe work

1.03.01 Engine jacket water system

Engine jacket water system
Closed cooling circuit, consisting of:
- Expansion tank
- Filling device (check and pressure reducing valves, pressure gauge)
- Safety valve(s)
- Thermostatic valve
- Required pipework on module
- Vents and drains
- Electrical jacket water pump, including check valve
- Jacket water preheat device

1.03.02 Automatic lube oil replenishing system

Automatic lube oil replenishing system:
Includes float valve in lube oil feed line, including inspection glass. Electric monitoring system will be provided for engine shut-down at lube oil levels "MINIMUM" and "MAXIMUM". Solenoid valve in oil feed line is only activated during engine operation. Manual override of the solenoid valve, for filling procedure during oil changes is included.

Oil drain
By set mounted cock

Pre-lubrication- and aftercooling oil pump:
Mounted on the module base frame; it is used for pre-lubrication and aftercooling of the turbochargers.

Period of operation: Pre-lubrication: 1 minute both pumps
Aftercooling: 15 minutes from engine stop only the **400/231** V pump

Consisting of:
- 1 piece oil pump 1500 W, **400/231** V
- 1 piece oil pump 1500 W, 24 V
- All necessary vents
- Necessary pipework

1.04 Heat recovery

Engine-mounted intercooler and lube oil heat exchanger, jacket water heat exchanger mounted to the engine res. to the module base frame, complete with interconnecting pipe work.
The exhaust gas heat exchanger is mounted to the heat recovery module.
The insulation of heat exchangers and pipe work is not included in GE Jenbacher scope of supply.

Heat exchanger - air/fuel mixture to warm water (intercooler)
The engine-mounted intercooler is of two stage design. The first stage is integrated with the warm water circuit. The second stage requires low temperature water.

Heat exchanger - lube oil to warm water
Heat recovery via a mounted heat exchanger which is integrated in the warm water circuit.

Heat exchanger - engine jacket water to warm water
The plate-type heat exchanger is mounted to the module base frame, complete with interconnecting pipework, for recovery of engine jacket water.
In this cooling circuit at least 30% of Glykol has to be used without any other additive!

1.05 Gas train

Pre-assembled, delivered loose, for installation into gas pipework to the module.

Consisting of:
- **Main gas train:**
  - Shut off valve
  - Gas filter, filter fineness <3 µm
  - Adapter with dismount to the pre-chamber gas train
  - Gas admission pressure regulator
  - Pressure gauge with push button valve, 0-500 mbar (0-7,25 psi)
  - Solenoid valves
  - Gas pressure switch (min.)
  - Leakage detector
  - Gas pressure regulator
  - TEC JET (has to be implemented horizontal)
  - Gas flow meter
  - p/t compensation

The gas train complies with DIN - DVGW regulations.
Maximum distance from TEC JET outlet to gas entry on engine, including flexible connections, is 1 m (39,37 in).

- **Pre-chamber gas train:**
  - Ball valve
  - Gas filter, filter fineness <3 µm
  - Solenoid valves
  - Pressure regulator
  - Calming distance with reducer
  - Pressure gauge with push button valve, 1-5 bar (0-72,5 psi)

Pre chamber gas pressure regulator (incl. stabilization section) assembled at the flexible connection pre chamber gas.

1.05 Pre-chamber gas compressor

The pre-chamber gas compressor is used to increase the pressure of the gas, required for the pre-chamber from appr. 80 mbar (1,16 psi) tb appr. 3,3 - 4 bar (47,9 - 58 psi).

Dimensions of the complete compressor unit:

• Length:	appr. 2300 mm (90,6 in)
• Width:	appr. 750 - 900 mm (29,5 - 35,4 in)
• Total hight:	appr. 2200 mm (86,6 in)

Consisting of:

- Compressor
- Three-phase current engine
- Solenoid valve at the gas compressor inlet
- Suction filter (=suction silencer)
- Starting relief installation with feedback
- Aftercooler for compressed gas with contensate drain
- Set of thermometers at the aftercooler
- Flexible hose to the pressure vessel
- Flexible connections at the compressor inlet and at the blowoff pipe
- Solenoid valves, transmitters and switches wired to the terminal box
- Pressure gas vessel with fittings and TÜV certificate for a pressure of 5 bar (72,5 psig)

1.07 Painting

• Quality:	Oil resistant prime layer Synthetic resin varnish finishing coat	
• Colour:	Engine:	RAL 6018 (green)
	Base frame:	RAL 6018 (green)
	Generator:	RAL 6018 (green)
	Module interface	

panel:	RAL 7035 (light grey)
Control panel:	RAL 7035 (light grey)

1.11 Engine generator control panel – DIA.NE XT

Dimensions:

• Height:	2200 mm (87 in) [including 200 mm (8 in) pedestal]
• Width:	1000 mm (40 in)
• Depth:	600 mm (24 in)

Control supply voltage from starter and control panel batteries: 24V DC

Supply of power for auxiliaries from auxiliary power panel:
3 x **400/231** V, **50** Hz, xx A

Consisting of:
DIA.NE XT 3 (Dialog Network new generation) **motor management system**

System elements visualisation with central engine and module control

1) Visualisation:
Industrial control with 10,4" QVGA TFT colour graphics display and 8 function keys.
10-key numeric keyboard for parameter input.
Keys for START, STOP, Generator circuit breaker OPEN, Generator circuit breaker CLOSED/SELECTED, display selection keys and special functions.
Interfaces:

- Ethernet (twisted pair) for connection to DIA.NE WIN server
- CAN-Bus: bus connection to the intelligent sensors and actuators
- Data bus connection to the control in- and outputs
  OPTION: Interfacing with the customer's plant management according to GE JENBACHER list of options (MODBUS-RTU slave, PROFIBUS-DP slave)

Protection class: IP 65 (front)
Dimensions: W x H x D = approx. 212 x 255 x 95 mm (8,4 x 10 x 3,75 in)

A clear and functional graphic compilation of measured values is displayed on the screen. User prompts are by means of direct-acting display selection keys and function keys.

Main displays:

- Electrical schematic
- Oil and hydraulic schematic
- Gas data
- Engine controllers
- Cylinder data
- Exhaust gas data
- Auxilliaries controllers
- Spare screen for customer specific purposes
- System display screens
- Parameter manager
- User setting

- Alarm management

Recipe handling:
Setting, display and storage of all module parameters

Alarm management:
Efficient diagnostic instrumentation listing all active fault messages both tabular and chronologically, with the recorded time.

2) Central engine and module control:
A real-time, modular industrial control system which handles all jobs for module and engine-side sequencing control (start preparation, start, stop, synchronizing, after-cooling, control of auxiliaries), as well as all control functions.

Control functions:
- Speed control in no-load and isolated operation
- Power output control in parallel operation system; job-specific with respect to internal and external set point values.
- LEANOX control system for control of boost pressure; dependent upon the generator terminal power and the mixture temperature via the engine-driven air-gas mixer
- Knocking control: adjustment of the ignition point, power output and (insofar as is locally possible) the mixture temperature in the event of detection of knocking.
- Load sharing between several modules in isolated operation
- Linear reduction of power output in the event of excessive mixture temperature and ignition failures

- Interface relays as per the interface list
- Multi-transducer, to record the following electrically measured variables of the generator:
  - Phase current (with slave pointer)
  - Neutral conductor current
  - Voltages Ph/Ph and Ph/N
  - Active power (with slave pointer)
  - Reactive power
  - Apparent power
  - Power factor
  - Frequency

An additional 0 - 20 mA output is produced for active power, as well as a pulse output for active power demand.

The following alternator supervisions are integrated with the multi-transducer (max. 8 functions simultaneous):
- Overload/short-circuit [51], [50]
- Over voltage [59]
- Undervoltage [27]
- Asymmetric voltage [64], [59N]
- Unbalance current [46]
- Failure Exitation [40]
- Overfrequency [81>]
- Underfrequency [81<]

- Lockable operation mode selector switch positions:
  - "OFF"
    No operation is possible, running set will shut down;

- "MANUAL"
  Manual operation using (start, stop) is possible, unit is not available for fully automatic operation.
- "AUTOMATIC"
  Fully automatic operation, according to remote demand signal:
  - Automatic start
    Fully automatic operation at full load
  - Stop with cooling down run for 1 minute
    Continuous operation of auxiliaries for 5 minutes after engine shutdown
- Demand switch with the positions:
  - Demand OFF
  - Demand ON
  - Remote demand
- Supply disconnecting device for auxiliaries with lockable circuit breaker

Shut-down functions with display:
- Low lube oil pressure
- Low lube oil level
- High lube oil level
- High lube oil temperature
- Low jacket water pressure
- High jacket water pressure
- High jacket water temperature
- Overspeed
- Emergency stop/safety loop
- Gas train failure
- Start failure
- Stop failure
- Engine start blocked
- Engine operation blocked
- Misfiring
- High mixture temperature
- Measuring signal failure
- Overload/output signal failure
- Generator overload/short circuit
- Generator over/undervoltage
- Generator over/underfrequency
- Generator asymmetric voltage
- Generator unbalanced load
- Generator reverse power
- High generator winding temperature
- Synchronising failure
- Knocking failure

Warning functions with display:
- Low jacket water temperature
- CPU battery failure

Operational functions with display:
- Ready to start
- Operation (engine running)

- Generator circuit breaker "CLOSED"

Remote signals:
(volt free contacts)

1NO = 1 normally open
1NC = 1 normally closed
1 COC = 1 change over contact

• Ready for automatic start (to Master control)	1NO
• Operation (engine runs)	1NO
• Collective signal "shut down"	1NC
• Collective signal "warning"	1NC

External (by others) provided command/status signals:

• Engine demand (from Master control)	1NO

Single synchronizing Automatic
With voltage balance

For automatic synchronizing of the module with the generator circuit breaker to the grid by PLC-technology, integrated within the module control panel.

Consisting of:

- Lockable synchronizing mode selector switch, with positions "MANUAL - OFF - AUTOMATIC"
  - AUTOMATIC:
    Automatic module synchronization, after synchronizing release from the control panel
  - MANUAL:
    Manual initiation of synchronizing by push button. Speed adjustment and closing of the circuit breaker is automatically controlled via microprocessor
  - OFF:
    Synchronization is disabled
- Additional PLC hardware for the fully automatic synchronizing of each module, and monitoring of the "CIRCUIT BREAKER CLOSED" signal.
  Logic for monitoring of:
  - Non-logic breaker positions
  - Switch "ON" trouble
  - Switch "OFF" trouble
- Automatic synchronizing device to control the electronic speed governor adjustment, double voltmeter, double frequency meter and synchronoscope
- Automatic voltage balancing
- Luminous push button "GENERATOR CIRCUIT BREAKER OPEN / SELECT"
  - To indicate synchronizing mode
  - To indicate "Generator circuit breaker closed"
  - For manual synchronizing selection with the synchronizing mode selector switch in the MANUAL position
  - For manual closing of the generator circuit breaker to the voltage free bus bar (first connection) with synchronizing mode selector switch in the MANUAL position
- Luminous push button "GENERATOR CIRCUIT BREAKER OPEN"
  - To indicate "Generator circuit breaker open"

- To manually open the generator circuit breaker
- Control switch
- Required relays for control and monitoring
- Voltage relay for monitoring of bussbar voltage (only for island operation)

Operational indications for:
- Generator circuit breaker CLOSED
- Generator circuit breaker OPEN

Fault indications for:
- Generator circuit breaker return signal fault
- Generator circuit breaker closing fault
- Generator circuit breaker opening fault

Remote signals
(Volt free contacts)

- Generator circuit breaker CLOSED 1 NO

The following reference and status signals must be provided by the switchgear supplier:

Generator circuit breaker CLOSED	1 NO
Generator circuit breaker OPEN	1 NO
Generator circuit breaker READY TO CLOSE	1 NO
Mains circuit breaker CLOSED	1 NO
Mains circuit breaker OPEN	1 NO

- Mains voltage 3 x 400/231V or 3x 110V/v3 -- other maasurement voltages available on request
- Bus bar voltage 3 x 400/231 V or 3x 110V/v3 -- other measurement voltages available on request
- Generator voltage 3 x **11 kV** or 3x 110V/v3 – other measurement voltages available on request

Voltage transformers in star point with minimum 50VA, Class 1

The following volt free interface-signals will be provided by GE Jenbacher to be incorporated in switchgear:
- CLOSING/OPENING command for generator circuit breaker (permanent contact) 1 NO + 1 NC
- Signal for circuit breaker undervoltage trip 1 NO

1.20.01 Starting system

Starter battery:
2 x 2 piece Pb battery with 12 cells, 2 x 12 V, 400 Ah (according to DIN 72311), complete with cover plate, terminals and acid tester.

Battery voltage monitoring:
Monitoring by an under voltage relay.

Battery charging equipment:

Capable for charging the starter battery with I/U characteristic and for the supply of all connected D.C. consumers.
Charging device is mounted inside of the module interface panel or module control panel.

- **General data:**
  - Power supply — **3 x 320 - 550 V, 47 - 63 Hz**
  - max. power consumption — 2120 W
  - Nominal D.C. voltage — 24 V(+/-1%)
  - Voltage setting range — 24V to 28,8V (adjustable)
  - Nominal current (max.) — 2 x 2 x 40 A
  - Dimensions — 240 x 125 x 125 mm
  - Degree of protection — IP20 to IEC 529
  - Operating temperature — 0 °C - 60 °C
  - Protection class — 1
  - Humidity class — 3K3, no condensation.
  - Natural air convection
  - Standards — EN60950,EN50178
    UL/cUL (UL508/CSA 22.2)

Signalling:

Green Led:	Output voltage > 20,5V
Yellow Led:	Overload, Output Voltage < 20,5V
Red Led:	shutdown

Control accumulator:
- Pb battery 24 VDC/18 Ah

1.20.03 Electric jacket water preheating

Installed in the jacket water cooling circuit, consisting of:
- Heating elements
- Water circulating pump

The jacket water temperature of a stopped engine is maintained between 56 °C (133 °F) and 60 °C (140 °F), to allow for immediate loading after engine start.

1.20.04 Flexible connections

Following flexible connections per module are included in the GE Jenbacher -scope of supply:

No. Connection	Unit	Dimension	Material
2 Warm water in-/outlet	DN/PN	100/10	Stainless steel
1 Exhaust gas outlet	DN/PN	600/10	Stainless steel
1 Fuel gas inlet	DN/PN	100/16	Stainless steel
2 Intercooler in-/outlet	DN/PN	100/10	Stainless steel
2 Lube oil connection	mm	28	Hose

Sealings and flanges for all flexible connections are included.

1.20.25 Warm water monitoring

The monitoring device is included in the warm water circuit. The components are delivered loose.

Consisting of:

- 1 Flow control — Shut down signal: minimum flow
- 1 Pressure switch — Shut down signal: maximum pressure
- 1 Temperature switch — Shut down signal: maximum temperature
- 1 Pressure relief valve

1.20.26 Warm water pump

Consisting of:

- 1 Pump with frequency converter, delivered loose for circulation of the required warm water flow per module, 3 x **400/231** V, **50** Hz
- 2 Manometers, at inlet and outlet of pump
- 1 balancing valve to control the warm water flow rate

The pump will be dimensioned upon the pressure drop of delivered GE Jenbacher parts in the warm water circuit and max. 0.5 bar (7.2 PSI) for the customer circuit.

1.20.27 Return temperature control

Control of the return temperature ensures a constant warm water temperature at the inlet of the module. This is made possible by mixing warm water from the outlet flow into the return flow.

Consisting of:

- 1 x 3-way valve with electrical regulating control (delivered loose)
- 1 PT 100 (delivered loose)
- 1 PID-regulation (installed in the control panel)

1.20.28 Pressure compensation reservoir

The Expansion Tank is designed for the warm water circuit of the respective module.

Scope of supply:

- Size of the expansion tank: — 150 l (delivered loose)
- Pressure gauge — (delivered loose)

2.00 Electrical equipment

Totally enclosed floor mounted sheet steel cubicle with front door wired to terminals. Ready to operate, with cable entry at bottom. Naturally ventilated.

Protection:	IP 42 external
	IP 20 internal (protection against direct contact with live parts)

Design according to EN 60439-1 / IEC 60439-1 and ISO 8528-4.
Ambient temperature 5 - 40 °C (41 - 104 °F), 70 % Relative humidity

Standard painting:	Panel:	RAL 7035
	Pedestal:	RAL 7020

2.01 Interlock Panel

(One panel prepared for max. 6 engines)

Purpose: **Specific release for „BLACK START OPERATION"**

Dimensions:

Height	2200 mm (87 in) [including 200 mm (8 in) foundation]
Width	800 mm (32in) - 1200 mm (48 in)
Depth	600 mm (24 in)

Control power supply (by supplier of the control power supply unit) from the battery 24 V DC, 16 A (tolerance: min. 22 V, max. 30 V, including waviness U_{pp} 3.6 V minus-grounded).
Auxiliary power supply (by the supplier of the auxiliary power supply unit):
400/231 V, **50** Hz, 16 A.

Comprising:

- Terminal strip with cable entry from bottom
- Interface relays/contacts as per the interface list
- Lockable selector switch with the following positions:

"Stop"	No „BLACK OUT START"possible
"1-6"	Release for Engine no. „1 - 6" for BLACK Start – prepared for 6 engines

- Lockable speed / power mode selector-switch with the settings:

„OFF„	Parallel island mode: with load sharing to customer engine

  - If existing = SPEED MODE
  - If **NO** load sharing line to customer engine is existing or possible – speed control adjusted with DROOP FUNCTION

„ON„	Parallel island mode: with full load of GE Jenbacher engines = POWER MODE
	(cos phi controller is working)

Function:
GEJ engines are working with full load (set point adjustable), and customer engines cover the remaining load! Possible function if power rating of customer engines are higher than the GEJ nominal power and same speed/power regulator reaction time!

- Emergency stop push button

- Interfaces from CUSTOMER ENGINE CONTROL to GE Jenbacher:
  - Load is shed for BLACK OUT Start of first engine.
  - STATUS: GENERATOR CB OF CUSTOMER ENGINE IS CLOSED
  - STATUS: GENERATOR CB OF CUSTOMER ENGINE IS OPEN
- SIGNAL FOR LOAD SHARING: with a Woodward 2301A speed governor
  (GE Jenbacher provides a load sharing signal with 4-16mA = 0-100%, this signal is wired on terminals in the cabinet).

NOTE:
Precondition for this operation mode without interlocking signals is an attended control room!

2.07 High voltage – Junction Box

Dimensions:
- Height: xx mm
- Width: xx mm
- Depth: xx mm

Electrical Data:
- Rated voltage 12 kV
- Rated short-circuit breaking current Ik" 20 kA **(20 or 31,5) BIL 75kV**

Essential components installed in the high voltage panel:
- 1 surge arrestor Zorc
- 3-pole design

3.03.01 Exhaust gas silencer

Residual sound pressure level:
Designed for a residual sound pressure level of **75** dB(A) in 10 m (32 ft) (as measuring area level according to DIN 45635 or ISO 3744) measured at the chimney escape.

Material:
Stainless steel or carbon steel, based upon exhaust gas temperature

Consisting of:
- Exhaust gas silencer
- Flanges, seals

Insulation:
The insulation for reducing surface irradiations of the exhaust gas silencer is not included in our scope of supply and must be provided locally.

Insulation thickness for outdoor installation:
- For 50 dB(A) in 10 m (32ft) 100 mm (4 inch) rock wool covered with 1 mm (0,04 inch) galvanized steel sheet

- From 55 dB(A) in 10 m (32ft) — 100 mm (4 inch) rock wool covered with 0,75 mm (0,03 inch) galvanized steel sheet
- For < 50 dB(A) in 10 m (32ft) — insulation thickness is determined for each project

Insulation thickness for indoor installation:
- Insulation has to be dimensioned upon heat radiation

3.10 Cooling system

The heat produced by the engine (intercooler, lube oil, jacket water) will be dumped through a cooling tower (not GEJ Scope of Supply), decoupled from engine cooling circuit by a decoupling heat exchanger (GEJ scope of supply) and the temperatures are controlled by an electrical temperature control valve (GEJ Scope of Supply).

At least 30% Glykol has to be used in the jacket water cooling circuit without any other anti-corrosion additive.
In the hot temperature water circuit no Glykol is needed but the appropriate amount of anti-corrosion additive - as released and written in the GE Jenbacher technical instructions.

4.00 Delivery, installation and commissioning

4.01 Carriage
CFR Karachi 2010

4.02 Unloading
Unloading, moving of equipment to point of installation, mounting and adjustment of delivered equipment on intended foundations **is** included in GE Jenbacher scope of supply.

4.03 Assembly and installation
Assembly and installation of all GE Jenbacher -components **is** included in GE Jenbacher scope of supply.

4.04 Storage
The customer is responsible for secure and appropriate storage of all delivered equipment.

4.05 Start-up and commissioning
Start-up and commissioning with the GE Jenbacher start-up and commissioning checklist **is** included.

4.06 Trial run
After start-up and commissioning, the plant will be tested in an 8-hour trial run. The operating personnel will be introduced simultaneously to basic operating procedures.

5.01 Limits of delivery

Electrical
- Module:

- At terminals of module interface panel
- At terminals of generator terminal box
  (screwed glands to be provided locally)
- Module control panel:
  At terminal strips
- Auxiliaries:
  At terminals of equipment which is supplied separately

Warm water
- At inlet and outlet flanges on module
- At inlet and outlet flanges of the exhaust gas heat recovery system

Low temperature water
At inlet and outlet flanges at module

Exhaust gas
At outlet flange of exhaust gas connection
At inlet and outlet flanges of the exhaust gas heat recovery system

Combustion air
The air filters are set mounted

Fuel gas
- At inlet and outlet flanges of gas train
- At inlet flange of gas pipework on module
- At outlet flange of the pre-chamber gas train
- At inlet flange of pre-chamber gas pipework on module
- At connection for boost pressure compensation on module
- At connection for boost pressure compensation on gas pressure regulator of the pre-chamber gas train

Lube oil
At lube oil connections on module

Draining connections and pressure relief
At module

Condensate
At condensate drain on exhaust gas heat exchanger

Insulation
Insulation of heat exchangers and pipework is not included in our scope of supply and must be provided locally.

First filling
The first filling of module, (lube oil, engine jacket water, anti freeze-, anti corrosive agent, battery acid) is not included in our scope of supply.

The composition and quality of the used consumables are to be strictly monitored in accordance with the "Technical Instructions" of GE JENBACHER.

Suitable bellows and flexible connections **must be provided locally** for all connections.
Cables from the module must be flexible.

5.02 Factory tests and inspections

The individual module components shall undergo the following tests and inspections:

5.02.01 Engine tests

Carried out as combined Engine- and Module test according to DIN ISO 3046 at GE Jenbacher test bench. The following tests are made at 100%, 75% and 50% load, and the results are reported in a test certificate:

- Engine output
- Fuel consumption
- Jacket water temperatures
- Lube oil pressure
- Lube oil temperatures
- Boost pressure
- Exhaust gas temperatures, for each cylinder

5.02.02 Generator tests

Carried out on test bench of the generator supplier.

5.02.03 Module tests

The engine will be tested with natural gas (Russian Natural gas with methane number 94). The technical data according to the specification can only be demonstrated to a certain extent with the available natural gas.
Carried out as combined Engine- and Module test commonly with module control panel at GE Jenbacher test bench, according to ISO 8528, DIN 6280. The following tests are made and the results are reported in a test certificate:
Visual inspection of scope of supply per specifications.

- Functional tests per technical specification of control system.
  - Starting in manual and automatic mode of operation
  - Power control in manual and automatic mode of operation
  - Function of all safety systems on module
- Measurements at 100%, 75% and 50% load:
  - Frequency
  - Voltage
  - Current
  - Generator output
  - Power factor
  - Fuel consumption
  - Lube oil pressure
  - Jacket water temperature
  - Boost pressure
  - Mixture temperature
  - Exhaust emission (NOx)

The module test for operating frequenzy 50 Hz and 6,3-6,6kV / 10,5kV-11kV will be carried out with the original generator, except it is not possible because of the delivery date. Then a test generator will be used for the module test.
To prove characteristics of the above components, which are not tested on the test bench by GE JENBACHER, the manufacturers' certificate will be provided.

5.03 Documentation

Preliminary documentation 60 days after receipt of a technically and commercially clarified order:

- Module drawing 1)
- Technical diagram 1)
- Drawing of control panel 3)
- List of electrical interfaces 2)
- Technical specification of control system 2)
- Technical drawing auxiliaries (if included in GE Jenbacher-limit of delivery) 1)

At delivery:

- Wiring diagrams 3)
- Cable list 3)

At start-up and commissioning (or on clients request):

- Operating and maintenance manual 4)
- Spare parts manual 4)
- Operation report log 4)

Available Languages
1) DEU, GBR
2) DEU, GBR, FRA, ITA, ESP
3) DEU, GBR, FRA, ITA, ESP, NLD, HUN, RUS, POL, TUR, CZE
4) DEU, GBR, FRA, ITA, ESP, NLD, HUN, RUS, POL, TUR, CZE, SLOWEN, SLOWAK, SERB, SCHWED, ROM, PRT, NORWEG, LITAU, LETT, BULGAR, CHINA, DNK, ESTN, FIN, GRC, KROAT