National Electric Power Regulatory Authority

Islamic Republic of Pakistan

Registrar

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No.NEPRA/R/TRF-72/EEPL-2007/3062-64
July 19, 2007

Subject: **Determination of the Authority in the Matter of Tariff Petition filed by Engro Energy (Pvt.) Ltd. (Case No. NEPRA/TRF-72/EEPL-2007)**
Intimation of Determination of Tariff pursuant to Section 31(4) of the Regulation of Generation, Transmission and Distribution of Electric Power Act (XL of 1997)

Dear Sir,

Please find enclosed the subject Determination of the Authority along with Annexure-I, II, III, IV & V (102 pages) in Case No. NEPRA/TRF-72/EEPL-2007.

2. The Determination is being intimated to the Federal Government for the purpose of notification of the approved tariff in the official gazette pursuant to Section 31(4) of the Regulation of Generation, Transmission and Distribution of Electric Power Act (XL of 1997) and Rule 16(11) of the National Electric Power Regulatory Authority Tariff (Standards and Procedure) Rules, 1998.

3. Please note that only Order of the Authority at para 78 of the Determination relating to the Reference Tariff and allowed adjustments & indexation along with Annexure-I, II & III needs to be notified in the official gazette. The Order is reproduced for the purpose of clarity and is attached herewith.

DA/as above.

19.07.07.
(Mahjoob Ahmad Mirza)

The Secretary
Cabinet Division
Government of Pakistan
Cabinet Secretariat
Islamabad

CC:
1. Secretary, Ministry of Water & Power, Islamabad.
2. Secretary, Ministry of Finance, Islamabad.

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ORDER OF THE AUTHORITY
IN CASE NO. NEPRA/TRF-72/EEPL-2007
TO BE NOTIFIED IN THE OFFICIAL GAZETTE

Pursuant to Rule 6 of the NEPRA Licensing (Generation) Rules 2000, Engro Energy (Pvt) Limited is allowed to charge, subject to adjustment of Capacity Purchase Price on account of net dependable capacity as determined by test jointly carried out by Central Power Purchasing Agency (CPPA) and the petitioner, the following approved specified tariff for delivery of electricity to CPPA of NTDC for procurement on behalf of Ex-WAPDA Distribution Companies:

Reference Tariff

Tariff Components	Year 1 to 10	Year 11 to 25	Indexation
Capacity Charge PKR/kW/Hour)			
O&M Local	0.1022	0.1022	WPI
O&M Foreign	0.0065	0.0065	US$/PKR
Cost of Working Capital	0.0277	0.0277	KIBOR
Insurance	0.0572	0.0572	Nil
Debt Service	0.7336	-	LIBOR
Return on Equity	0.2542	0. 2542	NIL
ROE during Construction	0.0229	0.0229	NIL
Total Capacity Charge	**1.2043**	**0.4707**	
A) Energy Charge for Operation on Gas Rs./kWh			
Fuel Cost Component	1.9785	1.9785	Fuel Price
Variable O&M Local	0.0285	0.0285	WPI
Variable O&M Foreign	0.1300	0.1300	US$ to PKR
B) Operation on HSD Rs./kWh			
Fuel Cost Component	7.1440	7.1440	Fuel Price

Note: i) Capacity Charge Rs./kW/hour is applicable to dependable capacity at the delivery point.

ii) Dispatch criterion will be Energy Charge.

iii) The above tariff is applicable for a period of 25 years commencing from the date of the Commercial Operation.

iv) Component wise tariff for operation on Gas and HSD is indicated at Annexure I & II.

v) Mechanism for calculating composite tariff (Permeate Gas+HSD) during gas curtailment is given at Annexure-III.

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The following indexations shall be applicable to reference tariff;

I. One Time Adjustment

a) Adjustment due to variation in net capacity

The reference tariff has been determined on the basis of minimum net capacity of 216.80 MW at delivery point at mean site conditions. All the tariff components except fuel cost component shall be adjusted at the time of COD based upon the IDC tests to be carried out for determination of contracted capacity. If the IDC is established higher than 216.80 MW, the adjustments shall be made according to the following formula:

i)	Revised O&M Local	=	0.1022/tested IDC x 216.80 MW
ii)	Revised O&M Foreign	=	0.0065/tested IDC x 216.80 MW
iii)	Cost of Working Capital	=	0.0277/tested IDC x 216.80 MW
iii)	Insurance	=	0.0572/tested IDC x 216.80 MW
iv)	Debt Service	=	0.7336/tested IDC x 216.80 MW
v)	Return on Equity	=	0.2542/tested IDC x 216.80 MW
vi)	ROE during Construction	=	0.0229/tested IDC x 216.80 MW
vii)	Variable O&M Local	=	0.0285/tested IDC x 216.80 MW
viii)	Variable O&M Foreign	=	0.1300/tested IDC x 216.80 MW

b) Adjustment in Insurance as per actual

The actual insurance cost for the minimum cover required under contractual obligations with the Power Purchaser not exceeding 1.35% of the Plant & Equipment cost will be treated as pass-through. Insurance component of reference tariff shall be adjusted as per actual on yearly basis upon production of authentic documentary evidence by EEPL according to the following formula;

Insurance (Revised) = AIC/$1.78 million x AP

Where;

AIC = Adjusted Insurance Component as per IDC Test

AP = Actual Premium

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c) Adjustment due to custom duties, withholding tax and Interest during Construction

Debt Service, Return on Equity and ROE during construction shall be adjusted on account of actual variation in customs duties, withholding tax, drawdown and Interest During Construction with reference to the estimated figures of USD 6.797 million and USD 14.983 million respectively. EEPL shall submit the relevant documents to NEPRA within 7 days of COD for adjustment of relevant tariff components.

d) Adjustment in project cost due to variation in Dollar/Rupee parity

Any variation in project cost during construction period on account of variation in dollar/Rupee parity shall be allowed through adjustment in the project cost. For the purpose of this adjustment petitioner shall provide payment schedule along with the exchange rate prevalent on the date of particular transaction. EEPL's final reference tariff table shall be revised on COD to incorporate all the permissible adjustment during construction period.

II. Pass-Through Items

No provision for income tax has been accounted for in the tariff. If EEPL is obligated to pay any tax on its ROE, the exact amount paid by the company may be reimbursed by CPPA to EEPL on production of original receipts. This payment will be considered as pass-through (as Rs./kW/hour) hourly payment spread over a 12 months period in addition to the capacity purchase price in the Reference Tariff. Furthermore, in such a scenario, EEPL will also submit to CPPA details of any tax shield savings and CPPA will deduct the amount of these savings from its payment to EEPL on account of taxation.

Withholding tax is also a pass through item just like other taxes as indicated in the government guidelines for determination of tariff for new IPPs. Withholding tax shall be allowed @7.5% or applicable rate on ROE. CPPA (NTDC) shall make payment on account of withholding tax at the time of actual payment of dividend subject to maximum of 7.5% or applicable rate of 15% equity according to the following formula:

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Withholding Tax Payable = [{15% * (E(Ref) – E(Red)} +ROEDC(Ref)] * 7.5%

Where:

E(Ref) = Reference Equity (US$ 51.167 million x 61)

E(Red) = Equity Redeemed

ROEDC(Ref) = Reference Return on Equity During Construction

In case Company does not declare a dividend in a particular year or only declares a partial dividend, then the difference in the withholding tax amount (between what is paid in that year and the total entitlement as per the Net Return on Equity) would be carried forward and accumulated so that the Company is able to recover the same as a pass through from the Power Purchaser in future on the basis of the total dividend pay out.

III. Indexations:

The following indexation shall be applicable to the reference tariff as follows;

a) Indexation applicable to O&M

The local part of Fixed O&M cost will be adjusted on account of Inflation (WPI) and Fixed O&M foreign will be adjusted on account of variation in dollar/Rupee exchange rate and US CPI. Quarterly adjustment for local inflation, foreign inflation and exchange rate variation will be made on 1st July, 1st October, 1st January & 1st April respectively on the basis of average of the latest available information with respect to WPI (notified by the Federal Bureau of Statistics), US CPI and revised TT & OD Selling rate of US Dollar as notified by the National Bank of Pakistan. The mode of indexation will be as follows:

(i) Fixed O&M

$F\ O\&M_{(LRev)} = 0.1022 * WPI_{(REV)} / 118.96$

$F\ O\&M_{(FRev)} = 0.0065 * US\ CPI_{(REV)} / 202.41 * ER_{(REV)} / 61$

Where:

$F\ O\&M_{(LRev)}$ = the revised applicable Fixed O&M Local Component of the Fixed Charges indexed with WPI

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F O&M ($_{FRev}$) = the revised applicable Fixed O&M Foreign Component of the Fixed Charges indexed with US CPI and Currency fluctuation

$WPI_{(REV)}$ = the Revised wholesale Price Index (manufactures)

$WPI_{(REF)}$ = 118.96 wholesale price index (manufactures) of March 2007 notified by the Federal Bureau of Statistics

US $CPI_{(REF)}$ = 202.41 US CPI for the month of March 2007

$ER_{(REV)}$ = the Revised TT & OD selling rate of US dollar as notified by the National Bank of Pakistan

The reference numbers indicated above shall be replaced by the revised numbers after incorporating the required adjustments at COD.

(ii) Variable O&M

The formula for indexation of Variable O & M component will be as under:

$$V\ O\&M_{(LREV)} = 0.0285 * WPI_{(REV)} / 118.96$$

$$V\ O\&M_{(FREV)} = 0.1300 * US\ CPI_{(REV)}/202.41 * ER_{(REV)}/61$$

Where:

V O&M $_{(LREV)}$ = The revised applicable Variable O&M local component indexed with WPI.

$VO\&M_{(FREV)}$ = The revised applicable Variable O&M Foreign component indexed with US CPI and currency fluctuation.

US $CPI_{(REF)}$ = 202.41 US CPI for the month of March 2007

ER $_{(REV)}$ = The Revised TT & OD selling rate of US dollar as notified by the National Bank of Pakistan

Note: The reference numbers indicated above shall be replaced by the revised numbers after incorporating the required adjustments at COD.

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b) Adjustment for LIBOR variation

The interest part of fixed charge component will remain unchanged throughout the term except for the adjustment due to variations in interest rate as a result of variation in quarterly LIBOR according to the following formula;

$$\Delta I = P_{(REV)} * (LIBOR_{(REV)} - 5.40\%) / 4$$

Where:

ΔI = the variation in interest charges applicable corresponding to variation in LIBOR. Δ I can be positive or negative depending upon whether $LIBOR_{(REV)}$ > or < 5.40%. The interest payment obligation will be enhanced or reduced to the extent of Δ I for each quarter under adjustment applicable on quarterly basis.

$P_{(REV)}$ = is the outstanding principal (as indicated in the attached debt service schedule to this order) on a quarterly basis on the relevant quarterly calculations date. Period 1 shall commence on the date on which the 1st installment is due after availing the grace period.

Working capital component of tariff will be adjusted on the basis of quarterly variation in reference KIBOR (10.4%) while spread (200 basis points) remaining the same.

c) Fuel Price Variation

The Variable Charge part of the tariff relating to fuel cost shall be adjusted on account of the fuel price variations as and when notified by the relevant authority, which in the instant case is the Oil & Gas Regulatory Authority (OGRA). In this regard, the variation in EEPL's allowed rate relating to fuel cost shall be revised according to the following formula:

FCg(Rev) = Rs.1.9816 per kWh * FPg(Rev)/Rs. 264.43 per MMBTU

Where:

FCg (Rev) = Revised fuel cost component of Variable Charge on permeate gas

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FPg (Rev) = The new price of permeate gas as notified by the relevant Authority per MMBTU of fuel adjusted for LHV-HHV factor.

FCd(Rev) = Rs. 7.1440 per kWh * [FPd(Rev)/ Rs.32.045 per Litre (Excl-GST)

Where:

FCd (Rev) = Revised fuel cost component of Variable Charge on diesel

FPd(Rev) = The new price of diesel as notified by the relevant Authority per Litre of fuel excluding 15% GST.

iii) Reference tariff table for permeate gas subject to permissible adjustments in accordance with mechanism as provided above will be applicable till 2014 or as long as allocated permeate gas 75 MMCFD is available, which ever is later. Use of HSD for operation on account of gas curtailment (10 days or equivalent hours), temporary interruptions (6 days or equivalent hours) and ATA of OGDCL (20 days or equivalent) is restricted to maximum of 36 days in a year or equivalent hours. The allowance for 36 days per annum or equivalent hours is to be treated as provision and not right of the power producer for its full utilization. EEPL will not be compensated by the power purchaser on account of gas curtailment from the allocated quantity 75 MMCFD, beyond maximum allowance of 10 days or equivalent hours in a year. The maximum allowance of 36 days will be reduced accordingly in case the schedule of ATA of gas processing plant and routine annual maintenance of power plant are matched and carried out simultaneously.

iv) During gas reservoir depletion phase that shall be established through the documentary evidence to be provided by the power producer, the shortfall in available gas will be met by commingling HSD fuel. In this case the maximum fuel cost component per kWh will not exceed the prevalent average fuel cost component per kWh of RFO (HSFO) based power plants. The composite applicable fuel cost component (Permeate Gas+HSD) per kWh will be on actual mix of fuel calculated in accordance with mechanism given in reference table-III. This arrangement will be

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applicable till such time the composite fuel rate per kWh does not exceed the prevalent average fuel cost component of RFO (HSFO) based power plants.

v) At any time during the reservoir depletion phase, if there is a sufficient cause shown by the power producer supported with concrete evidence to the fact that it is commercially no longer viable for EEPL to continue with existing tariff arrangement as given in para (iv) above and therefore, it considers modification in the existing plant facility, the company in that case will seek approval of the Authority for any additional investment or change of fuel for the proposed modification.

IV. Adjustment on account of inflation, foreign exchange variation, LIBOR variation and fuel price variation will be approved and announced by the Authority within seven working days after receipt of EEPL's request for adjustment in accordance with the requisite indexation mechanism stipulated herein.

Terms and Conditions of Tariff:

i) Use of Permeate Gas will be considered as primary fuel.

ii) All new equipment will be installed and the plant will be of standard configuration.

iii) Dispatch criterion will be based on the Energy Charge.

iv) Diesel oil will be used only for startups and other contingent requirements as mentioned above.

v) No startup charges have been accounted for in the above reference tariff table.

The above tariff and terms and conditions be incorporated as the specified tariff approved by the Authority pursuant to Rule 6 of the Licencing (Generation) Rules, in a Power Purchase Agreement between EEPL and CPPA.

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Annexure I

ENGRO ENERGY (PVT) LIMITED

Specified Tariff (Permeate Gas)

Year	Variable Charge (PKR/kWh)				Capacity Charge (PKR/kW/Hour)										Total	
	Fuel	Variable O&M Local	Variable O&M Foreign	Total	Fixed O&M Local	Fixed O&M Foreign	Insurance	Financing Cost on Working Capital	Return on Equity	Return on Equity for Construction Period	Withholding Tax @7.5%	Loan Repayment	Interest Charges	Total	Fixed Cost at 60% Plant Factor Rs./kWh	Cents/kWh
1	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.3297	0.4039	1.2252	4.1822	6.8560
2	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.3583	0.3754	1.2252	4.1822	6.8560
3	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.3893	0.3443	1.2252	4.1822	6.8560
4	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.4231	0.3106	1.2252	4.1822	6.8560
5	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.4597	0.2739	1.2252	4.1822	6.8560
6	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.4996	0.2340	1.2252	4.1822	6.8560
7	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.5429	0.1907	1.2252	4.1822	6.8560
8	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.5900	0.1437	1.2252	4.1822	6.8560
9	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.6411	0.0925	1.2252	4.1822	6.8560
10	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.6967	0.0370	1.2252	4.1822	6.8560
11	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
12	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
13	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
14	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
15	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
16	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
17	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
18	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
19	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
20	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
21	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
22	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
23	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
24	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
25	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
Levelized Tariff (1-25 Years)				**2.1402**	**0.1022**	**0.0065**	**0.0572**	**0.0277**	**0.2542**	**0.0229**	**0.0208**	**0.3128**	**0.1838**	**0.9882**	**3.7871**	**6.2084**

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Annexure II

ENGRO ENERGY (PVT) LIMITED
Specified Tariff (HSD)

Year	Variable Charge (PKR/kWh)				Capacity Charge (PKR/kW/Hour)										Total	
	Fuel	Variable O&M Local	Variable O&M Foreign	Total	Fixed O&M Local	Fixed O&M Foreign	Insurance	Financing Cost on Working Capital	Return on Equity	Return on Equity for Construction Period	Withholding Tax @7.5%	Loan Repayment	Interest Charges	Total	Fixed Cost at 60% Plant Factor Rs./kWh	Cents/kWh
1	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.3389	0.4152	1.2595	9.4061	15.4199
2	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.3683	0.3859	1.2595	9.4061	15.4199
3	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.4002	0.3539	1.2595	9.4061	15.4199
4	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.4349	0.3192	1.2595	9.4061	15.4199
5	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.4726	0.2816	1.2595	9.4061	15.4199
6	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.5136	0.2406	1.2595	9.4061	15.4199
7	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.5581	0.1961	1.2595	9.4061	15.4199
8	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.6065	0.1477	1.2595	9.4061	15.4199
9	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.6590	0.0951	1.2595	9.4061	15.4199
10	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.7162	0.0380	1.2595	9.4061	15.4199
11	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
12	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
13	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
14	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
15	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
16	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
17	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
18	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
19	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
20	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
21	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
22	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
23	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
24	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
25	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
Levelized Tariff (1-25 Years)				**7.3071**	**0.1051**	**0.0067**	**0.0588**	**0.0285**	**0.2614**	**0.0235**	**0.0214**	**0.3215**	**0.1890**	**1.0158**	**9.0001**	**14.7542**

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Annexure-III

Illustrative Reference Table For Calculating Composite Rate
(Permeate Gas+ HSD) in case of shortfall in allocated (75 MMCFD) permeate gas

Gas shortfall percent	0%	7%	13%	20%	24%	27%	33%	40%	47%	53% & above
Gas shortfall MMCFD	0	5	10	15	18	20	25	30	35	40 & above
Net Output of power plant (MW)	216.8	216.8	216.8	216.8	216.8	216.8	216.8	216.8	216.8	216.8
Reference Calorific value of gas (LHV) Btu/Cft	520	520	520	520	520	520	520	520	520	520
Available quantity of gas MMCFD	75	70	65	60	57	55	50	45	40	35
Available quantity of gas per hour MMCF	3.125	2.917	2.708	2.500	2.375	2.292	2.083	1.875	1.667	1.458
Heat value of available Gas MMBTUs/Hour	1625	1517	1408	1300	1235	1192	1083	975	867	758
Shortfall met by HSD (MMBTUs)	0	108	216	325	390	433	541	650	758	866
Calorific Value of HSD BTU/Litre-LHV	34470	34470	34470	34470	34470	34470	34470	34470	34470	34470
Consumption of HSD (Litres)	0	3134	6277	9419	11305	12562	15705	18848	21991	25133
Gas Price Rs./MMBTU-LHV	264.43	264.43	264.43	264.43	264.43	264.43	264.43	264.43	264.43	264.43
HSD Price Rs/Litre	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05
HSD Fuel cost HSD per Hour (Rs)	-	100,421	201,133	301,844	362,271	402,556	503,267	603,979	704,690	805,402
Fuel Cost Gas per Hour (Rs)	429,610	401,046	372,400	343,754	326,566	315,108	286,462	257,815	229,169	200,523
Total Fuel Cost per Hour (Rs)	429,610	501,467	573,533	645,598	688,837	717,663	789,729	861,794	933,860	1,005,925
Composite Rate FCC Rs/kWh	**1.9816**	**2.3130**	**2.6454**	**2.9779**	**3.1773**	**3.3103**	**3.6427**	**3.9751**	**4.3075**	**4.6399**

Note:

1. Reference gas price HHV= Rs. 238.38/MMBTU, converted to LHV by applying a factor of 1.109262
2. Reference Calorific value of permeate gas (LHV) 520 Btu/Cft is subject to change at COD in accordance with terms of the GSA.
3. The above reference table is applicable as per actual usage of gas and HSD. The maximum applicable composite rate in the gas reservoir depletion phase will not exceed the prevalent average fuel cost component of RFO (HSFO) based power plants.

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(NEPRA)
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NO. NEPRA/TRF-72/EEPL-2007

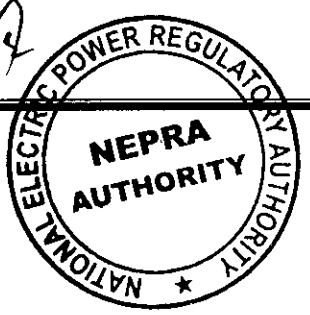
DETERMINATION

OF

TARIFF PETITION

Filed by

ENGRO ENERGY (PVT.) LIMITED (EEPL)



NATIONAL ELECTRIC POWER REGULATORY AUTHORITY (NEPRA)

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Case No. NEPRA/TRF-72/EEPL-2007
July 18, 2007

Petitioner

Engro Energy (Pvt.) Limited (EEPL)

Authority

Nasiruddin Ahmed
Member

Zafar Ali Khan
Member

19/7/07

Abdul Rahim Khan
Member

Saeed uz Zafar
Chairman

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Determination of the Authority in the matter of Tariff Petition filed by Engro Energy (Pvt) Limited- Case No. NEPRA/TRF-72/EEPL-2007

Background

Engro Energy (Pvt) Limited filed a tariff petition on 9.2.2007 for determination of generation tariff for 226.52 MW combine cycle power plant to be set up at Daharki in the province of Sindh. The power plant will operate on permeate gas from Qadirpur gas field. A copy of Tariff Petition filed by EEPL is attached herewith (Annexure-IV)

2. The Authority admitted the tariff petition on February 20, 2007 and decided to hold a hearing in the matter on March 14th, 2007 at Karachi. Notice of the admission/hearing was published in the national newspapers on 24.2.2007 to inform all the interested persons/stakeholders and to invite participation in the tariff-setting process through comments or by becoming a party to the proceedings as interveners. Invitations were also sent to the concerned Federal & Provincial Government ministries, Chambers of Commerce and Industries, representatives of professional bodies and experts, soliciting their views on the tariff petition.

3. A public hearing on the tariff petition was held on March 14, 2007 at Karachi, which was attended by the applicant, the power purchaser and other stakeholders.

4. The applicant has sought approval for two tariffs, one based on permeate gas and the other, in case of non-availability of permeate gas, on high speed diesel.

5. The following main issues have emerged from the tariff application, submission of the commentators and proceedings in the case:

- Availability of Gas and Alternate Fuel
- Net output & Efficiency of the power plant
- Project Cost
- Debt Equity Ratio

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- Fuel Cost
- O&M Expenses
- Insurance
- Working Capital
- Debt Service and ROE
- Applicable Tariff

Availability of Gas and Alternate Fuel

6. The petitioner has submitted that plant will be operated on low BTU (GCV 572 Btu/Cft) permeate gas from Qadirpur gas field. The company has been allocated 75 MMCFD gas for the project. EEPL has stated that permeate gas is different than other available low BTU gas which is directly supplied from the gas wells after condensate knock out and the pipeline quality gas which is supplied directly from the system. The permeate gas from Qadirpur gas field will be supplied as off gas down stream of a gas processing plant.

7. According to latest information provided by the petitioner the committed supply of 75 MMCFD permeate gas is available till 2014. Thereafter the gas reserve will start depleting gradually till completely used up in the year 2017. The permeate gas will be produced by OGDCL and supplied by SNGPL. The company will sign GSA with SNGPL accordingly for useful life of the project. EEPL has stated that supply of gas may vary due to the factors beyond OGDCL/SNGPL control, for which some allowance for use of alternate fuel (HSD) may be allowed. It has been indicated that variation in committed gas quantity may occur due to the following factors.

- Annual turn around of gas processing plant by the gas producer (OGDCL) during which the gas will not be available for about 20 days.
- Temporary interruptions due to tripping of gas processing plant or other operating problems.

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- Permeate gas supply curtailment due to variation in demand of pipeline quality gas in the SNGPL system.

8. In view of the above stated factors it is evident that the company would need an alternate fuel to run its power plant at full capacity. EEPL has proposed HSD as an alternate fuel to meet shortfall in allocated quantity of permeate gas.

9. Use of HSD as an alternate fuel is an expensive proposition compared to RFO. The Authority has considered the option of RFO as an alternate fuel instead of HSD as proposed by the petitioner. The issue has been discussed in detail with our team of experts and EEPL's representatives. Based on the facts brought out during discussions and also report submitted by the expert annexed to this determination, the Authority considers that use of RFO as an alternate fuel is not a viable option at this stage due to the following reasons.

- RFO can not be used as supplementary firing in HRSG.
- GT is designed on gas and HSD.
- GT can use RFO but then only RFO will be used in GT and can not be commingled with gas.
- With use of RFO as main fuel, permeate gas can be used in supplementary firing to the extent of 25 MMCFD.
- The balance 50 MMCFD allocated gas would be flared in to the atmosphere.
- For use of RFO, additional investment for modification of GT design and fuel storage tanks is required. Further variable O&M cost of power plant would become double compared to operation on gas, which will have bearing on tariff for EEPL.

10. In view of the above, HSD as an alternate fuel along with permeate gas as a main fuel, is therefore considered the best viable option in the given circumstances. The company has requested 36 days allowance per annum for operation on HSD. This comprises 20 days allowance (480 hours) to OGCDL for annual turn around, 6 days (144 hours) to OGDCL for temporary interruptions/tripping of gas compressor and 10 days (240 hours) for gas curtailments due to system requirement in the SNGPL system.

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11. The Authority considers that it is the responsibility of the gas supplier to supply committed quantity of gas to the power producer and the risk of unforeseen interruptions if any should be borne by the gas supplier and should not be passed on to the power purchaser. The company has assured that 75 MMCFD gas would be available to it throughout the year. The Authority understands that feasibility report of EEPL with the option of supplementary firing, approved by a panel of experts of PPIB was based on allocated quantity of 75 MMCFD permeate gas throughout the year. Further, the project cost, the output of power plant and other parameters for determining a tariff for EEPL have also been based on availability of 75 MMCFD gas all the time. The power purchaser in the Authority meeting held on 19.6.2007 also explained that feasibility report of EEPL was approved on the understanding and assurance given by the petitioner that allocated 75 MMCFD permeate gas would be available through out the year and for entire life of the project.

12. The Authority therefore, considers that allowance of 36 days for use of HSD as alternate fuel as asked for by the petitioner will put extra burden on the power purchaser which ultimately would be transferred to the end consumer. The petitioner in its latest communication has informed that non-availability of permeate gas during ATA and temporary curtailment as already mentioned above is requirement of the gas producer (OGDCL) and gas supplier (SNGPL) system which is not in control of the company. During non availability of gas, their power plant would be available, but on alternate fuel (HSD) as there will be no gas available to the power producer during this period. We have been informed that gas supplier has ensured guaranteed supply of 60 MMCFD permeate gas. The Authority noted that risk of 15 MMCFD on account of shortfall in allocated gas is being passed on to the power purchaser. EEPL in its communication has informed that the company is in process of negotiating GSA with the gas supplier/producer, who has guaranteed 75 MMCFD gas through out the year along with outage allowance which is far more than what the company has requested through various communications to NEPRA. EEPL has further stated that they will make every effort to curtail this allowance to an aggregate of 36 days. The petitioner has stated that this issue has been discussed in various meetings with PPIB, whereby EEPL has requested PPIB for amicable settlement of this issue with the gas supplier.

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13. The Authority while considering the fact that some other IPPs have been allowed 90 days allowance for use of HSD as an alternate fuel during the period when gas is not available, feels that request of the petitioner for an allowance of 36 days in a year when permeate gas would not be available due to constraints of the gas supplier/provider as mentioned above, is reasonable and therefore accepts demand of the petitioner. The maximum allowance of 36 days or 864 equivalent hours per annum for use of HSD on as and when required basis, is allowed to EEPL. This comprises 10 days or equivalent hours in a year for SNGPL on account of gas curtailment due to its system requirement, 20 days for OGDCL on account of ATA and 6 days for gas interruptions due to tripping of gas compressor. EEPL will not be entitled to any compensation by the power purchaser beyond 10 days per annum allowance for gas curtailment. The company as well as the power purchaser will make every effort that ATA of gas processing plant and routine annual maintenance of power plant by EEPL match with each other, in which case the maximum allowance of 36 days will be reduced to that extent. The power producer will make sure that the available permeate gas is optimally utilized and only the shortfall over available gas is met through HSD.

14. During temporary gas curtailment, the power purchaser will however be at liberty to operate the plant on a single fuel (Permeate gas) or a dual fuel (Gas+HSD) as the case may be. For operation on dual fuel the power purchaser will pay to the company a composite rate arrived at on hourly consumption of each fuel. The mechanism for calculating reference applicable fuel cost component in case of dual fuel operation is given at Annexure-III.

15. The plant would however, be available on HSD only for 20 days during annual turn around (shut down) and also during interruptions or tripping of the gas processing plant for maintenance which will not be more than 6 days or equivalent hours per annum. The company has however, agreed in good faith to match its period of annual maintenance schedule with the annual shut down of gas processing plant.

16. The Authority understands that the quantum as well as the period during which Qadirpur gas reservoir would be depleted is not known with certainty at this stage.

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However, it has been indicated that assured supply of 75 MMCFD permeate gas would be available till 2014 and thereafter gradual depletion would start until completely used up in the year 2017/2018. The Authority feels that in view of uncertain position of gas availability in the future, it would not be prudent at this stage to specify a period for operation of power plant on permeate gas or mix fuel (Gas+HSD) and conversion of power plant to RFO or any other fuel in case gas reservoir is completely depleted as far as applicable tariff over the life of the project is concerned. The Authority has; therefore, decided that tariff on permeate gas or composite rate (Gas+HSD) will be applicable throughout the life of the project in accordance with mechanism given in this determination and order of the Authority.

Net Output & Efficiency of the power plant

17. The petitioner has proposed GE 9171 9 E gas turbine with one HRSG and one steam turbine (1+1+1). The gross out put of the power plant with supplementary firing would be 226.52 MW. After deducting the allowance for mean site conditions and auxiliary consumption (7MW) the net output of the power plant on permeate gas will be 216.8 MW. The net out put of 216.8 MW has been calculated on the basis of following parameters;

Gross calorific value of permeate gas	= 572 Btu/Scft
Net calorific value of permeate gas	= 520 Btu/Scft
Gas allocation	= 75 MMCFD
Gas allocation per hour	= 3.125 MMCft
Net efficiency of CCPP	= 45.53%

18. The petitioner has indicated that calorific value of permeate gas from Qadirpur gas field varies in the range of GCV 565-625 Btu/Scft in a whole year which will have direct bearing on net out put of the complex. In view of this the Authority has decided to accept net out put of the power plant as proposed by the petitioner subject to the condition that final net dependable capacity of the complex will be determined on the basis of IDC test to be jointly carried out by the Central Power purchasing Agency (CPPA) and the petitioner.

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19. In order to completely utilize 75 MMCFD allocated gas, supplementary firing of gas in HRSG has been proposed. The petitioner has therefore, proposed a larger size of HRSG and steam turbine than the conventional configuration. According to the petitioner 56.4 MMCFD gas would be required in GT to generate 168 MW, while the balance quantity of 18.6 MMCFD allocated gas will be used for supplementary firing in HRSG, which will generate additional 48.8 MW and the total output of the complex will increase to 216.8 MW. In order to accommodate large quantity of steam the sponsors have proposed HRSG and a steam turbine (120 MW) of double capacity instead of 60 MW for conventional plant configuration. This arrangement has been proposed to avoid wastage of precious national resource by flaring of unused gas. The following information with respect to capacity and efficiency with and without supplementary firing of the proposed power plant has been provided to us by the petitioner.

Description	Without Supplementary Firing	With Supplementary Firing
Gross Plant Capacity ISO	196	226.52
Gross Plant Capacity Reference Conditions	180	223.8
Net Capacity	168.3	216.8
Gross Thermal Efficiency on Permeate Gas (MSC)	49%	47%
Net Thermal Efficiency	47.2%	45.53%

20. The petitioner has stated that net efficiency of the plant is slightly lower than the conventional plant configuration due to supplementary firing of permeate gas. The amount of gas burnt in the HRSG has an efficiency of the simple thermal cycle which is lower than the combined cycle operation. Further, the presence of high H_2S content (320ppm) in the permeate gas, requires that the exhaust steam temperature be kept at 10°C above acid dew point to avoid corrosion due to acid condensation. This would result a higher heat loss in the exhaust gas and thus lowers the net efficiency of plant. The petitioner has stated that the figure for net thermal efficiency has been carefully worked out keeping in view all the technical parameters.

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21. EEPL has proposed that in case of non availability of permeate gas or temporary curtailment of permeate gas due to the factors mentioned in the foregoing paras, the use of alternate fuel such as HSD is mandatory. The net thermal efficiency of power plant on HSD is proposed to be 44.4% with supplementary firing in HRSG. In the initial submissions the petitioner had estimated net thermal efficiency of 45.26% which was without supplementary firing. According to the latest information provided by the petitioner, it has been confirmed by the gas turbine and HRSG manufacturers that HSD can also be used as supplementary firing in HRSG and the revised net capacity and efficiency on HSD with supplementary firing as submitted by the petitioner would be 210.9 MW and 44.4% respectively.

22. The petitioner was asked to provide the detailed working for proposed net capacity and net efficiency of the power plant on each fuel with supplementary firing. The matter being of technical nature and unique for this project was referred to our Technical Expert for evaluation and recommendations for fixing a reasonable level of net capacity and efficiency that may be allowed to EEPL. The Authority in a meeting held on 11.06.2007 decided to appoint an independent technical expert for assistance of the Authority in arriving at a reasonable efficiency level that may be allowed to EEPL. The Authority's meeting to discuss the issue of net efficiency was held on 19.06.2007 in the presence of representatives of EEPL, CPPA and our technical expert. Our technical expert Mr. Abu Adil was asked to submit report to the Authority along with recommendations regarding net thermal efficiency on both fuels i.e Permeate gas and HSD based on information/data provided by the petitioner and his own professional experience in the field. The expert has submitted his report on 28.06.2007 which is attached herewith as Annexure-V. According to expert's recommendations the efficiency of the CCPP as proposed by the petitioner on permeate gas and HSD is reasonable. So the net thermal efficiency of CCPP on permeate gas with supplementary firing and HSD as proposed by the petitioner i.e. 45.53% and 44.4% is accepted.

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Project Cost

23. EEPL submitted a total project cost of US$ 228.97 million which is US$ 1010/kW. The following break up of various project cost components has been provided by the petitioner.

Cost Components	US$ Million
EPC Cost	168.000
Project Specific EPC Cost	10.000
Project Development	6.700
Services	12.830
Total CAPEX	197.530
IDC	17.320
Return on Equity during construction period	9.120
Financing Fee	3.330
Foreign Loan Registration Stamp Duty	1.670
Total Project Cost	228.970
Total project cost US$ per KW	1010

EPC Cost

24. EPPL did not provide the cost break-up of various plant & Equipment and other EPC cost in the tariff petition. The petitioner in response to our information direction submitted that it has proposed EPC Cost of US$ 168 million on the basis of estimates provided by their consultant M/s Fichtner of Germany in the feasibility study which was based on quotes received by them from various equipment suppliers. The following break up of EPC cost has been provided in the feasibility study for EEPL.

Description	US$ Million
Gas Turbine Unit	33.000
Heat Recovery Steam Generator	25.000
Steam Turbine unit with condenser	22.000
Cooling System	1.000
Balance of Plant	31.000
Electrical System	28.000
C & I System	8.000
Civil Works and Erection	20.000
Total	168.000

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25. The petitioner has stated that EPC market is currently highly un-predictive due to industrial boom all over the world in general and Middle East in particular. This has resulted in non-availability of EPC Contractors, and the ones who agree to bid for the projects are quoting very high cost due to ever increasing material prices and high premium being charged by the equipment suppliers as the shops are over booked coupled with long delivery times. EEPL has stated that they are working with their EPC Contractor M/s China National Chemical Engineering Group Corporation (CNCEC) and have selected world renowned critical equipment suppliers e.g. GE, ABB, Hangzhou Boiler, KSB etc to finalize the design and configuration of plant which is not only technically and economically viable for their unique project configuration but is also similar to the one approved in the feasibility study by PPIB. EEPL has informed that EPC Contractor has been selected after having floated ITB to 13 renowned EPC Contractors around the world.

26. The cost of similar gas turbine (GE 9171 9E) determined by the Authority in October 2006 in the case of Foundation Power Company Daharki Ltd (FPCDL) was US$ 27.777 million. EEPL has stated they have taken the same price as recommended by their consultant (Fichtner) in the feasibility report. In principle the price of a similar gas turbine should not increase over a short period. However, considering volatile market for equipment suppliers amid global demand supply position and general inflation in the international market, it seems reasonable to allow 10% increase over cost of gas turbine allowed to FPCDL. The approved cost for gas turbine therefore works out US$ 30.553 million.

27. EEPL has stated that HRSG selected for its plant is double in size compared to its conventional size for this type of GT. The decision to select bigger HRSG has been made to completely utilize the available quantity of permeate gas with supplementary firing and requested US$ 25 million as cost of HRSG. The cost of HRSG demanded by the petitioner is more than double of what has been allowed to FPCDL. The petitioner has stated that special metal/material will be used to avoid corrosion due to formation of acid (H_2SO_4) in the presence of high content of H_2S (320 ppm) in the permeate gas. After considering the allowance for bigger size of HRSG and further adjusting by 10% as done

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for Gas turbine cost, the cost of HRSG which is being allowed to EEPL works out US$ 23.179 million.

28. The cost of steam turbine estimated by EEPL is US$ 22.000 million. The petitioner has proposed a steam turbine of (approx) 120 MW capacity which is of double capacity than the conventional type of 60 MW capacity installed with 120 MW class of gas turbine. The decision to select bigger steam turbine has been made to fully utilize large quantity of steam produced in the HRSG from GT exhaust gas as well as supplementary firing of balance quantity of available permeate gas. The petitioner has stated that with supplementary firing of permeate gas and by selecting HRSG and steam turbine of large size they will be able to produce additional output of about 48.6 MW.

29. The cost of steam turbine allowed to FPCDL was US$ 14.734 million which was of 60 MW capacity. On this basis, the cost of 120 MW steam turbine calculates to US$ 29.50 Million. Factually the cost of 120 MW steam turbine should not be double to that of 60 MW steam turbine. Increasing FPCDL's cost of steam turbine by a factor of 1.6 times, the cost for EEPL's steam turbine of 120 MW works out US$ 23.574 million. In view of this the cost of steam turbine requested by the petitioner US$ 22.00 million seems reasonable and allowed as such.

30. EEPL has proposed US$ 31.000 million for balance of plant cost which also include black start facility. This will be accomplished by installing two generators of 2 MW each accompanied with control and switch gear. The Authority has allowed US$ 25.6 million for balance of plant in the case of Saif and Sapphire power Ltd. The demand being reasonable is allowed as such.

31. EEPL has requested US$ 28.00 for Electrical system cost. The same allowed to Foundation Power Company was 27.500 million. EEPL has stated that transmission line between Fauji and Rohri will be looped in and out of the power plant. This was identified in Load Flow study conducted by NTDC as part of the detailed feasibility study approved by PPIB. Therefore Engro has to install four lines compared to two lines. This has

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increased the scope and size of HV switchgear, protection system and ratings of the fault interrupting devices. The request of the petitioner being reasonable is accepted as such.

32. We have been informed that EPC contractors normally offer a lump sum price for EPC contract, which includes plant & equipment, transportation, installation & erection etc. It is therefore, understandable that item by item comparison of plant & equipment cost with other IPPs, especially with different plant capacity & configuration, would not result in correct estimation of cost. It is therefore considered more appropriate that cost comparison may be made on per kW cost basis. Accordingly, a comparative table showing plant & equipment cost demanded by the petitioner and allowed by the Authority is given hereunder:

Description	**Demanded US$ M**	**Allowed US$ M**
Gas Turbine	33.000	30.553
Heat Recovery Steam Generator	25.000	23.179
Steam Turbine	22.000	22.000
Water cooling system	1.000	1.000
Balance of Plant	31.000	31.000
Water & waste water system	3.100	3.100
Electrical system	28.000	28.000
C&I system	8.000	8.000
Civil works and erection	20.000	20.000
Total	171.100	166.832
Cost per kW US$	755	736

33. The petitioner has requested for some other project specific EPC Costs which include cost for housing colony and access road amounting to US$ 4.1 million and 0.300 million respectively. The cost for housing colony given in the feasibility report was US$ 3.00 million. The power purchaser in its comments has also recommended US$ 3.00 million for cost of housing colony. EEPL has stated that due to rise in prices of steel and other construction material, the cost for residential colony has been increased from US$ 3.00 million given in the feasibility report to US$ 4.1 million. It has also been stated by the petitioner that their cost for housing colony is less than what has been allowed by the Authority in case of Foundation Power Company which is located in the same area. The

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petitioner has indicated that their housing colony is adjacent to the existing colony of Engro Chemical plant and some of the facilities and costs will be shared. In view of this the Authority considers that US$ 3.500 million for cost of housing colony is a reasonable estimate and allowed to EEPL.

34. EEPL has estimated US$ 0.300 as cost of access road which being reasonable is accepted as such.

35. The petitioner has informed that US$ 2.500 million for gas pipeline cost initially submitted is withdrawn as SNGPL will construct, own and operate the gas pipeline, hence not considered now.

36. The approved total EPC cost after taking in to the account the cost for housing colony and access road works out US$ 170.632 million or US$ 751/kW. This is US$ 54/kW less than that of FPCDL (US$805/kW).

Project Development

37. EEPL has estimated US$ 6.7 million for project development cost with the following cost break-up:

Project Development cost	US$ Million
Permits, Feasibility, ITB, Bid evaluation,	0.730
Consultancy Financial (Lenders)	0.700
Consultancy (Legal & Commercial)	0.270
Company Overheads during development	2.340
Bank Charges for performance guarantee	1.500
Land acquisition Including fees	1.160
Total	6.700

38. The major item of project development cost included in above is the company overheads US$ 2.34 million. According to details provided by the petitioner, the company overheads includes, Salary, wages and benefits to the company employees (US$ 1.28 million), Office expenses including shared services from ECPL (US$ 0.29 million), travelling expenses (US$ 0.248 million) and head office expenses (US$ 0.487 million). The Authority has already allowed US$ 2.1 million in the case of FPCDL.

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Considering increase in salary & wages and general inflation in the country, the amount of US$ 2.340 million as requested by the petitioner is reasonable and, therefore, allowed.

39. After going through the details of bank charges and other cost items provided by the petitioner and making necessary adjustments, an amount of US$ 6.194 million is approved for project development cost. The break-up is given hereunder:

Project Development	**Approved US$ M**
Permits feasibility, bid evaluation	0.700
Company Overheads during development	2.340
Consultancy , financial, legal, commercial permits and bank charges	1.994
Land acquisition including fees	1.160
Total	6.194

Other costs and Services

40. EEPL has requested US$ 12.830 million for cost of services with the following break-up:

Services Cost	**US$ Million**
Administrative cost of project company	1.940
Construction Management	6.490
Insurance during construction	2.800
Utilities during construction	0.500
Fuel cost during testing	0.600
First fill of lubes & chemicals	0.500
Total	12.830

41. As per details provided by the petitioner the Administrative cost of the company US$ 1.94 million mainly include salary & wages of project staff during the project execution phase, traveling expenses of the company and shared services from ECPL and head office. The estimates for administrative cost of the project company have been compared with costs of other IPPs recently determined by the Authority and found to be at a reasonable level and, therefore, approved.

42. The cost for Construction Management requested by the petitioner as US$ 6.49 million is considerably on the higher side. The petitioner was asked to provide the

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detailed cost break-up of this cost component. According to the details provided by the petitioner the cost for construction management include owner's Engineer services and fee, traveling expense of project team, IT & Telecom Cost, Temporary Office facilities, transportation costs, schooling cost for staff kids and utility expenses etc. EEPL has stated that their estimated cost for construction management is high mainly due to the fact that O&M of the power plant after COD will be done by the company itself for which it needs to employ and train all the operational staff during the project execution phase.

43. The information provided by the petitioner has been thoroughly examined which shows that certain items of costs included under construction management of the company (e.g. IT& Telecom expenses, salary & wages of project team etc) are quite on the higher side when compared to that of other IPPs, therefore need to be rationalized. Accordingly after making necessary adjustments US$ 2.743 million is assessed a reasonable estimate for construction management costs of the company which is being allowed.

44. EEPL has requested US$ 2.800 million for Insurance during construction. The Authority has allowed 1.5% of EPC in case of other IPPs. On this basis the Insurance cost during construction comes to be US$ 2.502 million which is allowed to EEPL.

45. The estimate for Other Costs component such as Utilities during construction, fuel cost during testing and first fill of lubes are in line with determined by the Authority for other IPPs, therefore US$ 0.500 million each for utilities charges, fuel cost during testing and first fill of lubes is allowed. The fuel cost during testing after synchronization with the grid will however, be paid to the company by the power purchaser on the basis of units delivered.

46. As discussed above the total cost under the head 'Services cost' therefore, works out US$ 8.685 million, which is being allowed to EEPL.

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Financing Fee & Interest during construction

47. EEPL has proposed US$ 5.00 million comprising US$ 3.33 million for financing fee which is 1.8% of EPC cost and US$ 1.67 million for foreign loan registration stamp duty. According to the petitioner the financing fee including foreign loan registration stamp duty has been calculated @ 3% of the loan amount. EEPL has proposed foreign lending through IFC. On this basis, the financing cost for EEPL works out US$ 4.174 million. The cost for foreign loan registration stamp duty will however be adjusted as per actual subject to maximum of US$ 1.67 million at the time of COD.

48. EEPL has calculated US$ 17.32 million as Interest during construction. The IDC has been based on 28 months of construction period @ 8.4% (Libor 5.4% +3% spread) and calculated as per disbursement schedule provided by the petitioner.

49. The IDC for EEPL has been worked out US$ 14.983 million which is an estimated amount and will be adjusted at COD on the basis of actual disbursement of loan for the construction period allowed under the PPA.

50. EEPL has capitalized an amount of US$ 9.12 million for return on equity during the construction period and shown as component of total project cost, which principally is not correct and hence not considered here. The return on equity during construction period is taken care off separately while determining IRR based 15% return which takes into account the return during the construction period as well. The return during construction will however be adjusted as per actual equity investment during the construction period, at the time of COD

Custom Duty & Taxes

51. EEPL has stated that their EPC cost is inclusive of 5% custom duty on imported plant & equipment (about 70% of EPC cost) and 6% Withholding Tax on local services. Accordingly, US$ 6.797 million has been estimated for custom duty and other taxes

payable by the company. This will however, be adjusted on actual payment basis on production of original receipts at the time of COD.

52. EEPL has stated that no other taxes or duties have been considered in any other project cost. If levied the same will be pass through. The demand of the petitioner is reasonable and will be taken care of in the light of PPA.

53. Based on discussion in the foregoing pages the approved total project cost for EEPL is summarized in the table given below.

Project Cost	US$ (Million)
EPC cost including access road & housing colony	170.632
Project Development Cost	6.194
Services Cost	8.685
Total CAPEX	185.511
Financing fee and charges	4.174
Interest During Construction	14.983
Total Project Cost	204.668

Debt Equity Ratio

54. EEPL has proposed that 75% of the project cost will be funded through debt in foreign currency (USD). The funds will be obtained from the IFC who have consented to provide the required financing. In the initial submissions EEPL had proposed a mark up of LIBOR plus spread of 350 basis points. After negotiations with the lenders we have now been informed that their lenders have agreed to finance on LIBOR plus 300 basis points which is in line with determinations of the Authority for other IPPs. The tenor of loan would be 10 years after COD. The principal and interest payments will on semi annual basis.

55. The equity to be injected by the sponsors will be equivalent to 25% of the total project cost. The whole equity has been proposed in local currency with return based on 15% IRR net of 7.5% Withholding Tax. EEPL has requested that local equity will be indexed to WPI.

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56. The proposed financing structure and other assumptions are in general agreement with those of other such IPPs and hence accepted. However, WPI indexation on equity is not in line with GoP policy therefore can not be considered.

Fuel Cost

57. EEPL has worked out its fuel cost per kWh on permeate gas and HSD based on the following parameters;

Permeate Gas Price	264.9 Rs/MMBTU
HHV – LHV Factor	0.9015
Permeate gas price-LHV	293.84 Rs./MMBTU
Net thermal efficiency on Permeate gas with supplementary	45.53%
Heat Rate on permeate gas	7494 BTU/kWh
Calorific value of HSD-(NCV)	41800 KJ/KG
Density	0.87
Calorific value of HSD-(NCV)	36366 KJ/Litre
Calorific Value of HSD-(NCV)	34474 Btu/Litre
HSD price	37.7 Rs/Litre
HSD Price (without 15% GST)	32.045 Rs./Litre
Net thermal Efficiency on HSD With supplementary firing	44.4%
Heat Rate HSD	7685 BTU/kWh

58. EEPL has proposed the same price for permeate gas as for pipeline quality gas and worked out its fuel cost component on permeate gas on that basis. Since, permeate gas contain impurities such as CO_2 and high content of H_2S which lower the thermal efficiency as well as increase the project cost due to required modifications in the original design and configuration of power plant. The resulting high tariff due to these factors, should in principle be compensated through fixing lower price for permeate gas by the gas regulator.

59. Based on above parameters and taking the current pipeline quality gas price as Rs, 238.38 and adjusted for HHV-LHV with factor of 1.109262 (Rs.264.43/MMBTU), the fuel cost component for operation of complex on permeate gas and HSD with

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supplementary firing has been worked out as Rs. 1.9816/kWh and Rs. 7.1440/kWh respectively.

O & M Expenses

60. EEPL has estimated US$ 8.128 million for O& M costs per annum. The following break-up has been provided by the petitioner

O&M Component	US$ Million	Fixed	Variable
Operational Cost	3.004	100%	0%
Maintenance Cost	2.934	13%	87%
Chemicals/Lubricants	0.410	0%	100%
Insurance Cost	1.780	100%	0%

61. According to the information provided by the petitioner the Fixed component of O&M cost mainly consists of Operational cost and a part of maintenance cost. The operational costs of the company consist of Salary, wages and benefits, traveling and transportation, utility charges, office expenses etc. EEPL has estimated US$ 3.004 million for operation cost per annum. Some portion of maintenance cost (approx. 13%) such as IT& some consumable cost are fixed in nature and included in the fixed O&M component. Total Fixed O&M cost after including a portion of maintenance cost comes out to be US$ 3.385 million per annum. EEPL has provided detailed working and justification of per annum O&M cost. The petitioner has stated that 6% of fixed O&M cost would be in foreign currency while 94% would be in local and hence requested for indexation in the foreign and local component of fixed O&M cost. The Fixed O&M cost of EEPL has been thoroughly examined and found to be reasonable therefore allowed as such.

62. We have been informed that all Operation and routine maintenance of the complex will be carried out by the company itself. The Variable O&M cost of the company, therefore, includes the cost of spare parts required for maintenance of power plant, GT inspection, overhauling cost as per manufacturers recommendations and cost of

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consumables. The per annum Variable O&M requested by the petitioner based on 60% plant factor is US$ 2.963 million which being reasonable is accepted as such.

63. The O&M cost per unit has been worked out as hereunder:

Fixed O&M	Rs./kW/H
Local Component	0.1136
Foreign Component	0.0072
Variable O&M	
Local Component	0.0285
Foreign Component	0.1300

64. The O&M cost in case of operation of plant on HSD is considered to be the same as for operation on permeate gas. This is due to the fact that actual operation of power plant on HSD due to shortfall in allocated gas is not known at this stage. The maximum allowance of 36 days which is equivalent to 10% (approx) of total annual running hours will not considerably change the per annum O&M cost for the company. Therefore, the same tariff for O&M cost as worked out for permeate gas will be applicable in case of operation on HSD.

Insurance

65. EEPL has requested US$ 1.78 million for insurance of its plant and equipment, which is 1% of requested total EPC cost. The petitioner has informed that they will arrange insurance through local agent and pay annual insurance premium in local currency. The insurance cost of US$ 1.78 million being within the maximum limit of 1.35% of plant & equipment cost is therefore accepted. This will be adjusted on actual basis subject to maximum of 1.35% of plant & equipment cost on production of authentic documentary evidence at the time of COD.

Working Capital Requirement

66. The petitioner has requested Rs. 0.0589/kW/Hour on account of working capital requirement for the company. The petitioner has stated that for HSD as backup fuel, it

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requires fuel inventory equivalent to 7 days of plant operation at full capacity. EEPL has further stated that it also requires funds for initial inventory of essential spare parts estimated as US$ 6.5 million. The working capital requirement will be met through a separate loan based on KIBOR (10.4%) with spread of 200 basis points.

67. The demand of the petitioner being in line with decision of the Authority in other such case is accepted. Accordingly, the cost of interest charges to be recovered through working capital component of tariff has been worked out Rs. 0.277/kW/Hour. The cost of inventory for fuel and spare parts has been worked out on LIFO basis therefore, no adjustment on account of price variation for fuel stock and spare parts inventory is allowed. However, EEPL will be entitled to any variation in KIBOR rate over the reference value while spread remaining the same.

Debt Servicing

68. EEPL has proposed that 75% of the total project cost will be funded through debt in foreign currency (USD). The debt will be paid through semi-annual payments in 10 years after COD. The mark-up rate used by the petitioner for working out its annual debt servicing is LIBOR at 5.4% plus 300 basis points. The petitioner has requested for adjustment of PKR/US$ exchange rate variation on semi-annual basis.

69. The Authority in its recent determinations has allowed payment of debt service on quarterly basis. The power purchaser has also requested that for the purpose of uniformity and consistency debt servicing may be allowed on quarterly basis. EEPL is therefore allowed debt service payments on quarterly basis. Based on reference PKR/US$ exchange rate of 61 and LIBOR 5.4% and premium of 3% the debt service component of tariff has been worked out Rs. 0.7336/kW/Hour.

Return on Equity Investment

70. The company has proposed that 25% of total project cost will be funded through equity investment. EEPL has assumed 100% equity investment in local currency. The

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return on equity has been based on 15% IRR net of withholding tax, which will be indexed to WPI.

71. The arrangement proposed by the petitioner is in accordance with the 2002 GoP policy and hence accepted. However, WPI indexation on equity as requested by the petitioner can not be considered as the GoP policy does not allow such indexation. However, dollar to rupee exchange rate variation as allowed by GoP in the recent ECC decision of the cabinet dated 30.05.2007 will be allowed to EEPL.

Applicable Tariff

72. EEPL has requested that two separate tariffs one on permeate gas and the other on HSD in case of non-availability of permeate gas may be allowed. Request of the petitioner has been considered from different aspects while keeping in view the position of gas availability peculiar to this project. If the petitioner is allowed a single tariff based on permeate gas only then the following factors are worth consideration.

- As per the petitioner, the gas processing plant of the gas supplier (OGDCL) will shut down for 20 days for annual maintenance. During this period there will be no gas, but the power plant will be available on HSD only.
- According to the standardized PPA, the fixed cost component of the tariff is to be paid on the basis of hourly plant availability.
- The net capacity of EEPL's complex on permeate gas is 216.8 MW and in case of full operation on HSD fuel it decreases to 210.9 MW.
- The hourly availability of plant during 20 days of annual turn around would be at a reduced capacity of 210.9 MW. EEPL will be paid for fixed cost component of tariff on the basis of tariff calculated at net capacity of 216.8. This will result in less than 100% recovery of annual fixed cost for the company.

73. In order to ensure 100% recovery of annual fixed costs for the company it is considered justified that two separate tariffs; one based on permeate gas and the other on HSD be allowed to EEPL. The main fuel for EEPL will be permeate gas and reference

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tariff based on permeate gas will be applicable throughout the year except for a period of 20 days of annual turn around when tariff for HSD will be applicable.

74. The reference tariff on permeate gas and HSD will be applicable for 25 years life of the project. During the first phase of project life i.e. the period when allocated quantity of permeate gas is available, use of HSD along with available permeate gas subject to maximum of 36 days in a year or equivalent hours is allowed to meet shortfall in generated capacity of power plant on account of day to day variation in committed supply of gas during gas curtailments/interruptions. The allowance for 36 days per annum or equivalent hours is to be treated as provision and not right of the power producer for its full utilization, in view of gas supply constraints already discussed in the preceding pages. The operation of power plant on HSD will be kept to the minimum while ensuring 100% utilization of available gas. The procedure to monitor availability of gas on day to day basis will be finalized between EEPL and the power purchaser at the time of signing PPA.

75. In case of reservoir depletion (2nd phase), when gas availability will be less than allocated quantity due to gradual depletion of gas reservoir, the applicable composite rate per kWh for fuel cost component of tariff will be calculated as per actual mix of fuel (Gas+HSD) in accordance with reference table –III. The use of HSD along with available permeate gas is allowed to the extent such that the maximum applicable composite rate per kWh for fuel cost component charged by the power producer does not exceed the prevalent average fuel cost rate per kWh for RFO (HSFO) based power plants. For other cost components of tariff, the reference tariff table on permeate gas will be applicable. The power purchaser will however dispatch the plant according to the economic merit order. The power producer will make sure that 100% available permeate gas is utilized first and only the shortfall in permeate gas is met through HSD.

76. At any time during the reservoir depletion phase, if there is a sufficient cause shown by the power producer supported with concrete evidence to the fact that it is commercially no longer viable to continue with existing tariff arrangement and therefore, it considers modification in the existing plant facility, the company in that case will seek

approval of the Authority for any additional investment or change of fuel for the proposed modification.

77. Based on above decision of the Authority, reference tariff tables applicable on permeate gas and HSD and a reference table for calculating applicable composite fuel cost component is given per annexure-I, II and III.

ORDER

78. Pursuant to Rule 6 of the NEPRA Licensing (Generation) Rules 2000, Engro Energy (Pvt) Limited is allowed to charge, subject to adjustment of Capacity Purchase Price on account of net dependable capacity as determined by test jointly carried out by Central Power Purchasing Agency (CPPA) and the petitioner, the following approved specified tariff for delivery of electricity to CPPA of NTDC for procurement on behalf of Ex-WAPDA Distribution Companies:

Reference Tariff

Tariff Components	Year 1 to 10	Year 11 to 25	Indexation
Capacity Charge PKR/kW/Hour)			
O&M Local	0.1022	0.1022	WPI
O&M Foreign	0.0065	0.0065	US$/PKR
Cost of Working Capital	0.0277	0.0277	KIBOR
Insurance	0.0572	0.0572	Nil
Debt Service	0.7336	-	LIBOR
Return on Equity	0.2542	0. 2542	NIL
ROE during Construction	0.0229	0.0229	NIL
Total Capacity Charge	**1.2043**	**0.4707**	
A) Energy Charge for Operation on Gas Rs./kWh			
Fuel Cost Component	1.9785	1.9785	Fuel Price
Variable O&M Local	0.0285	0.0285	WPI
Variable O&M Foreign	0.1300	0.1300	US$ to PKR
B) Operation on HSD Rs./kWh			
Fuel Cost Component	7.1440	7.1440	Fuel Price

Note: i) Capacity Charge Rs./kW/hour is applicable to dependable capacity at the delivery point.

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ii) Dispatch criterion will be Energy Charge.

iii) The above tariff is applicable for a period of 25 years commencing from the date of the Commercial Operation.

iv) Component wise tariff for operation on Gas and HSD is indicated at Annexure I & II.

v) Mechanism for calculating composite tariff (Permeate Gas+HSD) during gas curtailment is given at Annexure-III.

The following indexations shall be applicable to reference tariff;

I. One Time Adjustment

a) Adjustment due to variation in net capacity

The reference tariff has been determined on the basis of minimum net capacity of 216.80 MW at delivery point at mean site conditions. All the tariff components except fuel cost component shall be adjusted at the time of COD based upon the IDC tests to be carried out for determination of contracted capacity. If the IDC is established higher than 216.80 MW, the adjustments shall be made according to the following formula:

i) Revised O&M Local	=	0.1022/tested IDC x 216.80 MW
ii) Revised O&M Foreign	=	0.0065/tested IDC x 216.80 MW
iii) Cost of Working Capital	=	0.0277/tested IDC x 216.80 MW
iii) Insurance	=	0.0572/tested IDC x 216.80 MW
iv) Debt Service	=	0.7336/tested IDC x 216.80 MW
v) Return on Equity	=	0.2542/tested IDC x 216.80 MW
vi) ROE during Construction	=	0.0229/tested IDC x 216.80 MW
vii) Variable O&M Local	=	0.0285/tested IDC x 216.80 MW
viii) Variable O&M Foreign	=	0.1300/tested IDC x 216.80 MW

b) Adjustment in Insurance as per actual

The actual insurance cost for the minimum cover required under contractual obligations with the Power Purchaser not exceeding 1.35% of the Plant & Equipment cost will be treated as pass-through. Insurance component of reference tariff shall be adjusted as per actual on yearly basis upon production of authentic documentary evidence by EEPL according to the following formula;

Insurance (Revised) = AIC/$1.78 million x AP

Where;

AIC = Adjusted Insurance Component as per IDC Test

AP = Actual Premium

c) Adjustment due to custom duties, withholding tax and Interest during Construction

Debt Service, Return on Equity and ROE during construction shall be adjusted on account of actual variation in customs duties, withholding tax, drawdown and Interest During Construction with reference to the estimated figures of USD 6.797 million and USD 14.983 million respectively. EEPL shall submit the relevant documents to NEPRA within 7 days of COD for adjustment of relevant tariff components.

d) Adjustment in project cost due to variation in Dollar/Rupee parity

Any variation in project cost during construction period on account of variation in dollar/Rupee parity shall be allowed through adjustment in the project cost. For the purpose of this adjustment petitioner shall provide payment schedule along with the exchange rate prevalent on the date of particular transaction. EEPL's final reference tariff table shall be revised on COD to incorporate all the permissible adjustment during construction period.

II. Pass-Through Items

No provision for income tax has been accounted for in the tariff. If EEPL is obligated to pay any tax on its ROE, the exact amount paid by the company may be reimbursed by CPPA to EEPL on production of original receipts. This payment will be considered as pass-through (as Rs./kW/hour) hourly payment spread over a 12 months period in addition to the capacity purchase price in the Reference Tariff. Furthermore, in such a scenario, EEPL will also submit to CPPA details of any tax shield savings and CPPA will deduct the amount of these savings from its payment to EEPL on account of taxation.

Withholding tax is also a pass through item just like other taxes as indicated in the government guidelines for determination of tariff for new IPPs. Withholding tax shall be allowed @7.5% or applicable rate on ROE. CPPA (NTDC) shall make

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payment on account of withholding tax at the time of actual payment of dividend subject to maximum of 7.5% or applicable rate of 15% equity according to the following formula:

Withholding Tax Payable = [{15% * (E(Ref) – E(Red)} +ROEDC(Ref)] * 7.5%

Where:

E(Ref) = Reference Equity (US$ 51.167 million x 61)

E(Red) = Equity Redeemed

ROEDC(Ref) = Reference Return on Equity During Construction

In case Company does not declare a dividend in a particular year or only declares a partial dividend, then the difference in the withholding tax amount (between what is paid in that year and the total entitlement as per the Net Return on Equity) would be carried forward and accumulated so that the Company is able to recover the same as a pass through from the Power Purchaser in future on the basis of the total dividend pay out.

III. Indexations:

The following indexation shall be applicable to the reference tariff as follows;

a) Indexation applicable to O&M

The local part of Fixed O&M cost will be adjusted on account of Inflation (WPI) and Fixed O&M foreign will be adjusted on account of variation in dollar/Rupee exchange rate and US CPI. Quarterly adjustment for local inflation, foreign inflation and exchange rate variation will be made on 1st July, 1st October, 1st January & 1st April respectively on the basis of average of the latest available information with respect to WPI (notified by the Federal Bureau of Statistics), US CPI and revised TT & OD Selling rate of US Dollar as notified by the National Bank of Pakistan. The mode of indexation will be as follows:

(i) Fixed O&M

$F\ O\&M_{(LRev)} = 0.1022 * WPI_{(REV)} / 118.96$

$F\ O\&M_{(FRev)} = 0.0065 * US\ CPI_{(REV)} / 202.41 * ER_{(REV)} / 61$

Where:

F O&M$_{(LRev)}$ = the revised applicable Fixed O&M Local Component of the Fixed Charges indexed with WPI

F O&M ($_{FRev}$) = the revised applicable Fixed O&M Foreign Component of the Fixed Charges indexed with US CPI and Currency fluctuation

$WPI_{(REV)}$ = the Revised wholesale Price Index (manufactures)

$WPI_{(REF)}$ = 118.96 wholesale price index (manufactures) of March 2007 notified by the Federal Bureau of Statistics

US $CPI_{(REF)}$ = 202.41 US CPI for the month of March 2007

$ER_{(REV)}$ = the Revised TT & OD selling rate of US dollar as notified by the National Bank of Pakistan

The reference numbers indicated above shall be replaced by the revised numbers after incorporating the required adjustments at COD.

(ii) Variable O&M

The formula for indexation of Variable O & M component will be as under:

V O&M$_{(LREV)}$ = 0.0285 * WPI $_{(REV)}$ /118.96

V O&M$_{(FREV)}$ = 0.1300 * US $CPI_{(REV)}$/202.41*$ER_{(REV)}$/61

Where:

V O&M $_{(LREV)}$ = The revised applicable Variable O&M local component indexed with WPI.

VO&M$_{(FREV)}$ = The revised applicable Variable O&M Foreign component indexed with US CPI and currency fluctuation.

US $CPI_{(REF)}$ = 202.41 US CPI for the month of March 2007

ER $_{(REV)}$ = The Revised TT & OD selling rate of US dollar as notified by the National Bank of Pakistan

Note: The reference numbers indicated above shall be replaced by the revised numbers after incorporating the required adjustments at COD.

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b) Adjustment for LIBOR variation

The interest part of fixed charge component will remain unchanged throughout the term except for the adjustment due to variations in interest rate as a result of variation in quarterly LIBOR according to the following formula;

$$\Delta I = P_{(REV)} * (LIBOR_{(REV)} - 5.40\%) / 4$$

Where:

ΔI = the variation in interest charges applicable corresponding to variation in LIBOR. Δ I can be positive or negative depending upon whether $LIBOR_{(REV)}$ > or < 5.40%. The interest payment obligation will be enhanced or reduced to the extent of Δ I for each quarter under adjustment applicable on quarterly basis.

$P_{(REV)}$ = is the outstanding principal (as indicated in the attached debt service schedule to this order) on a quarterly basis on the relevant quarterly calculations date. Period 1 shall commence on the date on which the 1st installment is due after availing the grace period.

Working capital component of tariff will be adjusted on the basis of quarterly variation in reference KIBOR (10.4%) while spread (200 basis points) remaining the same.

c) Fuel Price Variation

The Variable Charge part of the tariff relating to fuel cost shall be adjusted on account of the fuel price variations as and when notified by the relevant authority, which in the instant case is the Oil & Gas Regulatory Authority (OGRA). In this regard, the variation in EEPL's allowed rate relating to fuel cost shall be revised according to the following formula:

FCg(Rev) = Rs.1.9816 per kWh * FPg(Rev)/Rs. 264.43 per MMBTU

Where:

FCg (Rev) = Revised fuel cost component of Variable Charge on permeate gas

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FPg (Rev) = The new price of permeate gas as notified by the relevant Authority per MMBTU of fuel adjusted for LHV-HHV factor.

FCd(Rev) = Rs. 7.1440 per kWh * [FPd(Rev)/ Rs.32.045 per Litre (Excl-GST)

Where:

FCd (Rev) = Revised fuel cost component of Variable Charge on diesel

FPd(Rev) = The new price of diesel as notified by the relevant Authority per Litre of fuel excluding 15% GST.

iii) Reference tariff table for permeate gas subject to permissible adjustments in accordance with mechanism as provided above will be applicable till 2014 or as long as allocated permeate gas 75 MMCFD is available, which ever is later. Use of HSD for operation on account of gas curtailment (10 days or equivalent hours), temporary interruptions (6 days or equivalent hours) and ATA of OGDCL (20 days or equivalent) is restricted to maximum of 36 days in a year or equivalent hours. The allowance for 36 days per annum or equivalent hours is to be treated as provision and not right of the power producer for its full utilization. EEPL will not be compensated by the power purchaser on account of gas curtailment from the allocated quantity 75 MMCFD, beyond maximum allowance of 10 days or equivalent hours in a year. The maximum allowance of 36 days will be reduced accordingly in case the schedule of ATA of gas processing plant and routine annual maintenance of power plant are matched and carried out simultaneously.

iv) During gas reservoir depletion phase that shall be established through the documentary evidence to be provided by the power producer, the shortfall in available gas will be met by commingling HSD fuel. In this case the maximum fuel cost component per kWh will not exceed the prevalent average fuel cost component per kWh of RFO (HSFO) based power plants. The composite applicable fuel cost component (Permeate Gas+HSD) per kWh will be on actual mix of fuel calculated in accordance

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with mechanism given in reference table-III. This arrangement will be applicable till such time the composite fuel rate per kWh does not exceed the prevalent average fuel cost component of RFO (HSFO) based power plants.

v) At any time during the reservoir depletion phase, if there is a sufficient cause shown by the power producer supported with concrete evidence to the fact that it is commercially no longer viable for EEPL to continue with existing tariff arrangement as given in para (iv) above and therefore, it considers modification in the existing plant facility, the company in that case will seek approval of the Authority for any additional investment or change of fuel for the proposed modification.

IV. Adjustment on account of inflation, foreign exchange variation, LIBOR variation and fuel price variation will be approved and announced by the Authority within seven working days after receipt of EEPL's request for adjustment in accordance with the requisite indexation mechanism stipulated herein.

Terms and Conditions of Tariff:

i) Use of Permeate Gas will be considered as primary fuel.

ii) All new equipment will be installed and the plant will be of standard configuration.

iii) Dispatch criterion will be based on the Energy Charge.

iv) Diesel oil will be used only for startups and other contingent requirements as mentioned above.

v) No startup charges have been accounted for in the above reference tariff table.

The above tariff and terms and conditions be incorporated as the specified tariff approved by the Authority pursuant to Rule 6 of the Licencing (Generation) Rules, in a Power Purchase Agreement between EEPL and CPPA.

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ENGRO ENERGY (PVT) LIMITED

Specified Tariff (Permeate Gas)

Year	Variable Charge (PKR/kWh)				Capacity Charge (PKR/kW/Hour)										Total	
	Fuel	Variable O&M Local	Variable O&M Foreign	Total	Fixed O&M Local	Fixed O&M Foreign	Insurance	Financing Cost on Working Capital	Return on Equity	Return on Equity for Construction Period	Withholding Tax @7.5%	Loan Repayment	Interest Charges	Total	Fixed Cost at 60% Plant Factor Rs./kWh	Cents/kWh
1	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.3297	0.4039	1.2252	4.1822	6.8560
2	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.3583	0.3754	1.2252	4.1822	6.8560
3	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.3893	0.3443	1.2252	4.1822	6.8560
4	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.4231	0.3106	1.2252	4.1822	6.8560
5	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.4597	0.2739	1.2252	4.1822	6.8560
6	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.4996	0.2340	1.2252	4.1822	6.8560
7	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.5429	0.1907	1.2252	4.1822	6.8560
8	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.5900	0.1437	1.2252	4.1822	6.8560
9	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.6411	0.0925	1.2252	4.1822	6.8560
10	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208	0.6967	0.0370	1.2252	4.1822	6.8560
11	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
12	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
13	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
14	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
15	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
16	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
17	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
18	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
19	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
20	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
21	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
22	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
23	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
24	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
25	1.9816	0.0285	0.1300	2.1402	0.1022	0.0065	0.0572	0.0277	0.2542	0.0229	0.0208			0.4915	2.9594	4.8515
Levelized Tariff (1-25 Years)				**2.1402**	**0.1022**	**0.0065**	**0.0572**	**0.0277**	**0.2542**	**0.0229**	**0.0208**	**0.3128**	**0.1838**	**0.9882**	**3.7871**	**6.2084**

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

ENGRO ENERGY (PVT) LIMITED

Specified Tariff (HSD)

Year	Variable Charge (PKR/kWh)				Capacity Charge (PKR/kW/Hour)										Total	
	Fuel	Variable O&M Local	Variable O&M Foreign	Total	Fixed O&M Local	Fixed O&M Foreign	Insurance	Financing Cost on Working Capital	Return on Equity	Return on Equity for Construction Period	Withholding Tax @7.5%	Loan Repayment	Interest Charges	Total	Fixed Cost at 60% Plant Factor Rs./kWh	Cents/kWh
1	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.3389	0.4152	1.2595	9.4061	15.4199
2	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.3683	0.3859	1.2595	9.4061	15.4199
3	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.4002	0.3539	1.2595	9.4061	15.4199
4	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.4349	0.3192	1.2595	9.4061	15.4199
5	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.4726	0.2816	1.2595	9.4061	15.4199
6	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.5136	0.2406	1.2595	9.4061	15.4199
7	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.5581	0.1961	1.2595	9.4061	15.4199
8	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.6065	0.1477	1.2595	9.4061	15.4199
9	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.6590	0.0951	1.2595	9.4061	15.4199
10	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214	0.7162	0.0380	1.2595	9.4061	15.4199
11	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
12	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
13	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
14	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
15	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
16	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
17	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
18	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
19	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
20	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
21	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
22	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
23	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
24	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
25	7.1440	0.0293	0.1337	7.3071	0.1051	0.0067	0.0588	0.0285	0.2614	0.0235	0.0214			0.5053	8.1492	13.3594
Levelized Tariff (1-25 Years)				**7.3071**	**0.1051**	**0.0067**	**0.0588**	**0.0285**	**0.2614**	**0.0235**	**0.0214**	**0.3215**	**0.1890**	**1.0158**	**9.0001**	**14.7542**

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

Annexure-III

Illustrative Reference Table For Calculating Composite Rate
(Permeate Gas+ HSD) in case of shortfall in allocated (75 MMCFD) permeate gas

Gas shortfall percent	0%	7%	13%	20%	24%	27%	33%	40%	47%	53% & above
Gas shortfall MMCFD	0	5	10	15	18	20	25	30	35	40 & above
Net Output of power plant (MW)	216.8	216.8	216.8	216.8	216.8	216.8	216.8	216.8	216.8	216.8
Reference Calorific value of gas (LHV) Btu/Cft	520	520	520	520	520	520	520	520	520	520
Available quantity of gas MMCFD	75	70	65	60	57	55	50	45	40	35
Available quantity of gas per hour MMCF	3.125	2.917	2.708	2.500	2.375	2.292	2.083	1.875	1.667	1.458
Heat value of available Gas MMBTUs/Hour	1625	1517	1408	1300	1235	1192	1083	975	867	758
Shortfall met by HSD (MMBTUs)	0	108	216	325	390	433	541	650	758	866
Calorific Value of HSD BTU/Litre-LHV	34470	34470	34470	34470	34470	34470	34470	34470	34470	34470
Consumption of HSD (Litres)	0	3134	6277	9419	11305	12562	15705	18848	21991	25133
Gas Price Rs./MMBTU-LHV	264.43	264.43	264.43	264.43	264.43	264.43	264.43	264.43	264.43	264.43
HSD Price Rs/Litre	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05	32.05
HSD Fuel cost HSD per Hour (Rs)	-	100,421	201,133	301,844	362,271	402,556	503,267	603,979	704,690	805,402
Fuel Cost Gas per Hour (Rs)	429,610	401,046	372,400	343,754	326,566	315,108	286,462	257,815	229,169	200,523
Total Fuel Cost per Hour (Rs)	429,610	501,467	573,533	645,598	688,837	717,663	789,729	861,794	933,860	1,005,925
Composite Rate FCC Rs/kWh	**1.9816**	**2.3130**	**2.6454**	**2.9779**	**3.1773**	**3.3103**	**3.6427**	**3.9751**	**4.3075**	**4.6399**

Note:

1. Reference gas price HHV= Rs. 238.38/MMBTU, converted to LHV by applying a factor of 1.109262
2. Reference Calorific value of permeate gas (LHV) 520 Btu/Cft is subject to change at COD in accordance with terms of the GSA.
3. The above reference table is applicable as per actual usage of gas and HSD. The maximum applicable composite rate in the gas reservoir depletion phase will not exceed the prevalent average fuel cost component of RFO (HSFO) based power plants.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

ENGRO ENERGY (PVT) LIMITED

KHALID MANSOOR
Chief Executive Officer

February 9, 2007

The Registrar
National Electric Power Regulatory Authority,
OPF Building,
Shahrah-e-Jamhurriyat,
G-5/2, Islamabad

Subject: Application under Rule 6 of the National Electric Power Regulatory Authority Licensing (Generation) Rules, 2000 for Tariff Approval read with National Electric Power Regulatory Authority (Tariff Standards and Procedure) Rules, 1998 – [226.52] MW Combined Cycle Power Project based on Permeate Gas to be located at Qadirpur, Ghotki, Sindh (the "Project")

Dear Sir,

The Government of Pakistan (GOP)/PPIB on January 6, 2006 awarded a Letter of Interest to Engro Chemical Pakistan Ltd. (ECPL) to set up the Project pursuant to the GOP's Power Policy 2002. ECPL has incorporated a special purpose vehicle, namely, Engro Energy (Private) Limited (the "Project Company"), to implement the Project.

The Project is unique and of great national importance in the sense that it will utilize the permeate gas which otherwise is being flared and wasted.

The Project Company hereby submits its application for the approval of the Generation Tariff for the Project pursuant to Rule 6(1)(a) of the NEPRA Licensing (Generation Rules), 2000 and Rule 3 of the NEPRA (Tariff Standards and Procedure) Rules, 1998 read with the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 and the pertinent provisions of the GOP's Power Policy, 2002 (as amended). The application is submitted for the approval of two tariffs, one based on permeate gas and the other, in case of non-availability of permeate gas, based on high speed diesel.

Registrar
Dy. No. 435
Dated 9-02-07

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

PNSC Building, M. T. Khan Road, P.O. Box 5736,
Karachi-74000, Pakistan. Tel : 5611060-69 (10 Lines)
UAN : 111-211-211 Fax : 92-21-5610688 Website : www.engro.com

The Project Company through a separate application is simultaneously applying to NEPRA for the grant of a Generation License.

A Pay Order no. DDH 826207 dated February 2, 2007 in the sum of Rs. 2,578,750 (Two million five hundred seventy eight thousand seven hundred fifty only), being the non-refundable license application fee calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations 1999 as modified vide S.R.O.886(I)/2006 dated 28th August, 2006, is also attached herewith.

We have worked very hard to make the Project a win-win solution for all stakeholders, in particular the Power Purchaser. We look forward to working with you to expeditiously complete the regulatory process so that the Project Company can achieve Financial Closing and start construction at the earliest – the Project Company aims to implement the Project on a fast track basis to meet the growing energy needs of the country and to enable the Power Purchaser to have recourse to the cheap source of electricity generation.

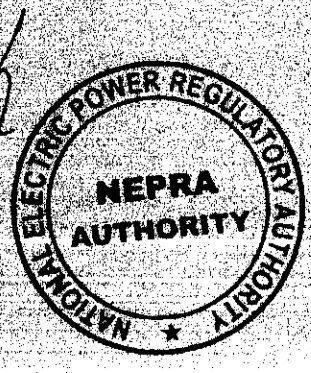
Thank you and with kind regards.

Yours very truly,

Khalid Mansoor
Chief Executive Officer

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

Application Fee



Payee's Only

Bank AL Habib Limited

SHAHEEN CENTRE BLOCK 7 CLIFTON KARACHI
,KARACHI,PAKISTAN. - 1019

Date 02 February 2007

THIS INSTRUMENT IS VALID FOR SIX MONTHS FROM DATE OF ISSUE.

Rs2578750 DDH 826207 /13004744/2007/0008-60

Amount PKR 2,578,750.00

ON DEMAND PAY TO THE ORDER
OF NATIONAL ELECTRIC POWER, REGULATORY AUTHORITY, ISLAMABAD.

AMOUNT PAKISTANI RUPEES TWO MILLION FIVE HUNDRED SEVENTY-EIGHT THOUSAND SEVEN HUNDRED FIFTY ONLY.

In Reimbursement Debit our A/C

For Bank AL Habib Limited

TO BANK AL HABIB LIMITED
ISLAMABAD
With Your
90-91 RAZIA SHARIF PLAZA, JINNAH AVENUE,,
BLUE AREA, ISLAMABAD, ISLAMABAD,
PAKISTAN.

ATTORNEY NO

ATTORNEY NO

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

Bank AL Habib Limited

DATE 02 February 2007

CUSTOMER ENGRO ENERGY (PVT) LTD.

DDH 826207 /13004744/2007/0008-60

BENEFICIARY NATIONAL ELECTRIC POWER, REGULATORY AUTHORITY, ISLAMABAD.

INSTRUMENT AMOUNT PKR 2,578,750.00

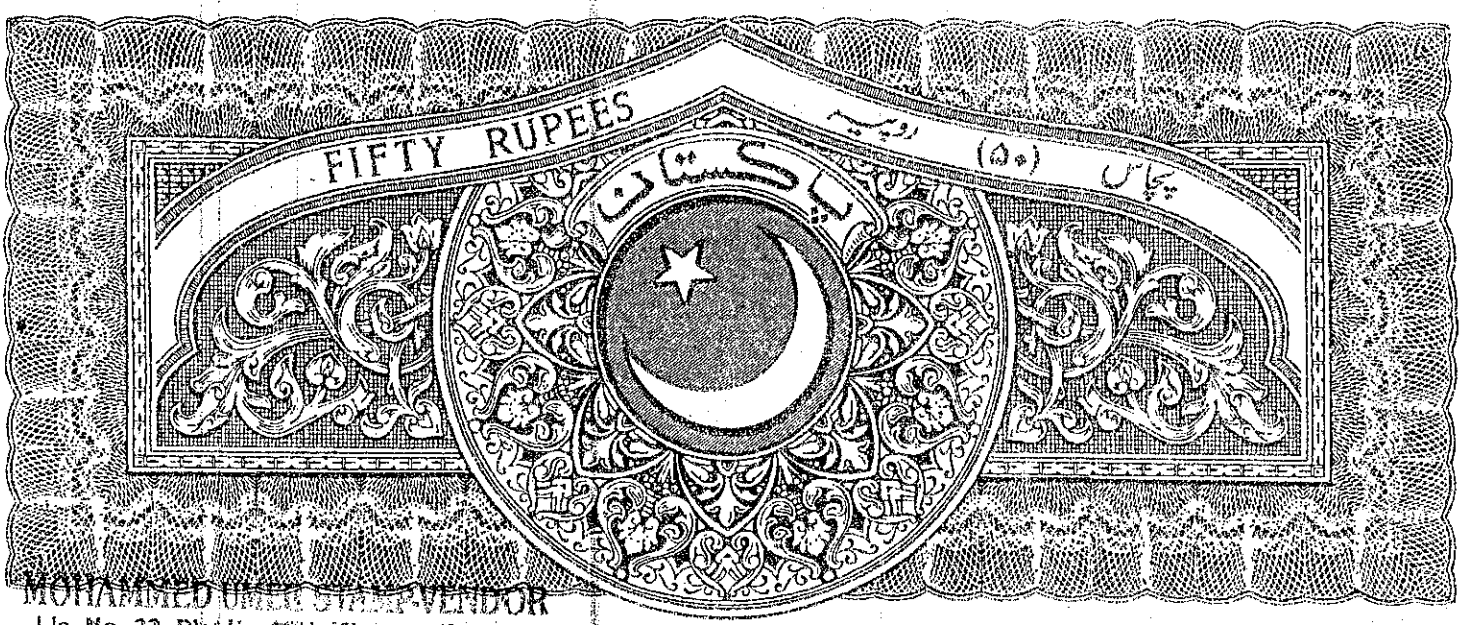
CHARGES PKR 1,289.00/- TOTAL PKR 2,580,039.00

CUSTOMER'S COPY

Affidavit

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

PAKISTAN 50 RS.



MOHAMMED UMER STAMP VENDOR
Lic. No. 33, Plot No. 8/1, Khurram Terrace,
Garden West, Karachi.
S.No 37787 DATE 01 FEB 2007
ISSUED TO WITH ADDRESS Engro Energy (Pvt) Ltd
THROUGH WITH ADDRESS
PURPOSE
VALUE RS 50 (ATTACHED)
STAMP VENDOR'S SIGNATURE

SYED NASIR HUSSAIN

BEFORE THE NATIONAL ELECTRIC POWER REGULATORY AUTHORITY

I, Khalid Mansoor, Chief Executive Officer and the duly appointed Attorney of Engro Energy (Private) Limited, hereby solemnly affirm and declare that the contents of the accompanying petition/application dated February 9, 2007, including all supporting documents are true and correct to the best of my knowledge and belief and that nothing has been concealed. I also confirm that any further documentation and information provided by me in connection with the accompanying petition/application shall be true to the best of my knowledge and belief.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

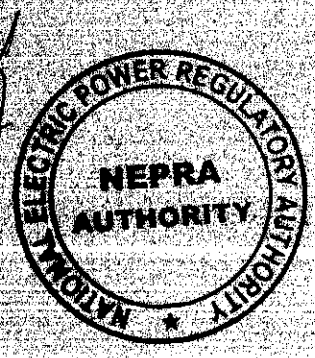
DEPONENT

23 FEB 2007

S. Nasir Hussain
Advocate & Oath Commissioner
Karachi Pakistan

42

Board Resolution



ENGRO ENERGY (PVT) LIMITED

ENGRO energy

CERTIFIED COPY OF RESOLUTION OF BOARD OF DIRECTORS

I, Andalib Alavi, Secretary, Engro Energy (Private) Limited hereby certify that the following resolution was passed by the Board of Directors in its 7th Meeting held on January 24, 2007.

Quote"RESOLVED that the Company file its application for Generation License and Tariff Determination with the National Electric Power Regulatory Authority (the "Authority"). FURTHER RESOLVED, that Mr. Khalid Mansoor, the Chief Executive Officer, is hereby authorized to file applications for Generation License and Tariff Determination on behalf of the Company with the Authority, to pay the necessary filing fees, sign the necessary documentation, negotiate, discuss and do all acts required for the processing and completion of these applications." ***Unquote***

For and on behalf of
ENGRO ENERGY (PRIVATE) LIMITED

ANDALIB ALAVI
Company Secretary

February 6, 2007.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

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PNSC Building, M. T. Khan Road, P.O. Box 5736,
Karachi-74000, Pakistan. Tel : 5611060-69 (10 Lines)
UAN : 111-211-211 Fax : 92-21-5636721 Website : www.engro.com

ENGRO ENERGY (PVT) LIMITED

RESOLUTION OF THE BOARD OF DIRECTORS OF ENGRO ENERGY (PRIVATE) LIMITED HELD ON January 24, 2007.

RESOLVED, that the Company file its applications for Generation License and Tariff Determination with the National Electric Power Regulatory Authority (the "**Authority**")

FURTHER RESOLVED, that Mr. Khalid Mansoor, the Chief Executive Officer, is hereby authorized to file applications for Generation Licence and Tariff Determination on behalf of the Company with the Authority, to pay the necessary filing fees, sign the necessary documentation, negotiate, discuss and do all acts required for the processing & completion of these applications.

Company Secretary

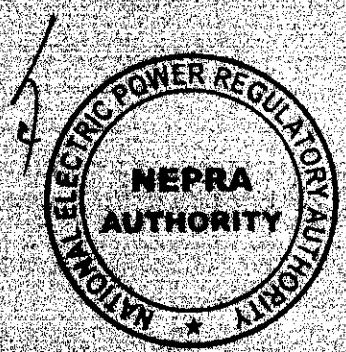
Chief Executive Officer

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

45

PNSC Building, M. T. Khan Road, P.O. Box 5736,
Karachi-74000, Pakistan. Tel : 5611060-69 (10 Lines)
UAN : 111-211-211 Fax : 92-21-5610688 Website : www.engro.com

Tariff Petition



NAME AND ADDRESS OF THE PETITIONER

Engro Energy (Private) Limited
7th Floor, PNSC Building
MT Khan Road
Karachi

GROUNDS AND THE FACTS FORMING THE BASIS OF THE TARIFF PETITION

Engro Chemical Pakistan Limited (ECPL) submitted a proposal to the Government of Pakistan's Private Power and Infrastructure Board (PPIB), Ministry of Water & Power, on October 18, 2005 to develop an innovative, fast-track project of 150 – 250 MW capacity combined cycle power plant at Daharki based on permeate gas from Qadirpur gas field.

The PPIB issued a letter of interest (LOI) to ECPL on January 6, 2006 for approximately 150 MW Gas-based power generation project.

The project company, Engro Energy (Private) Limited (EEL), was incorporated on February 28, 2006 under the Companies Ordinance, 1984, and 7th Floor, PNSC Building, MT Khan Road, Karachi, being its registered office.

Pursuant to the LOI, in January 2006, a detailed feasibility study was awarded to M/s Fichtner of Germany and M/s Hagler Bailly were engaged to conduct the Environmental Impact Assessment (EIA).

A draft feasibility report was submitted to the PPIB in April 2006. Fichtner representatives and Engro team made a presentation to the PPIB/Panel of Experts (POE) on May 5, 2006 explaining the salient features of this unique project based on permeate gas.

The POE communicated their observations/concerns on the draft feasibility on June 9, 2006. These suggestions/comments made by POE were addressed and incorporated in the final draft of the feasibility report which was submitted to the PPIB on August 17, 2006.

The PPIB/POE approved the feasibility study on September 20, 2006 and advised ECPL to file an application with National Electric Power Regulatory Authority (NEPRA) for Tariff determination.

The feasibility study indicates that GE 9E and Alstom GT 11N2 are the viable options for producing 175 to 180 MW power with the 75 MMSCFD allocated quantity of permeate gas. In case an additional quantity of 9-10 MMSCFD higher calorific gas (HCG) is made available to the project along with 75 MMSCFD permeate gas, then Siemens SGT5 –

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2000E shall also be the suitable option with higher output (246MW) and better efficiency.

The permeate gas which could not be utilized in the Gas Turbine would need to be flared. In order to ensure that all the allocated quantity of permeate gas shall be utilized, a supplementary firing in HRSG has been proposed to provide additional 50 MWs.

Key components and parameters of the tariff based on GE 9E with supplementary firing are as follows:

Gross Plant Capacity (MW) @ ISO conditions with 75MMSCFD gas	226.52
Gross Plant Capacity (MW) @ Mean Site Conditions	223.80
Net Plant Capacity (MW)	216.80
Notional Plant Load Factor	60 %

SCHEDULES OF CHARGES, COSTS, UNITS, PRICE AND OTHER ITEMS COMPRISING THE PROPOSED TARIFF

OPERATIONAL AND FINANCIAL ASSUMPTIONS

Plant Design and Operational Assumptions

Gross Plant Capacity @ ISO Conditions	226.52 MW
Gross Plant Capacity @ Reference Conditions	223.80 MW
Auxiliaries Consumption	7.00 MW
Net Plant Capacity @ Reference Conditions	216.80 MW
Gross Thermal Efficiency on permeate gas with supplementary firing	47.00 %
Net Thermal Efficiency on permeate gas with supplementary firing	45.53 %
Heat Rate on permeate gas at full load with supplementary firing	7907 KJ/KWh
Net Plant Capacity @ Reference Conditions on HSD without supplementary firing	155.30 MW
Net Thermal Efficiency on HSD without supplementary firing	45.26 %
Heat Rate on HSD at full load without supplementary firing	7953 KJ/KWh
Capacity Factor	60 % Notional
Degradation/partial loading	As per heat rate/performance curves from the Manufacturer
HHV of permeate gas	565-625 Btu/Scf
Plant Design point HHV	572 Btu/Scf

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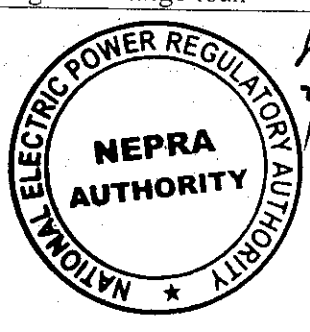
Permeate Gas H_2S Contents	Less than 320 ppm
Permeate Gas Price @ HHV (Same as Natural gas)	264.90 PKR/MMBtu
HHV - LHV factor	0.9015
Permeate Gas Price @ LHV	293.84 PKR/MMBtu
HSD Price delivered at site	37.70 PKR/Litre
Backup Fuel	HSD
HSD Storage	Seven (7) days
Reference Conditions	
Ambient Temperature	27 C
Relative Humidity	60%
Site Altitude	75 meter above sea level
Financial Assumptions	
EPC Cost	168.00 Million US$
Project specific EPC Cost	10.00 Million US$
Project Development Cost	6.70 Million US$
Services	12.83 Million US$
Total CAPEX (excl. IDC)	197.53 Million US$
IDC	17.32 Million US$
Return on Equity during Construction & Commissioning	9.12 Million US$
Financing Fee	3.33 Million US$
Foreign loan registration Stamp Duty	1.67 Million US$
Total CAPEX	228.97 Million US$
Term of agreement	25 years
IRR on equity investment	15%
Debt: Equity Ratio	75:25%
Funding	Equity in PKR; Debt in US $
Interest Rate	LIBOR(5.4%) plus 3.5% on foreign loan & KIBOR plus 2% on local loan for working capital
Tenure of foreign exchange loan	10 years + 2.33 years Grace Period



Number of Principal & Interest payments per year	Two semi annual payments
Discount rate for calculating Levelized tariff	10%
Reference Exchange Rate	1 US$ = 61 PKR
Working Capital Requirements	HSD Stock of 7 days
	6 Months DSRA (Debt Service Reserve Account) Lender's Requirement
	Spare parts for a period of 3 years
Indexation Assumptions	
Variable O&M – Local	Local WPI
Variable O&M – Foreign	US CPI and USD/PKR indexation
Escalable Component – Local	Local WPI
Escalable Component – Foreign	US CPI and USD/PKR indexation
Debt	Changes in 6 month LIBOR plus USD/PKR indexation
Fuel Component	Change in fuel price plus adjustment for part load operation and for degradation (Recoverable and Non Recoverable)

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The Summarized tariff table on Permeate Gas is as follows.

US Cents/KWh

	Energy Purchase Price (EPP)				Capacity Purchase Price (CPP)							
		Variable O&M				Fixed O&M						
	Fuel	Local	Foreign	Total	ROE	Local	Foreign	Interest on WC	Total Escalable	Non Escalable	Total	Total
Average (Year 1-10)	3.610	0.048	0.214	3.872	0.869	0.423	0.029	0.117	1.438	2.307	3.745	7.617
Average (Year 11-25)	3.610	0.048	0.214	3.872	0.869	0.423	0.029	0.038	1.359	0.000	1.359	5.231
Average (Year 1-25)	3.610	0.048	0.214	3.872	0.869	0.423	0.029	0.070	1.391	0.923	2.314	6.186
Levelized	3.610	0.048	0.214	3.872	0.869	0.423	0.029	0.096	1.417	1.562	2.979	6.851

Rs/KWh

	Energy Purchase Price (EPP)				Capacity Purchase Price (CPP)							
		Variable O&M				Fixed O&M						
	Fuel	Local	Foreign	Total	ROE	Local	Foreign	Interest on WC	Total Escalable	Non Escalable	Total	Total
Average (Year 1-10)	2.202	0.029	0.131	2.362	0.530	0.258	0.018	0.071	0.877	1.407	2.284	4.646
Average (Year 11-25)	2.202	0.029	0.131	2.362	0.530	0.258	0.018	0.023	0.829	0.000	0.829	3.191
Average (Year 1-25)	2.202	0.029	0.131	2.362	0.530	0.258	0.018	0.043	0.849	0.563	1.412	3.774
Levelized	2.202	0.029	0.131	2.362	0.530	0.258	0.018	0.059	0.865	0.953	1.818	4.179

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The Summarized tariff table on High Speed Diesel (HSD) is as follows.

US Cents/KWh

	Energy Purchase Price (EPP)				Capacity Purchase Price (CPP)							
		Variable O&M				Fixed O&M						
	Fuel	Local	Foreign	Total	ROE	Local	Foreign	Interest on WC	Total Escalable	Non Escalable	Total	Total
Average (Year 1-10)	13.516	0.052	0.387	13.955	1.213	0.591	0.041	0.163	2.008	3.220	5.228	19.183
Average (Year 11-25)	13.516	0.052	0.387	13.955	1.213	0.591	0.041	0.053	1.898	0.000	1.898	15.853
Average (Year 1-25)	13.516	0.052	0.387	13.955	1.213	0.591	0.041	0.097	1.942	1.288	3.230	17.185
Levelized	13.516	0.052	0.387	13.955	1.213	0.591	0.041	0.135	1.980	2.180	4.160	18.115

Rs/KWh

	Energy Purchase Price (EPP)				Capacity Purchase Price (CPP)							
		Variable O&M				Fixed O&M						
	Fuel	Local	Foreign	Total	ROE	Local	Foreign	Interest on WC	Total Escalable	Non Escalable	Total	Total
Average (Year 1-10)	8.245	0.032	0.236	8.513	0.740	0.361	0.025	0.099	1.225	1.964	3.189	11.702
Average (Year 11-25)	8.245	0.032	0.236	8.513	0.740	0.361	0.025	0.032	1.158	0.000	1.158	9.671
Average (Year 1-25)	8.245	0.032	0.236	8.513	0.740	0.361	0.025	0.059	1.185	0.786	1.971	10.484
Levelized	8.245	0.032	0.236	8.513	0.740	0.361	0.025	0.082	1.208	1.330	2.538	11.050

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PROPOSED REFERENCE TARIFF TABLE (US Cents/KWh)

On Permeate Gas

	ENERGY CHARGE				CAPACITY CHARGE							
	US Cents per kWh				US Cents per kWh							
					ESCALABLE COMPONENT							
		Variable O&M		TOTAL		Fixed O&M				Non	TOTAL	TOTAL
YEARS	FUEL	Local	Foreign	ENERGY CHARGE	ROE	Local	Foreign	Interest on WC	TOTAL	Escalable LOANS	CAPACITY CHARGE	TARIFF Cents/kWh
1	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.1663	1.4879	2.3071	3.7950	7.6665
2	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.1663	1.4879	2.3071	3.7950	7.6665
3	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.1663	1.4879	2.3071	3.7950	7.6665
4	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0956	1.4172	2.3071	3.7242	7.5958
5	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0956	1.4172	2.3071	3.7242	7.5958
6	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0956	1.4172	2.3071	3.7242	7.5958
7	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0956	1.4172	2.3071	3.7242	7.5958
8	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0956	1.4172	2.3071	3.7242	7.5958
9	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0956	1.4172	2.3071	3.7242	7.5958
10	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0956	1.4172	2.3071	3.7242	7.5958
11	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
12	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
13	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
14	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
15	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
16	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
17	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
18	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
19	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
20	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
21	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
22	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
23	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
24	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
25	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
YEARS	*AVERAGE TARIFF US Cents/kWh*											
1-10	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.1168	1.4384	2.3071	3.7455	7.6170
11-25	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0381	1.3597	0.0000	1.3597	5.2312
1-25	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0696	1.3912	0.9228	2.3140	6.1855
LEVEL. TARIFF	3.6097	0.0477	0.2141	3.8715	0.8690	0.4235	0.0292	0.0964	1.4180	1.5617	2.9797	6.8512

PROPOSED REFERENCE TARIFF TABLE (Rs/KWh)

On Permeate Gas

	ENERGY CHARGE				CAPACITY CHARGE							
	Rupees per kWh				Rupees per kWh							
				TOTAL	ESCALABLE COMPONENT					Non	TOTAL	TOTAL
		Variable O&M		ENERGY	ROE	Fixed O&M		Interest	TOTAL	Escalable	CAPACITY	TARIFF
YEARS	FUEL	Local	Foreign	CHARGE		Local	Foreign	on WC		LOANS	CHARGE	(Rs/kWh)
1	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.1014	0.9076	1.4073	2.3149	4.6766
2	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.1014	0.9076	1.4073	2.3149	4.6766
3	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.1014	0.9076	1.4073	2.3149	4.6766
4	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0583	0.8644	1.4073	2.2718	4.6334
5	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0583	0.8644	1.4073	2.2718	4.6334
6	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0583	0.8644	1.4073	2.2718	4.6334
7	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0583	0.8644	1.4073	2.2718	4.6334
8	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0583	0.8644	1.4073	2.2718	4.6334
9	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0583	0.8644	1.4073	2.2718	4.6334
10	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0583	0.8644	1.4073	2.2718	4.6334
11	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
12	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
13	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
14	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
15	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
16	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
17	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
18	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
19	2.2020	0.0291	0.1306	2.3617	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1911
20	2.2020	0.0291	0.1306	2.3617	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1911
21	2.2020	0.0291	0.1306	2.3617	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1911
22	2.2020	0.0291	0.1306	2.3617	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1911
23	2.2020	0.0291	0.1306	2.3617	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1911
24	2.2020	0.0291	0.1306	2.3617	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1911
25	2.2020	0.0291	0.1306	2.3617	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1911
YEARS			*AVERAGE TARIFF*	*Rs/kWh*								
1-10	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0712	0.8774	1.4073	2.2847	4.6464
11-25	2.2020	0.0291	0.1306	2.3617	0.5300	0.2583	0.0178	0.0232	0.8294	0.0000	0.8294	3.1910
1-25	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0424	0.8486	0.5629	1.4115	3.7732
LEVEL. TARIFF	2.2019	0.0291	0.1306	2.3616	0.5300	0.2583	0.0178	0.0588	0.8649	0.9527	1.8176	4.1792

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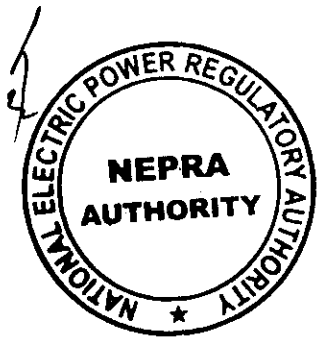
PROPOSED REFERENCE TARIFF TABLE (US Cents/KWh)

On High Speed Diesel (HSD)

	ENERGY CHARGE				CAPACITY CHARGE							
	US Cents per kWh				US Cents per kWh							
					ESCALABLE COMPONENT							
		Variable O&M		TOTAL		Fixed O&M				Non	TOTAL	TOTAL
YEARS	FUEL	Local	Foreign	ENERGY CHARGE	ROE	Local	Foreign	Interest on WC	TOTAL	Escalable LOANS	CAPACITY CHARGE	TARIFF Cents/kWh
1	######	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.2321	2.0769	3.2204	5.2973	19.2530
2	######	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.2321	2.0769	3.2204	5.2973	19.2530
3	######	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.2321	2.0769	3.2204	5.2973	19.2530
4	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1334	1.9782	3.2204	5.1986	19.1543
5	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1334	1.9782	3.2204	5.1986	19.1543
6	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1334	1.9782	3.2204	5.1986	19.1543
7	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1334	1.9782	3.2204	5.1986	19.1543
8	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1334	1.9782	3.2204	5.1986	19.1543
9	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1334	1.9782	3.2204	5.1986	19.1543
10	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1334	1.9782	3.2204	5.1986	19.1543
11	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
12	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
13	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
14	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
15	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
16	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
17	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
18	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
19	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
20	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
21	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
22	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
23	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
24	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
25	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
YEARS			*AVERAGE TARIFF*	*US Cents/kWh*								
1-10	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1630	2.0078	3.2204	5.2282	19.1839
11-25	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0532	1.8980	0.0000	1.8980	15.8537
1 -25	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.0971	1.9419	1.2881	3.2301	17.1858
LEVEL. TARIFF	13.5164	0.0518	0.3874	13.9557	1.2130	0.5911	0.0407	0.1345	1.9793	2.1800	4.1593	18.1150



PROPOSED REFERENCE TARIFF TABLE (Rs/KWh)

On High Speed Diesel (HSD)

	ENERGY CHARGE				CAPACITY CHARGE							
	Rupees per kWh				Rupees per kWh							
		Variable O&M		TOTAL	ESCALABLE COMPONENT					Non	TOTAL	TOTAL
YEARS	FUEL	Local	Foreign	ENERGY CHARGE	ROE	Fixed O&M Local	Fixed O&M Foreign	Interest on WC	TOTAL	Escalable LOANS	CAPACITY CHARGE	TARIFF (Rs/kWh)
1	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.1416	1.2669	1.9644	3.2314	11.7443
2	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.1416	1.2669	1.9644	3.2314	11.7443
3	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.1416	1.2669	1.9644	3.2314	11.7443
4	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0814	1.2067	1.9644	3.1711	11.6841
5	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0814	1.2067	1.9644	3.1711	11.6841
6	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0814	1.2067	1.9644	3.1711	11.6841
7	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0814	1.2067	1.9644	3.1711	11.6841
8	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0814	1.2067	1.9644	3.1711	11.6841
9	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0814	1.2067	1.9644	3.1711	11.6841
10	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0814	1.2067	1.9644	3.1711	11.6841
11	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
12	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
13	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
14	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
15	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
16	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
17	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
18	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
19	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
20	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
21	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
22	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
23	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
24	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
25	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
YEARS	*AVERAGE TARIFF Rs/kWh*											
1-10	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0994	1.2248	1.9644	3.1892	11.7022
11-25	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0324	1.1578	0.0000	1.1578	9.6708
1-25	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0592	1.1846	0.7858	1.9703	10.4833
LEVEL. TARIFF	8.2450	0.0316	0.2363	8.5130	0.7399	0.3606	0.0248	0.0821	1.2074	1.3298	2.5372	11.0502

GENERAL ASSUMPTIONS

The following has been assumed while calculating the tariff. Any changes to these assumptions will result in a change to the proposed tariff.

- Customs duties on the import of plant, equipment, material and spare parts are considered @ 5%. Any change in the customs duties or any other duty or tax on import of equipment & material will be "pass through" to the Power Purchaser. Similarly, customs duties on spare parts after COD will be "pass through" to the Power Purchaser.

- Only 6% withholding tax on local services assumed. No other taxes on payments to be made to the EPC Contractor assumed. Any additional tax, if levied, will be "pass through" to the Power Purchaser.

- 7.5 % withholding tax on dividend payment assumed. Any change in the aforesaid withholding tax regime will be "pass through" to the Power Purchaser. General sales tax and all other taxes will also be treated as "pass through".

- Zakat deduction on dividends (currently @ 2.5%), as required to be deducted under Zakat Ordinance, is considered as "pass-through".

- Debt is assumed in foreign currency (USD) and Equity is assumed in local currency (PKR).

- The Return on Equity for the construction & commissioning period shall be adjusted at the time of COD according to the actual Equity disbursement during such period.

- Power purchaser/NTDC shall be exclusively responsible for the financing, construction, operation and maintenance of the Interconnection and Transmission Facilities.

- Exchange Rate (PKR/USD) is taken @ PKR 61 per USD.

- No cost of utilizing NTDC telecom media is assumed. Any costs incurred with regard thereto will be treated as "pass through".

- Main Energy meter and electronic recorder for continuous recording of readings will be provided by NTDC at its own cost.

- No cost for main gas metering station is assumed. It is assumed that it shall be provided by gas supplier at its own cost.

- Tolerance band of ± 3 % in dispatch is assumed.

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- Thirty days per year Schedule Outage for Washing and Combustion Inspection; forty-five days for Washing and Hot Gas Path Inspection and sixty days for Washing and Major Overhaul have been assumed. Five hundred hours per year for Forced Outage are assumed. During these periods, full capacity payments shall be paid by the Power Purchaser.

- Cost of seven (7) days HSD storage (100% load @ reduced Contract Capacity of 155 MW) is assumed in the working capital.

- Working capital for bridge financing to cover the lag between payments to be made to the Gas Supplier and payments to be received from the Power Purchaser/NTDC is not considered as per assurance of Power purchaser that Power Purchaser shall pay the Seventy percent (70%) of Capacity payments in advance every month from COD. In case it is not given then the working capital of 15 days Fuel (Gas) cost shall be considered & financial cost shall be passed to Power Purchaser .

- Fuel cost component for energy delivered before COD and all the testing after COD shall be paid by the Power Purchaser to the Company. Capacity Payments and Energy Payments shall be made during Annual Testing.

- No O&M Reserve, Maintenance Reserve Account, Contingency Reserve Account or any other Reserve account (except DSRA for 6 months) has been considered in the Tariff model. In case Company is required to do so, the financial impact would be "pass through".

- The fuel component and Capacity will be adjusted for aging (permanent degradation), fouling (recoverable degradation) and ambient degradation factors in order to compensate the effect of performance deterioration by these factors as per Manufacturer's curves.

- The fuel component will be adjusted for changes in calorific value of the permeate gas as per Manufacturer's curve.

- In case of 100 % HSD use, degradation will be different and HSD based tariff shall be applicable.

- Partial loading shall be compensated as per performance curves.

- Required gas pressure (32 bars) shall be maintained by Gas Supplier at gas inlet stop valve of gas turbine. Therefore, gas booster compressors and auxiliaries are to be installed & maintained by gas supplier as per decision of PPIB with OGDCL & SNGPL (Copy attached)

- Additional cost for gas turbine start-up, shut down and part load operation with HSD or HSD admixture to gas shall be compensated by factors as per gas turbine Manufacturer recommendation.

- No open cycle operation prior to COD assumed.
- The Complex will operate in open cycle below 50% load.
- The Complex will operate on HSD upto 50% load. Conversion from HSD to gas will take place from 50% to 60% load.
- During the Term, if there is any gas supply interruption (temporary interruption or annual turn around of supplier), and plant is required to dispatch on HSD, the Power purchaser will pay HSD based tariff.
- Number of Cold, Warm and Hot start-ups will be as per Manufacturer's recommendations. Cost of start-ups shall be "pass through".
- For operation and maintenance requirement of plant on permeate gas and HSD, equivalent operating hours at different loads, fuel, shut down/start-up and trips shall be considered as per Manufacturer recommendations.
- The Power Purchaser shall supply power to the plant during off load period at fuel component rate.
- In case of open cycle mode operation, heat rate / efficiency will be different and energy component will be adjusted accordingly.
- GSA shall be equivalent to the PPA term.
- 24 months prior to gas reservoir depletion or in case of sudden/catastrophic failure of reservoir, Company to get capacity payments from Power Purchaser until GOP shall allow one of the following:
  - New Gas Allocation;
  - HSD based tariff throughout the year for the remainder of the PPA Term as per GOP's Fuel policy;
  - If the plant is required to convert on LSFO then all costs pertaining to O&M, alternate fuel heat rate, modification cost and alternate fuel storage tanks cost shall be "passed through" to the Power Purchaser in the form of a supplemental tariff. Furthermore, the Power Purchaser shall make the Capacity Payments to the Project Company during the Conversion Period.
  - Termination of the IA and recovery by the Project Company of items "a", "b" and "f" under Schedule 2 to the IA.
- In case of operation on HSD, the Power Purchaser shall make Energy Payments on weekly basis to avoid the requirement for the additional working capital.
- No post-COD LC in favour of the Power Purchaser assumed.

- HSD tariff shall be determined now and agreed to avoid any operational delays.

REFERENCE PROJECT COST

Power plant EPC Cost	**168.00 Million US$**
Project Specific EPC	
Gas pipeline	2.5 Million US $
Residential Colony	4.1 Million US $
Water & waste water pipelines	2.3 Million US $
Access Road	0.3 Million US $
Evaporation Ponds	0.8 Million US $
Total Project specific EPC Cost	**10.00 Million US $**
Total EPC Cost	**178.00 Million US$**
Project Development Cost	
Permits, Feasibility, ITB, Bid Evaluation etc.	0.73 Million US $
Consultancy Financial (Lenders)	0.70 Million US $
Consultancy (Legal & Commercial)	0.27 Million US$
Company Overhead during Development	2.34 Million US $
Bank Charges for Performance Guarantee,	1.50 Million US $
Land acquisition incl. fees	1.16 Million US $
Total Project Development Cost	**6.70 Million US$**
Services Cost	
Administrative costs of project company	1.94 Million US $
Construction Management	6.49 Million US $
Insurance during construction	2.80 Million US $
Utilities during construction	0.50 Million US$
Fuel cost during testing	0.60 Million US $
First Fill of lubes & chemicals	0.50 Million US $
Total Cost of Services	**12.83 Million US$**
Financing Cost	
Financing Fee	3.33 Million US$
Foreign loan registration Stamp Duty	1.67 Million US$
Interest during Construction	17.32 Million US$
Return on Equity during Construction	9.12 Million US$
Total Cost of Financing	**31.44 Million US$**
Total Project Cost	**228.97 Million US$**

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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KEY FACTORS UNDERLYING THE CALCULATIONS OF THE TARIFF

FUEL COMPONENT

The gas supplier will charge the gas cost based on HHV. A conversion factor of 1.1093 has been used to convert Gross calorific value to Net Calorific value.

The Gross thermal efficiency of 47 % has been assumed. This efficiency number is relatively on the lower side due to supplementary firing in HRSG. The supplementary firing option has been incorporated to ensure utilization of all the allocated quantity of permeate gas (75MMSCFD) and producing more power instead of flaring the balance quantity of gas thus averting loss of precious and scarce national resource.

The Net thermal efficiency of CCPP based on permeate gas would be 45.53 %.

The proposed thermal efficiency with permeate gas is for 100% loading on a brand new machine. The following factors are assumed to be applicable to the Fuel component:

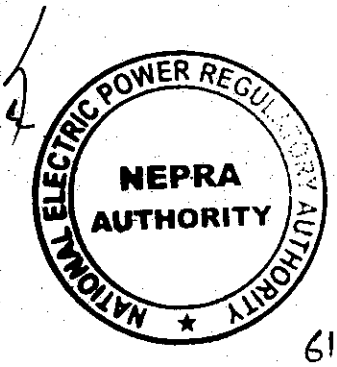
- Heat rate degradation factor (Recoverable and Non-recoverable) as per Manufacturer's data to compensate for the effects of efficiency degradation due to aging and fouling.
- Partial load Heat rate adjustment as per Manufacturer's data to compensate for the lower efficiency while operating on partial load.
- Part load operation with HSD or HSD admixture to the permeate gas shall be compensated by factors based on the data from the Manufacturer.

The Gross thermal efficiency while operating on HSD without supplementary firing in HRSG will be 46.8%. This efficiency number is also relatively on the lower side due to part load operation of steam turbine @ 50 MW vs. name plate capacity of 127 MW.

The Net thermal efficiency on HSD would be 45.26 %.

The start-up cost shall be charged on the condition of the plant (Hot, Warm and Cold) prior to start-up.

The fuel component would be indexed with any change in the price of gas.



VARIABBLE O&M COMPONENT

Variable O&M cost component will be part of Energy charge and will be allocated to local and foreign components.

Local Component
This component mainly consists of lubricants, chemicals for water treatment, small consumable parts and other supplies which will be procured locally. This component shall be escalated with local inflation rate (WPI).

Foreign Component
It consists of (i) replacement cost of imported spare parts on completion of their service life (ii) replacement cost of spare parts in case of premature failure (unscheduled maintenance), (iii) technical services obtained from foreign experts during maintenance. This component shall be indexed with US CPI and US$/PKR exchange rate.

FIXED O&M COST

Local fixed O&M cost
It includes insurance, O&M staff cost, Administrative cost of the Project Company including remuneration to employees and Chief Executive Officer, rents, utilities and local taxes. It also includes costs such as NEPRA annual fee, bank charges for SNGPL bank guarantee, audit fees, legal and consultancy fees etc. This component shall be indexed to local WPI.

Foreign fixed O&M cost
This component mainly consists of Major overhauling cost which shall be undertaken as per Manufacturer's recommendation. It is subject to both US CPI and US$/PKR indexation.

RETURN ON EQUITY

Equity rate of return is based on 15 % IRR net of 7.5% withholding tax. Equity portion is 25 % of project cost at COD. Equity is based on local currency and shall be indexed to WPI.

NON ESCALABLE COMPONENT

This component represents repayment of debt. The debt is assumed to be in foreign currency bearing an interest rate of LIBOR + 3.5 %. The term of the loan will be 10 years after COD. Principal repayment and interest payment shall be on semi annual basis.

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DEBT REPAYMENT PROFILE (ANNUITY BASED)

Period	Principal	Principal Repayment	Interest	Balance	Debt Service
	Million $	Million $	Million $	Million $	Million $
1	171.730	5.503	7.642	166.227	13.145
2	166.227	5.748	7.397	160.479	13.145
3	160.479	6.003	7.141	154.476	13.145
4	154.476	6.271	6.874	148.205	13.145
5	148.205	6.550	6.595	141.655	13.145
6	141.655	6.841	6.304	134.814	13.145
7	134.814	7.146	5.999	127.669	13.145
8	127.669	7.464	5.681	120.205	13.145
9	120.205	7.796	5.349	112.410	13.145
10	112.410	8.143	5.002	104.267	13.145
11	104.267	8.505	4.640	95.762	13.145
12	95.762	8.883	4.261	86.879	13.145
13	86.879	9.279	3.866	77.600	13.145
14	77.600	9.692	3.453	67.909	13.145
15	67.909	10.123	3.022	57.786	13.145
16	57.786	10.573	2.571	47.212	13.145
17	47.212	11.044	2.101	36.169	13.145
18	36.169	11.535	1.610	24.633	13.145
19	24.633	12.049	1.096	12.585	13.145
20	12.585	12.585	0.560	0.000	13.145

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FACTORS INFLUENCING EPC COST & TARIFF

Permeate Gas:

Permeate gas is a low Btu Gas with high Sulphur contents. Due to low Btu nature of the gas, only few turbines were found to be suitable for operation on this gas. Also, due to high sulphur contents (320ppm), the exhaust gas temperature of HRSG has to be kept on the higher side to avoid corrosion due to acid gas condensation resulting in lower steam generation in HRSG thus causing lower efficiency. High sulphur contents have also necessitated use of special material in HRSG to accommodate supplementary firing.

Supplementary Firing:

75 MMCFD of permeate gas has been allocated to Engro IPP. In order to avoid flaring of balance permeate gas which could not be consumed in gas turbine, supplementary firing is incorporated into the design of HRSG. This has resulted in increased capacity of the power plant by 50 MW. However, it has relatively lowered the efficiency of the cycle slightly as compared to a conventional Combined Cycle plant based on pipeline quality natural gas.

Black Start Facility, 4 MW Capacity:

The power plant will be capable of black start. This is accomplished by installing two MV generators of 2 MW each. Moreover, control and switchgear for the generators will also be installed.

Two extra 220kV Lines (incoming from Fauji IPP lines):

Transmission line between Fauji and Rohri will be looped in and out of the power plant. This was identified in Load Flow Study conducted by NTDC. Therefore, Engro IPP has to install four lines as compared to two lines. This has increased the scope and size of HV switchgear, protection system and ratings of the fault interrupting devices.

Remote Water off-Take Facility:

Water off-take will be from Ghotki feeder canal which is seven KM away from the proposed Power Plant. This requires pumping station, water pipeline, right of way, overhead transmission line complete with poles, conductors, MV switchgear and transformers.

Reverse Osmosis (RO) Plant:

Well water arrangement has been designed as a back-up when Ghotki canal is closed for maintenance. A RO plant will be installed at the proposed site to treat the well water and make it suitable for steam generation.

Construction of Residential Colony:

Since EEL's power plant will be at a remote location, there is a need to construct an appropriate residential colony for the staff in order to attract and retain good quality human resource.

Security:

On account of remote location of the proposed Power Plant, in addition to construction of a suitable residential facility for the O&M staff, provision of security for the power plant and the Company's staff has been budgeted.

Access Road:

Plant is located away from the main road. An access road of approximately 1 KM shall be built for the proposed Power Plant. This necessitated additional civil work and right of way.

RELIEF OR DETERMINATION SOUGHT;

The Petitioner requests the learned Authority to kindly approve generation tariff based on (a) permeate gas and, in the case of non-availability thereof, (b) high speed diesel, as submitted herein.

EVIDENCE IN SUPPORT OF THE PETITION.

- Minutes of Meeting of PPIB dated July 22, 2006
- Letter of Interest dated January 6, 2006
- Performance Guarantee
- Feasibility Study approval letter dated September 20, 2006
- 75 MMCFD Gas Allocation letter for IPP
- PPIB letter to SNGPL for GSA negotiation with ENGRO
- Authority Permission to CPPA to procure power from Engro

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
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AUTHORITY

GOVERNMENT OF PAKISTAN
MINISTRY OF WATER AND POWER
(PRIVATE POWER & INFRASTRUCTURE BOARD)

No. 1(102)PPIB-1029/06/PRJ

22nd July 2006

SUBJECT: **MEETING TO REVIEW THE ISSUES RELATED TO THE PROJECT BASED ON QADIRPUR GAS**

Please find enclosed herewith the minutes of the meeting held on 15th July 2006 to discuss gas supply to IPP based on Qadirpur permeate gas.

(N. A. Zuberi)
Director (Projects)

Encl: As above

1. Mr. K. W. Sharaq
GM (Transmission)
SNGPL
Lahore

2. Mr. Najam K. Hyder
E.D. (C.A),
OGDCL
Islamabad

3. Mr. Saeed Ullah Shah
Director General (Gas)
MoP&NR
Islamabad

4. Mr. Fazal Ahmad Khan
GM (WPPO)
WAPDA House
Lahore

5. Mr. Sheikh Imran ul Haque
General Manager
Business Development
ENGRO Chemical Pakistan Ltd.
Karachi

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CC:
ES to Managing Director, PPIB Islamabad

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MINUTES OF THE MEETING

A meeting to discuss gas supply to the new IPP (Engro Power Project) based on Qadirpur Permeate low BTU gas was held on 15th July 2006 in the Board Room of PPIB, Islamabad under the Chairmanship of Director (Projects) PPIB. List of participants is at Annexure-A.

2. The Chair welcomed the participants and informed that PPIB is processing a 150 MW power project (the IPP) by Engro Chemical Pakistan Limited, based on Qadirpur permeate gas. The Sponsors of IPP has prepared first draft of the feasibility study. In order to finalize the feasibility study, issues of gas pricing and delivered gas pressure to the IPP, need to be discussed:

3. It was informed that OGDCL is the major shareholder of the joint venture operating in Qadirpur Gas Field from which the permeate gas after passing through a certain process would be supplied to the IPP through SNGPL. The gas supply arrangement between OGDCL and SNGPL would be made separately and gas pricing between OGDCL and SNGPL would be finalized under the auspices of Ministry of Petroleum & Natural Resources (MoP&NR), which is to be notified by Government of Pakistan after determination by OGRA.

4. As regards the gas pressure and pricing related to SNGPL and IPP it was discussed that IPP may finalize the feasibility study on the basis that: (i) gas price in terms of Rs/MMBTU notified for power sector, would be charged and; (ii) permeate gas without any purification would be provided by SNGPL at the required pressure for normal operation of the IPP.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

ANNEX-A

LIST OF PARTICIPANTS

Held on 15th July 2006 at in PPIB Board Room Islamabad

1. Mr. N.A. Zuberi, Director (Projects), PPIB
2. Mr. Asif Ali Abro, Senior Manager (Projects), PPIB
3. Mr. Nasir Jamal, Deputy Manager (Projects), PPIB
4. Mr. Najam K. Hyder, E.D. (C.A), OGDCL
5. Mr. M. Amjad Ehsan, Manager (Power Projects), OGDCL
6. Mr. K. W. Sharaq, GM (Transmission), SNGPL
7. Mr. Rana Muhammad Amjad, Chief Engineer (WPPO), WAPDA
8. Mr. Mansoor Muzaffar Ali, Deputy Director (Gas), MoP&NR
9. Mr. S. Imran ul Haq, GM, Business Development, ECPL

****

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

GOVERNMENT OF PAKISTAN
MINISTRY OF WATER AND POWER
(PRIVATE POWER & INFRASTRUCTURE BOARD)

No. 1(102) PPIB -1026/06/PRJ

6th January 2006

Mr. Sheikh Imranul Haque
General Manager
Business Development
ENGRO Chemical Pakistan Ltd.
Karachi

Subject: LETTER OF INTEREST (LOI) FOR APPROXIMATELY 150 MW GAS POWER GENERATION PROJECT AT DAHARKI, SINDH BY ENGRO CHEMICAL PAKISTAN LIMITED (ECPL)

Reference: Your Proposal dated 18th October 2005

Dear Sir,

In terms of the provisions of the Policy for Power Generation Projects, 2002 (the "Policy"), the Government of Pakistan (GOP) hereby confirms its interest in your proposal for conducting a feasibility study (the "Feasibility Study") for establishing an approximately 150 MW gas private power project to be located at Daharki, Sindh. As per the Policy, you are required to complete your Feasibility Study for the Subject Project, **at no risk and cost to, and without any obligation on the part of, the GOP and its agencies,** within six *(6) months* from the date of this LOI.

2. You are required to carry out the Feasibility Study, complete, at internationally acceptable standards and in accordance with the terms and conditions stipulated in the Policy. The Feasibility Study must include an Environmental Impact Assessment Study, detailed design of power house, load flow and stability studies, design of interconnection/transmission lines, details pertaining to infrastructure, project [illegible]ing plan, financing terms, tariff calculations and assumptions of financial calculations including economic/financial analysis. You are advised to liaise with the

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

50 - Nazimuddin Road, F-7/4, Islamabad - Pakistan
Tel: (92-51) 9201848, 9206357, 9214723, 9222378 Fax: (92-51) 9217735, 9215723
Email: ppib@ppib.gov.pk Internet: http://www.ppib.gov.pk

power purchaser while determining your plant size and site, project layout, trans line and interconnection arrangements, etc.

3. You will carryout the Feasibility Study according to the specific milestones appended herewith at **Annex-A**, and submit monthly progress reports showing progress against these milestones.

4. PPIB will appoint a Panel of Experts to monitor the conduct of the Feasibility Study and its progress, to verify attainment of the aforesaid milestones and to ensure implementation of the project consistent with national and provincial needs. However, draft Feasibility Study shall not be considered for approval unless you provide pre-qualification details, communicated to you through our Comfort Letter dated 20th December 2005; and/or any other information pertaining to the pre-qualification process.

5. The Main Sponsor will be liable for all obligations and liabilities of and on behalf of other Sponsors. Further processing of the Feasibility Study is subject to GOP acceptance in accordance with the Policy.

6. The validity of this LOI is 6 Months, calculated in accordance with paragraph 9, whereafter it will automatically lapse immediately. **Issuance of this LOI or the lapsing of its validity, or your conducting a Feasibility Study thereunder, cannot form the basis of any claim for compensation or damages by the Sponsors or the project company or any party claiming through them against the Government of Pakistan/PPIB or any of its agencies, employees or consultants on any grounds whatsoever, during or after the expiration of its validity.**

7. You are, therefore, required to complete the Feasibility Study for the Subject Project within the validity of this LOI. In case there is delay in completion of the Feasibility Study within the validity of this LOI, a one-time extension may be granted upto a maximum period of 180 days, provided the Panel of Experts is satisfied that the Feasibility Study is being conducted in a satisfactory manner and is likely to be

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

WHEREAS:

A. Upon the request and proposal of the Sponsor to establish an electric power plant in Pakistan, the Beneficiary has issued a Comfort Letter # 1(102)PPIB 1026/05/PRJ dated December 20, 2005 to the Sponsor, and has promised that, upon furnishing of this Performance Guarantee, the Beneficiary shall issue a Letter of Interest (the LOI) to the Sponsor.
B. As required by the Beneficiary under the comfort letter and in consideration thereof, the Sponsor hereby furnishes this Performance Guarantee in order to ensure and / or cover the performance of its obligations under LOI.
C. At the request of the Sponsor, the Guarantor has agreed to furnish this Performance Guarantee in favor of the Beneficiary.

NOW THEREFORE, this Performance Guarantee witnesseth as under:

1. In the event that the Sponsor defaults in, delays performance of, or does not perform, its obligations under the LOI, of all of which events the Beneficiary shall be the sole arbiter, the Guarantor shall, on first demand, pay a sum of Rs.10,000,000/- (Rupees Ten Million Only) to the Beneficiary.
2. the Guarantor hereby binds itself **unconditionally and irrevocably**, and undertakes and guarantees to pay in accordance with this Performance Guarantee, **as primary obligor and not merely as surety**, on first demand of the Beneficiary, without protest or demur and **without reference, notice or recourse to the Sponsor or any other person**, and hereby expressly waives all rights to deny its obligations to the Beneficiary irrespective of any dispute, differences or disagreement between the Sponsor and the Beneficiary or contestation by any other party or person.
3. At any time during the validity of this Performance Guarantee, the **Beneficiary may, at its sole discretion and decision,** demand payment from the Guarantor. The decision of the Beneficiary as to the Sponsor's default, delay, or failure in performance under the LOI, shall be final and binding on the Guarantor, **and shall not be challenged or questioned by the Guarantor in any manner whatsoever.**
4. Unless extended in writing by the Guarantor, this Performance Guarantee shall remain in full force and effect until **10-06-2006** or such extended date as it is legally applicable, and the Guarantor's obligation under this Performance Guarantee shall be for payment of the sum of Rs.10,000,000/- (Rupees Ten Million Only).
5. The Beneficiary may, if and when and in such manner as the Beneficiary in its sole discretion deems appropriate, grant time or other indulgence to or accept or make any composition or arrangement with the Sponsor and / or vary, renew, discharge, realize, release, enforce or deal with any other securities, guarantees, obligations, decrees, contracts, or agreements, now or hereinafter made or held by the Beneficiary, and such acts shall not affect in any way whatsoever the Beneficiary rights under this Performance Guarantee and shall not effect in any way whatsoever the Guarantor's liability hereunder, or discharge the Guarantor from its obligations under this Performance Guarantee.
6. This Performance Guarantee explicitly stipulates in full the terms of the Guarantor's undertaking and this undertaking shall not be modified or amended in any way whatsoever.
7. This performance Guarantee shall be governed by the laws of Pakistan.

For and on behalf of the Sponsor

Aftab Ahmed
A. S. No. 1622

Aftab Ahmed
NIC # 42301-6918772-7

Witnesses:

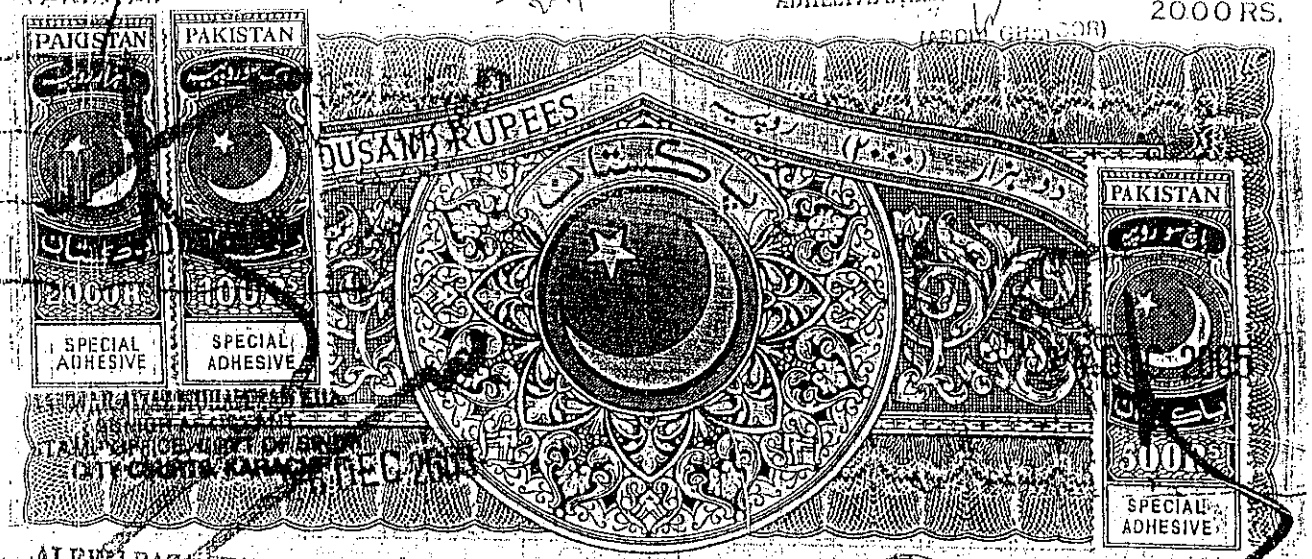
1._____

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

Arshad Aziz
NIC # 42501-1390139-9

Arshad Aziz
AS No. 1521

71



24 DEC 2005

KANWAR AIZAZ MUHAMMAD KHAN
SENIOR ASSISTANT
OF SINDH
KARACHI

Bank Guarantee # 07/07
Guarantee Issued On 31-12-2005
Amounting Rs.10,000,000/-
Valid Upto 10-06-2006

Performance Guarantee

To: Managing Director
Private Power & Infrastructure Board
Ministry of Water& Power
Government of Pakistan
50 Nazimuddin Road
F – 7/4, Islamabad.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

THIS PERFORMANCE GUARANTEE is executed at Karachi on this 31st Day of December 2005 BY:

MCB Bank Limited formerly Muslim Commercial Bank Limited having our Registered Office at F6 G6, JINNAH AVENUE ISLAMABAD AND REGISTERED OFFICE AT MCB Tower, I.I Chundrigar Road, Karachi (hereinafter referred to as the "Guarantor", which expression shall mean and include its successors, administrators and legal representatives, whether jointly or severally);

On the request and on behalf of M/s. Engro Chemical Pakistan Limited (hereafter referred to as the "Sponsor", which expression shall mean and include its successors, executors, administrators, legal representatives and permitted assigns, whether jointly or severally);

In favor of Private Power & Infrastructure Board, Ministry Of Water & Power; Government Of Pakistan, Islamabad [hereinafter referred to as the "Beneficiary", which expression shall mean and include its successors, administrators and legal representatives, whether jointly or severally).

--Cont: pg 2--

Aftab Ahmed
A. S. No. 1024
MCB Bank Limited

Arshad Aziz
A.S.No.1521
MCB Bank Limited

GOVERNMENT OF PAKISTAN
MINISTRY OF WATER AND POWER
(PRIVATE POWER & INFRASTRUCTURE BOARD)

No. 1(102)PPIB-1026/06/PRJ 20th September 2006

Sheikh Imran ul Haque
General Manager
Business Development
ENGRO Chemical Pakistan Ltd.
Karachi

Subject: ENGRO POWER PROJECT- FEASIBILITY STUDY

References: (A) Letter of Interest (LOI) dated 6th January 2006 issued by PPIB to Engro Chemical Pakistan Limited (ECPL) for setting up approximately 150 MW Combined Cycle Power Project in Sindh.

(B) PPIB letter No. 1(102) PPIB-1026/06/PRJ, dated 19th September, 2006

Dear Sir,

We are pleased to in form you that the revised final feasibility study for the 150-250 MW Engro Power Project submitted by you was discussed in detail by POE in the meeting held on 18th September 2006 and POE decided that:

> *The feasibility study for 150-250 MW Engro Combined Cycle Power Project (CCPP) submitted by Engro Chemical Pakistan Limited was approved subject to the provision that the Panel of Experts monitored the conduct of feasibility study for timely completion as per the international standards and milestones set forth in the LOI. It was also decided that due to ever changing nature of data, the experts on the panel, jointly and/or individually, will not be responsible for the reliability of data given in the feasibility study.*

2. Accordingly you are requested to approach NEPRA either for acceptance of upfront tariff which is available on NEPRA's website (www.nepra.org.pk) or tariff determination.

Best regards,

Yours sincerely,

(Khalid I. Rahman)

1. Mr. Saeed-uz-Zafar, Chairman NEPRA, Islamabad
2. Mr. Tariq Hameed, Chairman WAPDA, WAPDA House, Lahore

House No. 59, Nazimuddin Road, F-7/4, Islamabad - Pakistan
Tel: (9251) 920 1848, 920 6357, 9222178, 9222425 Fax: (9251) 9217735, 9215723
Email: ppib@ppib.gov.pk Internet: http://www.ppib.gov.pk

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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DHK IPP file

NG (II)-7(55)/05-Pt
Government of Pakistan
Ministry of Petroleum & Natural Resources
Directorate General (Gas)
21-E, Huma Plaza Blue Area
****

Islamabad, the 12th September 2005

The Managing Director,
Private Power Infrastructure Board,
Ministry of Water & Power,
H # 50, Nazimuddin Road, F-7/4,
Islamabad.

Subject:- ALLOCATION OF GAS FOR TWO IPPS

Dear Sir,

I am directed to say that Economic Coordination Committee (ECC) of the Cabinet in its meeting held on 1st September 2005 has interalia decided the following;

i) Permeate gas (about 75 MMCFD of 575 Btu/Scf) from Qadirpur field is allocated to SNGPL and placed at the disposal of PPIB for setting up a new IPP of 150 MW capacity;

ii) 20 MMCFD Low Btu gas upgraded by the producer (M/s PEL)to 300 Btu/Scf from Kandra field is allocated to SSGCL which along-with 5 MMCFD pipeline quality gas from SSGCL's system at Sukkur is placed at the disposal of PPIB for setting a new IPP of 60 MW capacity at Sukkur; and

2. Please take appropriate measures to implement the above decisions under intimation to this office on regular basis for reporting to the concerned quarters.

(Mansoor Muzaffar Ali)
Deputy Director (Gas)

Copy to:

1. Managing Director, Sui Southern Gas Company Limited, Karachi.
2. Managing Director, Sui Northern Gas Pipeline Limited, Lahore.
3. Managing Director, OGDCL, Islamabad.
4. Managing Director, Petroleum Exploration (Pvt) Ltd, Islamabad.

For Similar action Please.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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GOVERNMENT OF PAKISTAN
REVENUE DIVISION
CENTRAL BOARD OF REVENUE

NATIONAL TAX NUMBER CERTIFICATE

(Issued under section 20 of the Finance Act, 1999)

National Tax Number (NTN) 2639742-7

Name: ENGRO ENERGY PRIVATE LIMITED

Address: 7TH FLOOR PNSC BUILDING M.T KHAN ROAD
KARACHI
PHONE NO: 5611060

Status/Nature: Company

NIC/Firm Reg./Company Inc.Number. 0000012175/20060207

This certificate shall be prominently displayed at a conspicuous place of the premises in which business or work for gain is carried on. It is also required to be indicated on the signboard wherever it is affixed.

Date of Issue 19/05/2006

Chairman

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

National Electric Power Regulatory Authority

Islamic Republic of Pakistan

2nd Floor, OPF Building, G-5/2, Islamabad.
Ph: 9206500, 9207200 Fax : 9210215
E-mail: office@nepra.org.pk

Registrar

No. NEPRA/R/PAR-14/CPPA-2006/50-52

-2007

Chief Operating Officer
Central Power Purchasing Agency
325-WAPDA House
Shahrah-e-Quaid-e-Azam
Lahore

Subject: **Request of Central Power Purchasing Agency of NTDC for acquiring Power (215 MW) from Engro Chemical Pakistan Ltd. (ECPL) Combined Cycle Power Plant (Daharki)**

The Authority in its Regulatory Meeting 06-385 held on December 28, 2006 considered the subject power acquisition request of Central Power Purchasing Agency (CPPA) of National Transmission and Despatch Company Ltd. (NTDC).

2. The Authority has admitted the Power Acquisition Request and granted permission to CPPA to procure power from Engro Chemical Pakistan Ltd. (ECPL) to the extent of 215 MW. A copy of the Authority decision is attached herewith.

DA/as above.

8.01.07.

(Mahjooh Ahmad Mirza)

CC:

1. Chief Executive Officer, National Transmission & Despatch Co. Ltd. (NTDC), 414 WAPDA House, Shahrah-e-Quaid-e-Azam, Lahore.

2. President, Engro Chemical Pakistan Ltd., 8th Floor, PNSC Building, M.T. Khan Road, Karachi.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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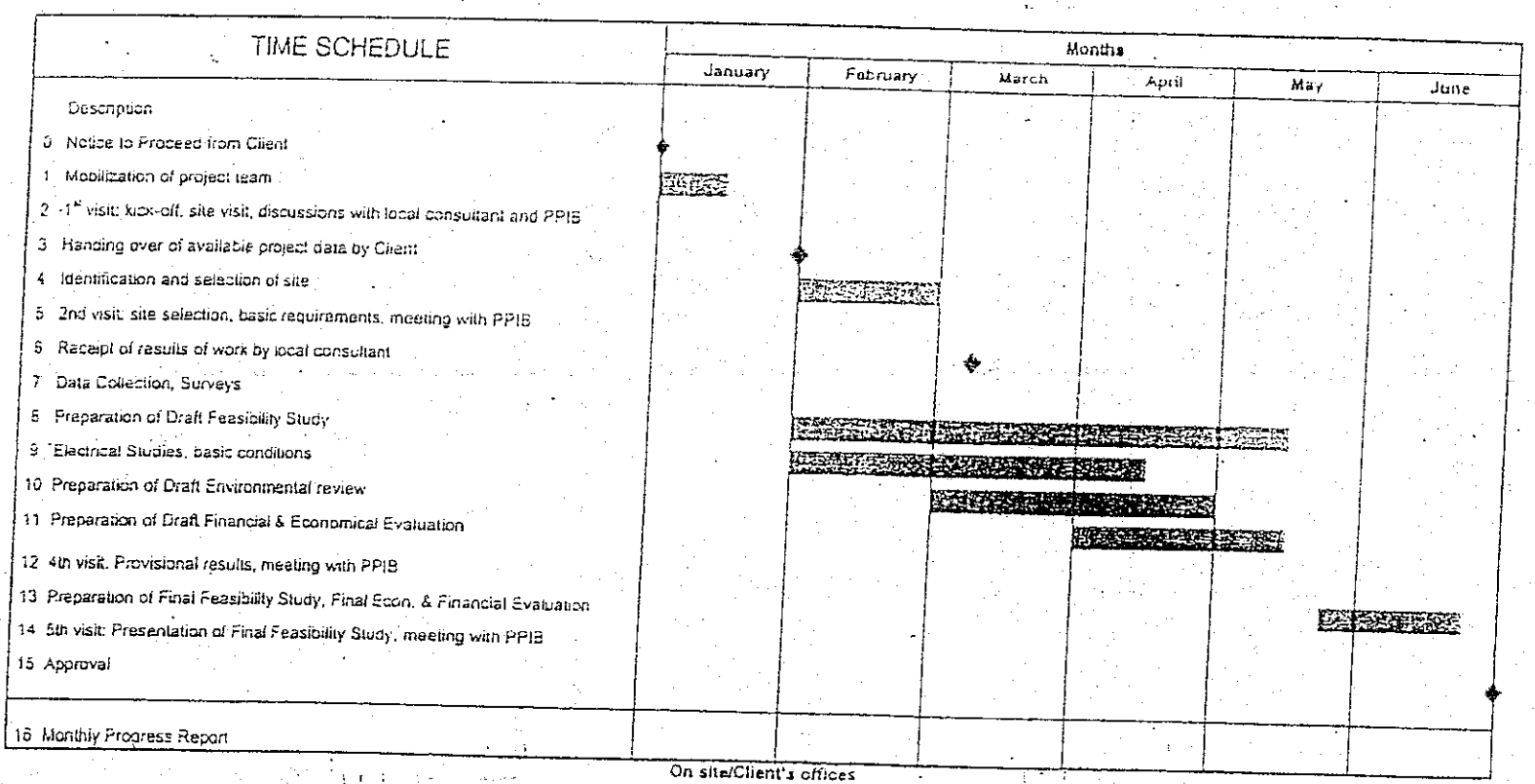
TIME SCHEDULE

Engro Chemical Pakistan Limited



completed shortly. Furthermore, extension in validity of the LOI will only be provided upon submission of a bank guarantee in double the original amount and valid beyond six months of the extended LOI period.

8. In case, if you fail to meet the relevant milestones and standards, PPIB will terminate this LOI and encash the Bank Guarantee.

9. This LOI has been issued in duplicate on the date hereof, and it shall come into effect when one copy hereof is received by PPIB after having been duly countersigned by you. Nevertheless, this LOI shall lapse if the countersigned copy is not received at PPIB within fifteen (15) days of its issuance.

With kind regards,

For and on behalf of
Engro Chemical
Pakistan Limited

S. Z. Haque
Jan 9, 2006

Yours sincerely,

(Zafar Ali Khan)
Managing Director

Encl: As above

cc: Chairman, WAPDA

Copy for information please:

Secretary, Ministry of Water & Power, Islamabad.

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

December 28, 2006

DECISION TAKEN IN THE AUTHORITY REGULATORY MEETING 06-385 HELD ON DECEMBER 28, 2006 REGARDING REQUEST OF CENTRAL POWER PURCHASING AGENCY (CPPA) OF NTDC FOR ACQUIRING POWER (215 MW) FROM ENGRO CHEMICAL PAKISTAN LTD. (ECPL) COMBINED CYCLE POWER PLANT(DHARAKI)

The Authority considered all relevant aspects of the case, the working paper presented by the Registrar and admitted the application and granted permission to Central Power Purchasing agency (CPPA) of NTDC to procure power from Engro Chemical Pakistan Ltd. (ECPL) to the extent of 215 MW. CPPA and Engro Chemical Pakistan Ltd. (ECPL) be informed accordingly.

5/1/07

(Abdul Rahim Khan)
Member /Vice Chairman

(Nasiruddin Ahmed)
Member

(Lt.Gen® Saeed uz Zafar)
Chairman

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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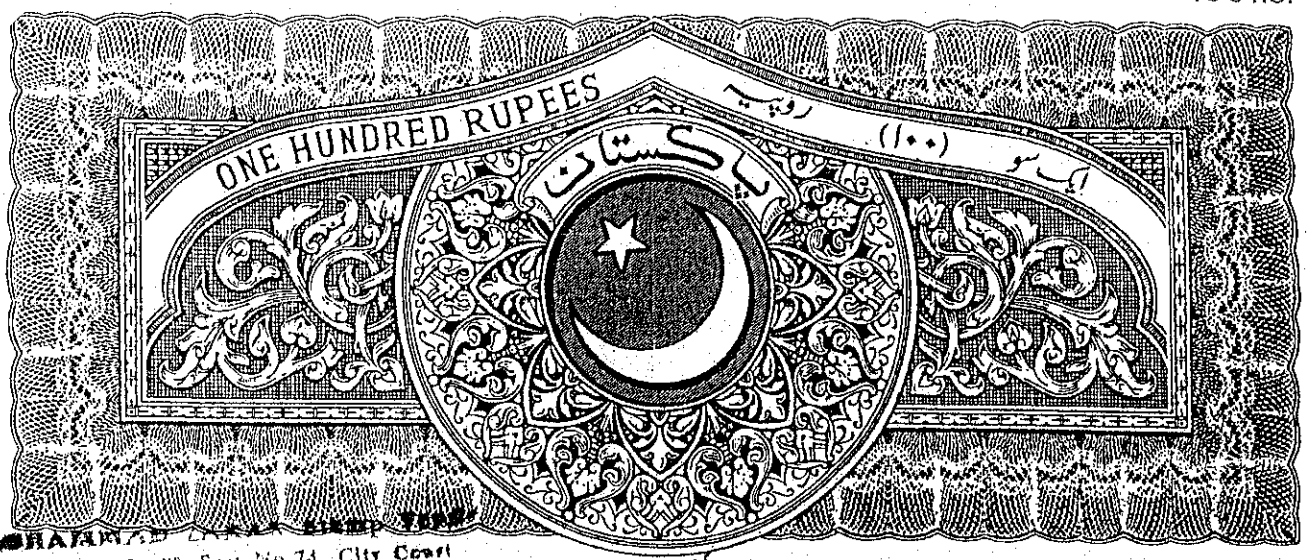
100 RS.



...HAMMAD ... Stamp Vendor
License No.30, Seat No.74, City Court
KARACHI, PAKISTAN

11 NOV 2005

Bank Guarantee No. 57 / 07
Dated 31.12.2005
Amount Rs. 10,000,000/-
Valid Upto 10.01.2007

M/s. Managing Director
Private Power & Infrastructure Board
Ministry of Water & Power
Government of Pakistan
50 Nazimuddin Road
F 7 / 4, Islamabad.

Extension Of Bank Guarantee

At the request of our client M/s. Engro Chemical Pakistan Limited we have extended the validity of the above-mentioned guarantee upto 10.01.2007. Now this bank guarantee shall remain in force and binding on the guarantor till 10.01.2007.

All other terms and conditions will remain unchanged.

This amendment is the integral part of the subject bank guarantee; please keep attached to it with the original bank guarantee.

Aftab Ahmed
A. S. No. 1622

Arshad Aziz
AS No. 1521
MCB Bank Limited

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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MANAGING DIRECTOR

GOVERNMENT OF PAKISTAN
MINISTRY OF WATER & POWER
PRIVATE POWER & INFRASTRUCTURE BOARD
****

No. 1(102) PPIB-1026/06/PRJ
12th October 2006

Subject: ENGRO POWER PROJECT - GSA NEGOTIATIONS

Dear Sir,

Please be informed that Engro Chemical Pakistan Limited (ECPL) has completed the feasibility for a 150-250 MW combined cycle power plant at Daharki, Sindh, based on Qadirpur permeate gas. The Panel of Experts (POE) appointed by PPIB has approved the feasibility study and ECPL is now in the process of approaching NEPRA for tariff determination.

2. As per ECC decision dated 1st September 2005 (copy enclosed), 75 MMCFD low BTU permeate gas from Qadirpur Field was allocated to SNGPL and was put on PPIB's disposal for a new IPP. As the project is being processed based on that allocated gas, therefore, ECPL desires to finalize Gas Supply Agreement (GSA) after negotiating it with SNGPL, at the earliest. PPIB would appreciate if the GSA negotiations could be commenced between SNGPL and ECPL for Engro Power Project.

Best regards,

Yours sincerely,

(Khalid I. Rahman)

Mr. Abdul Rashid Lone
Managing Director
SNGPL
Lahore

CC:
1. Mr. Saeed Ullah Shah, Director General (Gas) MoP&NR, Islamabad
2. Mr. Khalid Mansoor, Vice President, Engro Chemical Pakistan Limited, Karachi

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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50 - Nazimuddin Road, F-7/4, Islamabad - Pakistan
Tel: (92-51) Direct: 9203142 PABX: 9205421-23, 9206357 Fax: (92-51) 9217735, 9215723

2121 PENNSYLVANIA AVE NW
WASHINGTON, DC 20433 USA
TELEPHONE:202-4738911
FACSIMILE: 202-974-4318

January 25, 2006

Mr. Khalid Mansoor
Chief Executive Officer,
Engro Energy (Pvt) Limited
Karachi, Pakistan

Re: Pakistan – Engro Energy Power plant, Pakistan.

Dear Mr. Mansoor,

We understand that Engro Energy is developing a thermal power project, which includes planning for the design, financing, supply, construction, operation and maintenance of a 220 MW gas fired thermal power plant to be located near Dharki, in Sindh, Pakistan ("the Project").

We are pleased to inform you that the International Finance Corporation ("IFC") would be interested in principle in financing this Project, including providing debt for its own account, as well as assisting in the mobilization of additional funds from other sources. IFC has not carried out a due diligence review of the proposed Project, and this letter does not constitute a commitment by IFC. The indicative terms provided below are provided prior to due diligence and do not constitute an offer or a commitment from IFC. IFC's decision to provide financing for the Project is contingent upon due diligence, the approval by IFC's management and Board of Directors and the execution of financing and security documentation in form and substance satisfactory to IFC.

Assuming an appropriate debt/equity ratio, IFC could consider providing an IFC "A" Loan of up to 25 percent of total Project costs with a total tenor of 10 years. Indicative pricing of the IFC loan is expected to be around LIBOR plus a spread of 350 bps. Principal repayments on the IFC Loan would commence after a grace period of six months following the commencement of commercial operations.

The pricing, tenor and other terms of the IFC Loan would be based on the Project structure, offtaker credit risk and market conditions and will be determined in consultation with potential participant banks. The pricing would very likely reflect WPPO's credit risk as offtaker for the Project's output and payment security.

This letter may be used by Engro Engery as evidence of its loan pricing assumption in order to obtain its tariff from National Electric Power Regulatory Authority, for the Engro Engergy power project, only as an indication of IFC's in-principle interest in providing financing.

Best regards,

Asad Yaqub
Senior Investment Officer
Infrastructure Department

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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National Electric Power Regulatory Authority,
2nd Floor OPF Building, G-5/2,
Islamabad

Attention: **Mr. Mahjoob Ahmed Mirza**

SUBJECT: **TARIFF PETITION FILED BY M/S ENGRO ENERGY (PVT) LTD, (CASE NO.NEPRA/TRF-72/EEPL-2007)**

Reference: Your Letter No.NEPRA/TRF-72/EEPL-2007/2563 dated.12.06.2007.

Please find enclosed herewith my views/working on the subject matter as desired by NEPRA.

D...A/ As above

ABU ADIL 25/06/07
INDEPENDENT EXPERT
H. No.446, Road No.2,
D.O.H.S. Phase-I,
Malir Cantt, Karachi

Registrar
Dy. No. 1039
Dated 28-06-07

Member (Tariff)
D. 13/6
Dated 25.6.07

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

SUBJECT: **COMMENTS/VIEWS ON THE TARIFF PETITION FILED BY M/S ENGRO ENERGY (PVT) LTD, CASE NO.NEPRA/TRF-72/EEPL-2007**

Reference: NEPRA letter No.NEPRA/TRF-72/EEPL-2007/2563 dated.12.06.2007 (Annex-1)

Based on the informations provided by NEPRA vide above referred letter, discussion meeting with the Petitioner in NEPRA Head Office on 19.06.2007 attended by NEPRA Authority and other officers, CPPA, subsequent discussion in NEPRA on 20.06.2007 and further clarifications from the Petitioner, my comments/views and recommendations on the subject case are as under:

1. Engro Energy (Pvt) limited has filed tariff petition with NEPRA for their combined cycle Power Plant based on permeate gas (main fuel) and HSD (Alternate fuel) with supplementary firing in the HRSG. The Plant will be located near Qadir Pur Gas Fields near Dharki in the Province of Sindh.

   The combined cycle project is a unique as it will use low Btu (565-625 Btu/Ft^3), high sulphur contents (H_2S=320 PPM) permeate gas which is currently being flared. The guaranteed gas supply is 60 MMSCFD, which is said to be enhanced to 75 MMSCFD by 2009 when the CCP Plant is scheduled to be commissioned.

   The combined cycle Plant will comprise of 01 Gas Turbine (GE PG 9171E) 01 HSRG and 01 Steam Turbine. The plant can utilize 75% of the available gas (56.3 MMSCFD) through conventional combined cycle system. The balance 25% of the gas (18.7 MMSCFD) will also be used in supplemental firing in the HRSG enhancing the Steam Turbine out put by 89% and that of the Combined Cycle Plant by 29% at mean site condition.

2. The Petitioner M/s Engro Energy after finalizing the configuration and technical details with the EPC Contractor M/s China National Chemical Engineering Corporation (CNCEC) has proposed the following Net out put and Net Thermal efficiency of the project with supplementary firing:

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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Fuel	Net Output (MW)	Net Efficiency %	Ambient Condition
Permeate Gas	216.8	45.53	Mean site condition 80.6^{0}F (27^{0}C), 60% R.H
HSD	210.9	44.40	

3. The petitioner in support has submitted following two reasons for the drop in the net thermal efficiency of about 4.47% when compared to net thermal efficiency of 50% recently allowed by NEPRA to Fauji Foundation Combined Cycle Plant having same configuration of 01 Gas Turbine (GE PG 9171E), 01 HRSG and 01 Steam Turbine.

(i) High sulpher contents in low Btu permeate Gas (H_2S=320 PPM) for the Petitioner Plant as compared to low Btu, low sulpher contents Gas (H_2S=20 PPM) for Fauji Foundation, resulting high HRSG Flue Gas Exhaust temp (stack temp) for the Petitioner Plant The impact has been shown as 2% reduction in net thermal efficiency.

(ii) Supplemental firing in the HRSG as approved by POE/PPIB to enhance the capacity by fully utilizing the permeate gas. In the presentation of M/s Engro Energy the impact has been shown as 2.7% reduction in net thermal efficiency due to supplemental firing. There is no supplemental firing in case of Fauji.

4. Each of the above reasons would be discussed in detail as under.

4.1 Impact of Low Btu High Sulpher permeate Gas

i. Whenever fossil fuel containing sulpher are fired in heaters or boilers, sulpher dioxide and to small extent sulpher trioxide are formed in addition to CO_2 and water vapour. The SO_3 combines with water vapour in the flue gas to form sulphuric acid and condenses on heat transfer surfaces which

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could lead to corrosion and destruction of the surfaces. The condensation occurs on surfaces that are at or below the dew point of the acid gas.
While thermal efficiency of the equipment is increased with reduction in the exit gas temp: (or enthalpy); lower temperatures than the acid dew point are not advisable for the metallic surfaces in contact with the gas (Extract from An article "Cold end Corrosion causes and Cures" by V Ganapathy, ABCO Industries, Abilene Texas – Annex-2).

ii. Sulphuric acid dew point is a function of the fuel sulphur content, of the fuel air ratio and the conversion rate of SO_2 to SO_3. GE's base line practice is to assume a 5% conversion rate for SO_2 to SO_3 by volume for the dew point calculation.

iii. In case of Engro Energy, the permeate gas has 320 PPM (0.320%) of hydrogen sulphide. Taking SO_2 to SO_3 conversion fraction of 0.05, water vapour in the exhaust flue gas as 10 to 11%, the acid dew point temp: of the exhaust flue gas has been worked out in between 116.69 to 117.58^{0}C (Annex-3).

It is further important to recognize that the dew point control requires the fluid temp: (water) in the HRSG tubes to be above the dew point.

iv. Now looking at the heat balance cycle of Engro Energy Plant submitted by the EPC Contractor (Annex-4), the feed water inlet temperature to the economizer is 120^{0}C i.e. 3^{0}C above the dew point temp: (117^{0}C). The feed water leaves the economizer at a temp: of 133^{0}C and the flue gas is exhausted to atmosphere at a temp: of 137^{0}C which seems to be reasonable temperature to avoid cold end corrosion.

v. M/s Engro Energy in their presentation has shown 2% reduction in efficiency due to use of permeate gas (H_2S=320 PPM) resulting high flue gas exhaust temp: of 137^{0}C as compared to Fauji Foundation Plant using low sulphur gas (H_2S=20 PPM) resulting exhaust flue gas temp: of 110^{0}C.

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In this regard, an extract from GE paper is reproduced (Annex-5):

"Sulpher content in the fuel may require adjustment in the temperature of the stack gas and the water entering the HRSG economizer to prevent condensation of corrosive sulphuric acid. The increased gas stack temp: required by higher sulphur content decreases out put and efficiency. Performance variation with fuel type (hydrogen, ash and sulphur content typical of each) is presented as under:"

STAG 209 E (PG 9171 E)
Two Pressure Non-Reheat

Fuel	Net Plant Output (%)	Net Plant Thermal Efficiency (%)
Natural Gas	Base	Base
Distillate Oil	-3.0	-2.1
Residual oil	-9.3	-7.6

The above table is not specific for comparison with the Petitioner single pressure non-reheat STAG (PG 9171E) using low Btu, high sulphur permeate gas with flue gas exhaust temp: of 137^0C, but it can be assumed that the drop in Net Thermal Efficiency may be around 1.5% to 2%.

4.2 Impact of Supplemental Firing

General Electric in their publication "GE combined cycle product line and performance, GER-35746" has described supplementary firing in the HRSG as an option for enhancing combined cycle plant capacity; the same is reproduced as under:

"Supplementary firing of the HRSG can be utilized to increase steam turbine capability by as much as 100%. This will increase plant capacity by about 25% Cogeneration of Power and process energy is usually the incentive for HRSG

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supplementary firing; however peaking capacity credits or leveling fuel consumption over the ambient temperature range to accommodate "take or pay" fuel contracts may also justify the option. The incremental efficiency for power produced by supplementary firing is in the 34------36% range based on the lower heating value of the fuel.

A typical performance impact of HRSG supplementary firing of a three pressure Reheat steam cycle using natural gas and at site conditions of 90°F, 30% R.H has been shown as under.

"Output increase by 28% and efficiency drop by 4.43%".

The above reference can be used for comparison of the performance impact of supplementary firing in the HRSG of Engro Single Pressure Non-Reheat Steam Cycle using permeate gas at mean site condition of 80.6°CF(27°C), 60% R.H.

- Net Output of Engro Combined Cycle

Without Supplementary Firing (MW)	With Supplementary Firing (MW)	Increase (MW)	Increase (%)
168.27	216.8	48.53	29

- Net Thermal efficiency of Engro Combined Cycle.

Without Supplementary Firing (%)	With Supplementary Firing (%)	Decrease (%)
48	45.53	2.47

The increase in output of 29% with decrease in efficiency by 2.46% with supplemental firing in the HRSG is reasonable when compared with G.E typical performance

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impact of increase of 28% in output with 4.43% decrease in efficiency on supplemental firing in the HRSG of the most efficient combined cycle.

In this perspective we can say that overall impact of drop in efficiency by 4.47% due to use of low Btu high sulphur (H_2S = 320 ppm) permeate gas is reasonable.

5. Benefit of Supplemental Firing

- An additional out put of 48.53 MW at an additional cost of 22.9 M. USD (USD 472 per KW) will be achieved which is much needed in the present scenario of Power shortage in the Country.
- M/s Engro has made a levelized Tariff comparison of 25 years with and without supplementary firing (SF) in their presentation which is reproduced as under:

		With SF	**Without SF**
*	Net Capacity (MW)	216.8	168.27
*	Project Cost (M.USD)	205 (USD 946/KW)	182.1 (USD 1082/KW)
*	Net Efficiency %	45.53	48.0
*	Proposed Tariff Cents/Kwh	6.21	6.50
*	EPP Cents/Kwh.	3.50	3.37
*	CPP Cents/Kwh.	2.71	3.13

In addition it will avoid flaring and wasting of balance permeate gas which could not be utilized in Gas Turbine. However supplementary firing will only be feasible if 75 MMSCFD of permeate gas is available by the time the combined cycle is commissioned which has been assured by the petitioner.

6. Efficiency on HSD

The EPC Contractor has guaranteed a net output of 210.9 MW and net efficiency of 44.40% of the combined cycle plant on HSD with supplemental firing.

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When it is compared with net output and net efficiency on permeate gas with supplementary firing, the following variations are seen.

	Permeate Gas	HSD	Diff:	% age
Net Out put (MW)	216.8	210.9	5.9	-2.7%
Net Efficiency (%)	45.5	44.4	-	-1.1%

Heat flow diagram on HSD oil has not been provided by M/S. Engro Energy. Since the sulphur content in HSD is also 1%, therefore the impact on efficiency on HSD due to high sulphur content may be theoretically the same as on permeate gas; however the impact of supplemental firing in the HRSG on HSD may vary and may be more than 2.7% as for the permeate gas. The overall impact on efficiency on HSD as compared to permeate gas seems to be reasonable.

7. RFO Conversion

Conversion of the Engro CCPP plant on RFO at this stage is not recommended on account of following reasons.

- Additional cost for RFO storage tanks, Decantation system, Fuel forwarding system, Fuel Treatment Plant, Fuel additives etc increasing the CAPEX cost while its utilization will be for a short period of Gas interruption. Max. 36 days in a year.
- HSD will have to be used in addition to permeate gas and RFO for start up, shutdown and low load operation.
- Conversion on RFO can be considered when Qadir Pur Gas starts depleting in between 2014, 2017 and no alternate arrangement of Gas is available.

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8. Recommendations:

Based on the informations provided by the petitioner, and subsequent discussions, the following are the recommendations:

i) Net out put and net efficiency on permeate gas (H_2S content 320 ppm) and HSD with supplementary firing as proposed by Engro Energy (Pvt) Ltd in their tariff petition seems to be reasonable.

ii) Supplementary Firing in the HRSG to enhance the net output is feasible if 75 MMSCFD of gas is ensured by the time combined cycle plant is ready for operation.

iii) Conversion of RFO can be made when the permeate gas starts depleting in between 2014 to 2017.

iv) While fixing the price of low Btu permeate gas (H_2S contents 320 ppm) by OGRA/Govt. of Pakistan, the impact of 4.47% reduction in efficiency due to high sulphur content in the gas and due to supplemental firing to utilize full gas quantity may be considered.

ABU ADIL 25/6/07.
INDEPENDENT EXPERT

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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Annex-1 (½)

National Electric Power Regulatory Authority

Islamic Republic of Pakistan

Registrar

2nd Floor, OPF Building, G-5/2, Islamabad.
Ph: 9206500, 9207200 Fax : 9210215
E-mail: office@nepra.org.pk

No. NEPRA/TRF-72/EEPL-2007/2563

12-06-2007

Mr. Abu Adil
House No. 446
Road No. 2
DOHS Phase-I
Malir Cantt.
Karachi

Subject: **Tariff Petition filed by Engro Energy (Pvt) Ltd. (Case No. NEPRA/TRF-72/EEPL-2007**

A tariff Petition filed by Engro Energy (Pvt.) Ltd. is under process with the Authority. According to information/data provided by the petitioner, net thermal efficiency of CCPP on permeate gas and HSD (as alternate fuel) with supplementary firing has been proposed as 45.52% and 44.4% respectively. (Necessary details are attached herewith).

2. In order to determine a reasonable net thermal efficiency level for this unique project, on both fuels (Permeate Gas and HSD) the Authority has desired to obtain your independent expert views/working on the issue.

3. You are therefore requested to please attend discussion meeting on 19.6.2007 at 10.00 AM at Main NEPRA Office G-5/2 Islamabad which will also be attended by the representatives of the Power Purchaser (CPPA) and the petitioner.

4. Please note that the Authority will be pleased to reimburse all your actual traveling expenses along with remuneration as permissible under the NEPRA Rules.

DA/as above.

12.06.07.
(Mahjoob Ahmad Mirza)

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

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Annex I (2/2)

Efficiency Calculations

Maximum Gas Available 75MMSCFD

Mode of Operation		Gross ISO Condition		Mean Site Condition		Mean Site Condition	
		Gross Output MW	Gross Efficiency	Gross Output MW	Gross Efficiency	Output MW	Net Efficiency
Gas Turbine		126.57	33.12%	116.7	32.63%		
Steam Turbine, Heat Cycle Efficiency with Supplementary firing		35.1%		35.7%			
1GT + 1ST (without supplementary firing)	Gas Turbine	126.57		116.7			
	Steam Turbine	61		56.57			
	Combined Cycle	187.57	49%	173.27	48.4%	168.27	47%
1GT + 1ST (with supplementary firing)	Gas Turbine	126.57		116.7			
	Steam Turbine	99.95		107.1			
	Combined Cycle	226.52	47.57%	223.8	47.0%	216.8	45.5%

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY

Annex 2 (1/3)

Cold end corrosion: causes and cures

Calculating dew points of various acid gases and options for reducing cold end corrosion of heat recovery exchangers are

V Ganapathy, ABCO Industries, Abilene, Texas

WHENEVER FOSSIL FUELS containing sulfur are fired in heaters or boilers, sulfur dioxide, and to a small extent sulfur trioxide, are formed in addition to CO_2 and water vapor. The SO_3 combines with water vapor in the flue gas to form sulfuric acid and condenses on heat transfer surfaces, which could lead to corrosion and destruction of the surfaces. This condensation occurs on surfaces that are at or below the dew point of the acid gas. Also, when cooled below the water vapor dew point, CO_2 can combine with water vapor to form carbonic acid, which though weak, can attack mild steel.

While thermal efficiency of the equipment is increased with reduction in exit gas temperature (or enthalpy), lower temperatures than the acid gas dew point are not advisable for metallic surfaces in contact with the gas.

In municipal solid waste fired plants, in addition to sulfuric acid, one has to deal with hydrochloric and hydro bromic acid formation.

This article deals with methods for solving cold, or back end corrosion as it is called, with the most commonly used heat recovery equipment, namely economizers or water heaters. These are used to preheat feed water entering the system (Fig. 1) and operate at low metal temperatures, thereby increasing their susceptibility to corrosion by sulfuric, hydrochloric, hydrobromic and carbonic acid.

Estimating the dew point of these acid gases is the starting point in understanding the problem of back end corrosion. Appendix 1 gives the dew points of the various acid gases as a function of their partial pressures in the flue gas.[1] Fig. 2 gives the dew point for sulfuric acid.[2]

CO_2+ = 87%, H_2O = 12%, N_2 = 73%, SO_2 = 0.02%, HCL = 0.015%.02 = 6 %. HBR = 0.01%. all by volume. To compute the sulfuric acid dew point, one should know the amount of SO_3 in the flue gases. The formation of SO_3 is primarily derived from two sources.

1. Reaction of SO_2 with atomic oxygen in the flame zone. It depends on the excess air used and the sulfur content.
2. Catalytic oxidation of SO_2 with the oxides of vanadium and iron, which are formed from the vanadium in the fuel oil.

It is widely agreed that 1 to 5 % of SO_2 converts to SO_3. Hence the % volume in our case would be 4 ppm, assuming a 2 % conversion.

Using these numbers and after proper conversion and

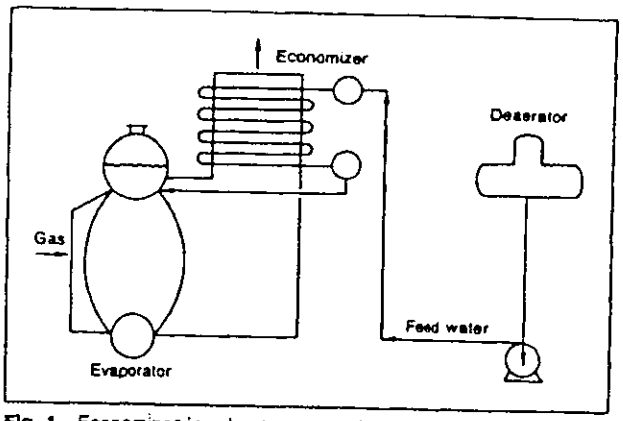

Fig. 1—Economizer in a heat recovery boiler system.

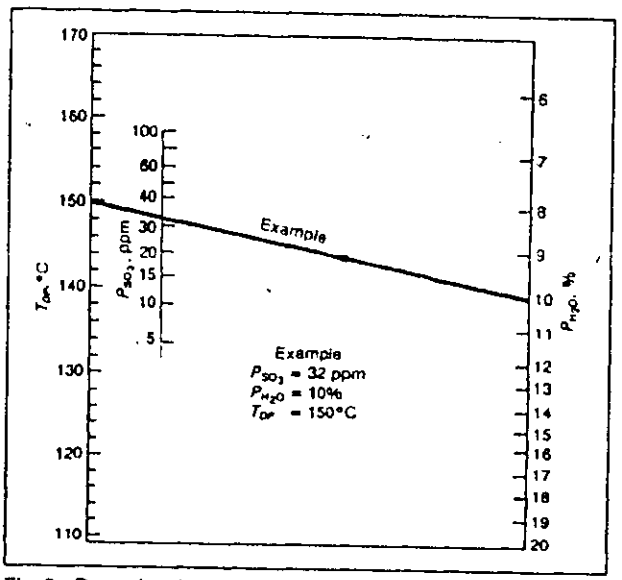

Fig. 2—Dew point of sulfuric acid as a function of partial pressures of SO_3 and water vapor.

substitution in the equations in Appendix 1, we have: dew point of sulfuric acid = 267°F, dew point of hydrochloric acid = 128°F, dew point of hydrobromic acid = 134°F and dew point of water vapor = 121°F.

Hence, it is apparent the limiting dew point is that due to sulfuric acid and any heat transfer surface should be above this temperature (267°F) if condensation is to be avoided.

There is a misconception even among experienced engineers that the gas temperature dictates the metal temperature of surfaces such as economizers. It is not so. To explain this, an example will be worked to show the metal temperature of an economizer with two different gas temperatures. Appendix 2 shows this calculation.

Continued

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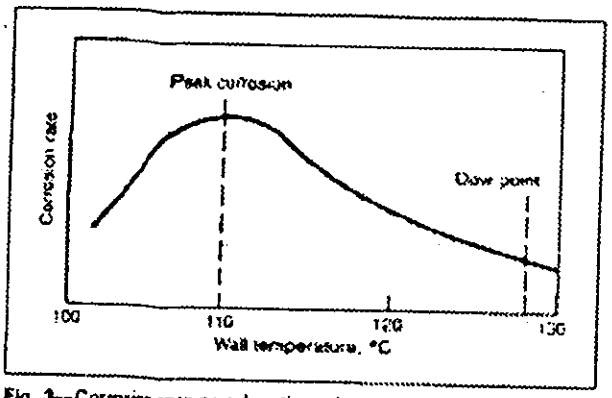

Fig. 3—Corrosion rate as a function of wall temperature.

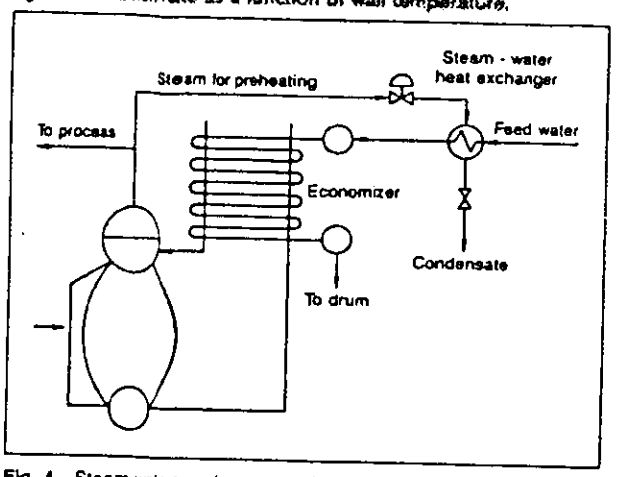

Fig. 4—Steam-water exchanger preheats feed water.

It can be seen that the water side coefficient is so high that the tube wall temperature runs very close to the water temperature in spite of a large difference in the gas temperatures. Thus, the tube wall temperature will be close to the water temperature and the water temperature fixes the wall temperature and hence, the dew point. Some engineers think that by increasing the flue gas temperature the economizer corrosion can be solved; not so.

It should be noted also that the maximum corrosion rate occurs at a temperature much below the dew point (Fig. 3).

Methods of dealing with cold end corrosion. Basically there are two approaches used by engineers to combat the problem of cold end corrosion:

A. Avoid it by using protective measures such as maintaining a high cold end temperature so that condensation of any vapor does not occur.

B. Permit condensation of acid vapor or both acid and water vapor, thereby increasing the duty of the heat transfer surface, and use corrosion resistant materials such as glass, teflon, etc.

Methods of avoiding cold end corrosion:

1. Maintain a reasonably high feed water inlet temperature. If the computed dew point is say 250°F, a feed water of 250°F should keep the minimum tube wall temperature above the dew point. With finned heat transfer surfaces, the wall temperature will be slightly higher than with bare tubes.

The simplest way would be to operate the deaerator at a slightly higher pressure, if the feed water enters the economizer from a deaerator (Fig. 1).

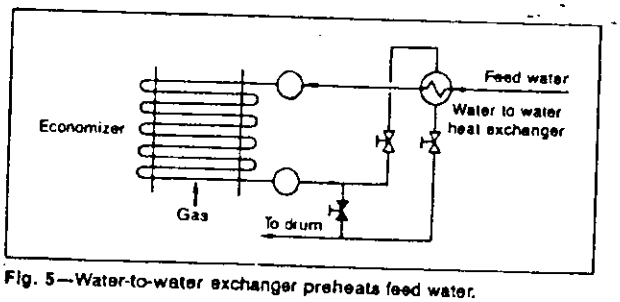

Fig. 5—Water-to-water exchanger preheats feed water.

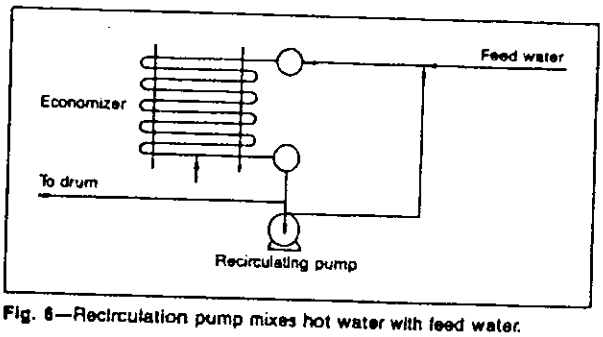

Fig. 6—Recirculation pump mixes hot water with feed water.

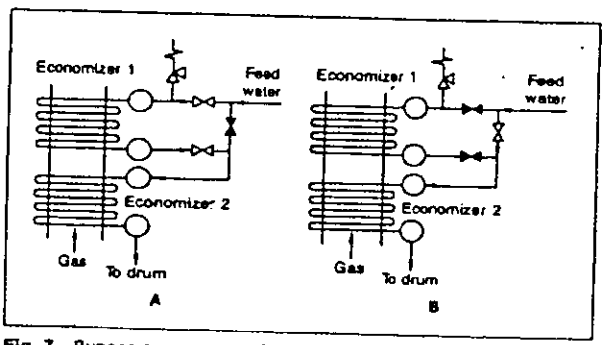

Fig. 7—Bypass arrangement for economizer. In "b" economizer one is bypassed. This increases exit gas temperature and avoids steaming but does not solve dew point corrosion in economizer two.

At 5 psig the saturation is 228°F and at 10 psig it is 240°F

2. In case the deaerator pressure cannot be raised, a heat exchanger may be used ahead of the economizer (Fig. 4) to increase the feed water temperature. It may be steam or water heated.

3. Fig. 5 shows a method for using an exchanger to pre heat the water. The same amount of water from the economizer exit preheats the incoming water. By controlling the flow of the hotter water, one can adjust the water temperature to the economizer so that a balance between corrosion criterion and efficiency of operation can be maintained.

4. Hot water from either the economizer exit or the steam drum (Fig. 6), can be recirculated and mixed with the incoming water. The economizer has to handle a higher flow, but the exchanger is eliminated and a pump is added.

Note that some engineers have the misconception that bypassing a portion of the economizer (Fig. 7) would solve the problem; not so. While bypassing, the heat transfer surface reduces the duty on the economizer and increases the exit gas temperature; it does not help to increase the wall temperature of the tubes, which is the most important variable. A higher exit gas temperature probably helps the downstream ductwork and equipment, but not the economizer. One benefit, however, from bypassing is

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Annex 2 (3/3)

The author

V. Ganapathy is a heat transfer specialist with ABCO Industries Inc., Abilene, Texas. He is engaged in the engineering of heat recovery boilers for process, incineration and cogeneration applications. He also develops software for engineering of heat recovery systems and components. He holds a B Tech degree in mechanical engineering from Indian Institute of Technology, Madras, India, and nology from Madras University. Mr Ganapathy is the author of over 150 articles on boilers, heat transfer and steam plant systems and has written four books: Applied Heat Transfer, Steam Plant Calculations Manual, Nomograms for Steam Generation and Utilization and Basic Programs for Steam Plant Engineers (book and diskette), copies of which are available from him. He also has contributed several chapters to the that steaming possibilities in the economizer are minimized.

Permitting condensation on surfaces. By using proper materials one can protect the heating surfaces from corrosion attack, if condensation is likely. This concept has now been extended to recovering the sensible and latent heat from the flue gases, thereby increasing the thermal efficiency of the system by several percentage points in what are called condensing heat exchangers. If flue gases contain say 10% by volume water vapor, by condensing even half of it, approxi mately 30 Btu/lb of flue gas can be recovered. This is nearly equivalent to a 120°F drop in gas temperature if sensible heat alone is transferred.

A large amount of sensible and latent heat in the flue gas can be recovered if the gas is cooled below the water dew point. This implies that sulfuric acid, if present in the gas stream, will condense on the heat transfer surfaces as its dew point is much higher than that of water vapor.

Borosilicate glass and teflon coated tubes have been widely used as heat transfer surfaces for this service. Glass is suitable for low pressures and temperatures (less than 450°F and 20 to 100 psig). However, presence of fluorides and alkalis is harmful to the glass tubes.

One manufacturer of condensing heat exchangers uses teflon coated tubes. A thin film (about 0.015 in.) is extruded onto carbon or alloy steel tubes, and the surface is resistant to corrosion of sulfuric acid. Finned tubes cannot be used as teflon cannot be extruded onto these surfaces. Hence, these exchangers will be larger than those with extended surfaces, however, the higher heat transfer rates with condensation process improves the overall heat transfer coefficients and partly compensates for the lower surface area per linear foot of bare tubes.

The high initial investment associated with condensing heat exchangers has to be carefully reviewed along with the energy recovered, fuel costs, etc. If the fuel cost is not high, then the payback period for this type of equipment may be long.

Materials such as cast iron and stainless steels probably have better corrosion resistance than carbon steel, but still they are not Conclusion The article outlined the importance of the dew point of acid gas and methods for dealing with the problem of condensation on heating surfaces such as economi zers. Similar methods could be used for air heaters. The basic difference lies in the fact that the back end temperature is a function of both the gas and air temperatures. Steam air heating or air bypassing have been used to combat the problem of corrosion. Replaceable matrices and corrosion resistant materials such as enamels have been used at the cold end of regenrative air heaters

APPENDIX 1-Dew points of acid gases[1]

HCl, HBr, HNO_3 and SO_2 correlations were derived from vapor-liquid equilibrium data.[4] The H_2SO_4 correlation is from reference 5.

Hydrobromic acid:

$1,000/T_{DP} = 3.5639 - 0.1350 \ln(PH20) - 0.0398 \ln(PHBr) + 0.00235 \ln(PH2_0) \ln(PHBr)$

Hydrochloric acid:

$1,000/T_{DP} = 3.7368 - 0.1591 \ln(PH_20) - 0.0326 \ln(PHCl) + 0.00269 \ln(PH_20) \ln(PHCl)$

Nitric acid:

$1,000/TD_P = 3.6614 - 0.1446 \ln(P_H)$

Sulfurous acid:

$1,000/T_{DP} = 3.9526 - 0.1863 \ln(P_{H0}) + 0.000867 \ln(PSO_2) - 0.000913 \text{ in } (PH20) \ln(P_{so2})$

Sulfuric acid:

$1,000/T_{DP} = 2.276 - 0.0294 \ln(P_{H20}) - 0.0858 \ln(PH_2SO_4) + 0.0062 \ln(P_{H20}) \ln(PH_2SO_4)$

Where: T_{DP} is dew point temperature (K) and P is partial pressure (mmHg).

Compared with published data, the predicted dew points are within about 6K of actual values except for H_2SO_4 which is within about 9K.

REFERENCES

[3] Pierce, R. R., "Estimating acid dewpoints in stack gases," *Chem. Eng.*, Apt. 11, 1973.
[4] Perry, R. H., and Chilton C. H., ed., "Chemical Engineers' Handbook," 5th ed., McGraw-Hill, New York, 1973.
[5] Verhoff, F H., and Banchero, J. T, "Predicting Dew Points of Flue Gases," *Chem. Eng.* Prog., August, 1974.

APPENDIX 2-Determining tube wall temperatures of economizers

The average wall temperature of a bare tube economizer is given by the simple equation:

$$t_w = 0.5[t_i + t_g - U(t_g - t_i)(1/h_o - 1/h_i)]$$

Where:

h_i = heat transfer coefficient inside tubes, Btu/ ft^2h °F
h_o = heat transfer coefficient outside tubes, Btu/ ft^2h °F
t_i = temperature of water inside tubes, °F t_g = temperature of gas outside tubes, °F
t_w = average tube wall temperature, °F
U = overall heat transfer coefficient, Btu/ft^2h °F 1/U = 1 /h_i + 1/h_o, neglecting fouling and metal resistance, which are much smaller.

Typically h_i = 1,000, h_o = 15 and hence U = 4.77

Case 1: Determine t_w when t_g = 750°F and t_i =50°F tw = 0.5 [250 + 750 - 14.77 (750 - 250) (0.066 - 0.00 1)] = 260°F

Case 2: t_g = 350°F, t_i = 250°F

$t_w = 0.5$ [250 + 350 - 14.77 (350 - 250) (0.066 - 0.001)] = 252°F

Thus, for a variation of 400°F gas temperature, the tube wall temperature hardly changes by 8°F Thus, the water temperature fixes the tube wall temperature.

LITERATURE CITED

1 Kiang, Yen-Hsiung, "Predicting dewpoints of acid gases," Chemical Engineering, Feb. 9, 1981, p. 127.
2 Ganapathy, V., "Nomograms for steam generation and utilization," Fairmont Press, 1986, p. 15.

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Feedwater recirculation is limited to LP economizer inlet water temperatures of 10 to 15°F (5.5 to 8°C) below the stack temperature. One way to extend the amount of FW temperature control with recirculation is to add an economizer bypass, which operates in conjunction with the recirculation system. This approach maximizes the available recirculation flow available from upstream within the HRSG, while obviating the need to pass all of the mixed FW through the LP economizer. Other options to achieve higher FW temperatures include an external FW heater (closed or open), bypassing the LP economizer entirely, or eliminating it from the system design. Systems with entirely bypassed LP economizers and systems without LP economizers typically require pegging of the LP drum to maintain the LP evaporator temperature above the sulfuric acid dewpoint.

4.5.2.2.2.1 Sulfuric Acid Dewpoint Calculation

Sulfuric acid dewpoint is a function of the fuel sulfur content, of the fuel to air ratio, and the conversion rate of SO_2 to SO_3. The conversion of SO_2 in the combustion products to SO_3 is necessary for the formation of sulfuric acid (H_2SO_4). The conversion of SO_2 to SO_3 depends on many variables, among which are combustor geometry, temperature, catalytic action, ash and carbon particles, pressure, time and fuel properties. In a gas turbine, there are two mechanisms by which SO_3 may be produced from SO_2:

1. Combination of SO_2 with atomic oxygen in the flame. $SO_2 + 0 \rightarrow SO_3$.
2. Catalytic oxidation on heated surfaces.

There are various empirical calculation methodologies for sulfur dewpoint, the Pierce method, the Okkes method, and the Verhoff & Banchero equations. These are the approved methods for calculation. GE's base line practice is to assume a 5% conversion rate for SO_2 to SO_3 by volume.

Heat Recovery Steam Generators with emission control catalysts convert more of the SO_2 leaving the gas turbine to SO_3. Catalysts for NOx control oxidize up to 5% of the remaining SO_2 to SO_3. Un-reacted ammonia passing through the catalyst combines with SO_3 to form Ammonium Bisulfate (NH_4HSO_4) and Ammonium Sulfate ([NH_4]2SO_4). Ammonium salt formation occurs at temperatures below 600°F (315°C), typical of the low temperature sections of the HRSG. Ammonium Bisulfate is a sticky substance, which deposits on the HRSG tubes, and over time, corrodes the HRSG tubes. Ammonium Sulfate also deposits on the HRSG surfaces. These deposits increase backpressure on the gas turbine and reduce the heat transfer efficiency of the HRSG; both of these effects have a negative impact on combined cycle system performance.

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Oxidizing catalysts used to reduce CO emissions will oxidize SO_2 to SO_3 at rates up to 50% further increasing the sulfur dewpoint.

A summary of the impacts of these components is shown in the following Table 1.

4.5.2.2.2.2 Performance Optimization with Fuel Sulfur

Since the dewpoint is a function of the amount of water vapor in the exhaust gas, and the combustion of distillate oil and natural gas produce different amounts of water vapor, separate lines are shown for each. It is important to recognize that dew point control requires the fluid temperature in the HRSG tubes to be above the dew point. Simply having the stack gas temperature above the dew point is not sufficient. Sulfuric acid will condense on the tube if the metal temperature is below the dew point. Tube wall temperatures are very close to fluid temperatures in economizers and evaporators. Therefore, for units with low temperature economizers, inlet feedwater temperature must be above the dew point. For units without low temperature economizers but having low temperature evaporators, the evaporator pressure must be high enough to ensure that the water saturation temperature is above the dew point.

For frequent operation with lower sulfur dew points (typically less than 175 to 200°F (80 to 95°C) depending on LP drum pressure), the feedwater temperature to the HRSG low temperature economizers is controlled to be at or above the dew point. Typically, recirculation of HRSG feedwater from the low temperature economizer discharge to the HRSG feedwater inlet is used in this situation. Net plant output is reduced slightly as recirculation flow increases, due to the power consumed by the recirculation pump.

If the decision is made to control feedwater temperature to the acid dew point using economizer recirculation, a further decision is required regarding the addition of HRSG heat transfer surface to minimize performance loss. In the absence of customer specific requirements, this decision must be made based on a performance and cost trade off analysis.

Unless performance evaluation criteria are very high the full addition of HRSG heat transfer surface to maximize plant output and efficiency is not justified when controlling feedwater temperature to the acid dew point. The optimum cost performance trade off lies somewhere between these two extremes of approximately 160°F (71°F).

The fuel sulfur content and customer evaluation parameters, as well as the customer's position with respect to feedwater temperature control, must be understood early in project development to avoid changes that impact cost, schedule and performance.

gatecycle report 1

GateCycle Report - EXH Report
Model: CNCEC2 Case: CNCEC2
Prepared using GateCycle Version 5.41.0.r

Equipment ID: S13 Type: EXH Description: Exhaust

Ports:	Flow tonm/hr	Temperature C	Pressure bar	Enthalpy kJ/kg	Quality /x of CH
Inlet	1546.43	136.79	1.00428	168.04	3.97317

Main Inputs:

Pressure Control Method	No pressure control
Stack Warning Temperature	93.33 C
Water Dew Point	48.08 C
SO2 to SO3 (H2SO4) conversion (fraction)	0.05
Acid Dew Point (ABB)	116.60 C
Acid Dew Point (Ganapathy)	117.58 C
Acid Dew Point (Niessen)	117.58 C
Acid Dew Point (Haase-Borgmann)	117.15 C
Acid Dew Point (Haase-Borgmann-Totmann)	117.36 C

Miscellaneous Values:

LHV	0.0	kcal/kg
Cp	0.2577	kcal/kg-C

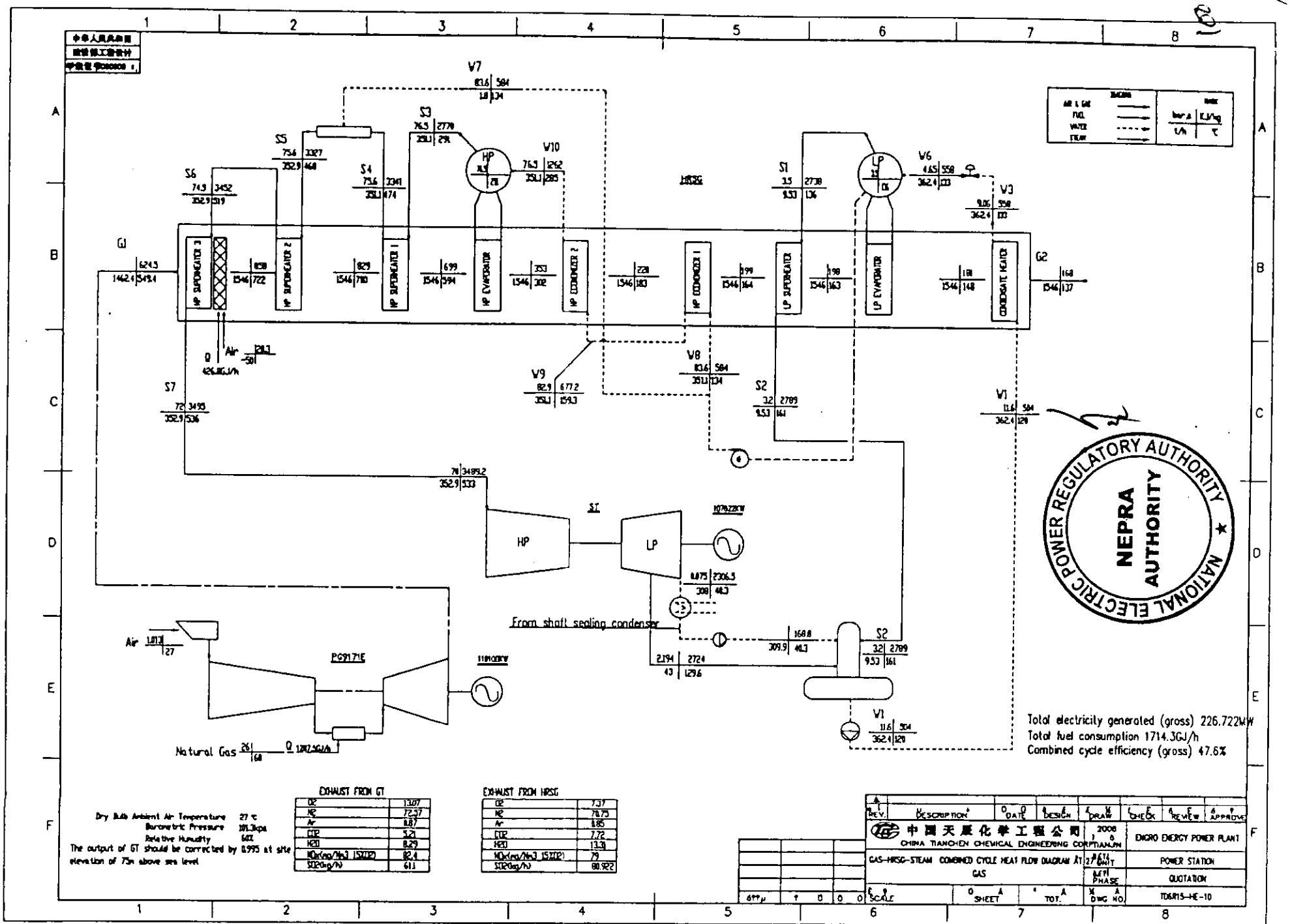
Gas Constituents

Nitrogen	0.7056	Oxygen	0.1091
Carbon Dioxide	0.0651284	H2O	0.1117
Hydro Carbons	0.0	Argon	0.0083756
Hydrogen	0.0	Carbon Monoxide	0.0
Sulfur Dioxide	2.2071e-005	Hydrogen Sulfide	0.0
Carbonyl Sulfide	0.0		
H/C Ratio	3.97317	Molecular Weight	28.47

Heat Rate Adjustment:
Flow does not affect adjusted heat rate calculations

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA
AUTHORITY

Annex W4



Dry Bulb Ambient Air Temperature 27 ℃
Barometric Pressure 101.3kpa
Relative Humidity 60%
The output of GT should be corrected by 0.995 at site elevation of 75m above sea level

EXHAUST FROM GT	
O2	13.07
N2	72.57
Ar	0.87
CO2	5.21
H2O	8.29
NOx(mg/Nm3 15%O2)	82.4
SO2(kg/h)	611

EXHAUST FROM HRSG	
O2	7.37
N2	78.75
Ar	0.85
CO2	7.72
H2O	13.31
NOx(mg/Nm3 15%O2)	79
SO2(kg/h)	80.922

REV.	DESCRIPTION	DATE	DESIGN	DRAW	CHECK	REVIEW	APPROVE
0		2008					

中国天辰化学工程公司 CHINA TIANCHEN CHEMICAL ENGINEERING CORP.

	ENGRO ENERGY POWER PLANT
GAS-HRSG-STEAM COMBINED CYCLE HEAT FLOW DIAGRAM AT GAS	POWER STATION
	QUOTATION
SCALE	DWG NO. TD&R15-HE-10
SHEET	
TOT.	

3/22

Annex- 5

GER-3574G

GE Power Systems

GE Combined-Cycle Product Line and Performance

D.L. Chase
P.T. Kehoe
GE Power Systems
Schenectady, NY

w-pressure economizer for high thermal efficiency will require material that resists corrosion because feedwater passing through this section may have a high oxygen concentration, and the external tube surface temperature may be below the exhaust gas dew point temperature. *Figure 14* shows a three-pressure non-reheat HRSG with integral deaerator.

Fuel characteristics affect combined-cycle performance in a variety of ways. High hydrogen content in fuels such as natural gas results in high water content in the combustion products. Water has a higher heat content than air or other combustion products, so fuels with high hydrogen content increase output and efficiency. Ash-bearing fuels foul the gas turbine and HRSG; therefore, equipment and system design considerations that accept fouling reduce plant output and efficiency. Sulfur content in the fuel may require adjustment in the temperature of the stack gas and the water entering the HRSG economizer to prevent condensation of corrosive sulfuric acid. The increased stack gas temperature required by higher sulfur content decreases output and efficiency. Performance variation with fuel type (hydrogen, ash and sulfur content typical of each) is presented in *Table 12*.

The STAG product line includes gas turbines with Dry Low NO_x (DLN) combustors that can operate with stack gas NO_x emission concentration as low as 9 ppmvd at 15% oxygen (15.5 g/GJ) without water or steam injection, when operating on natural gas fuel. Water or steam injection may be required to meet NO_x emission requirements when operating on distillate oil fuel. Also, gas turbines are available with

STAG 209E

FUEL	NET PLANT OUTPUT (%)	NET PLANT THERMAL EFFICIENCY (%)
NATURAL GAS	BASE	BASE
DISTILLATE OIL	-3.0	-2.1
RESIDUAL OIL	-9.3	-7.6

NOTES 1. OPERATING POINT = BASE LOAD
2. TWO PRESSURE, NON-REHEAT RECOVERY FEEDWATER HEATING SYSTEM CYCLE

Table 12. STAG combined-cycle performance variation with fuel characteristics