

REFERENCES

1. A.Abeygunawardana. (2008, August). *A world without oil or coal “A solution to Sri Lanka’s electricity crisis in the post fossil fuel era”*, (1st edition).[on line].Available: www.efsl.lk/reports/Ashoka.pdf
2. “Electricity Generated”. Internet: www.ceb.lk ,[2014.08.17]
3. “Exergy”. Internet: www.wikipidiea.com , [2014.08.17]
4. “Natural Coal formation Process” Internet:www.wikipidiea.com,[2014.08.19]
5. International Energy Agency publications, (2009, January). “*Power generation from Coal*”, [on line]. Available: www.iea.org/ciab/papers.pdf
6. “1st Law of thermodynamics”. Internet : www.wikipidiea.com [2014.08.20]
7. “2nd Law of Thermodynamics”. Internet: www.wikipidiea.com [2014.08.20]
8. M.J.Moran, H.N.Shapiro. “The Second Law of Thermodynamics” in *Fundamental of Engineering Thermodynamics*, 5th Edition, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, pp. 177-178
9. A.Bejan, G.Tsatsaronis, M.Moran. “*Thermal design and optimization*”, John Wiley and Sons Inc., U.S.A, 1996
10. S.C. Kaushika, V.SivaReddy, S.K.Tyagib. “Energy and exergy analyses of thermal power plants” *Renewable and Sustainable Energy Reviews*. [online]. pp 1857-1872.Internet: www.elsevier.com/locate/rser
11. M.J Moran, H.N Shapiro. “Exergy Analysis” in *Fundamental of Engineering Thermodynamics*, 5th Edition, John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester. pp. 272-312
12. T.Kotas. “Basic Exergy Concept” *The Exergy Method in Thermal plant Analysis*, Krieger publishing company, Florida,(1995), pp 44-45
13. Dr. P.Valdimarsson.(January 2011), “Basic concepts of thermo economics” in *Short Course on Geothermal Drilling, Resource Development and Power Plants*,[on line].Available: www.unugtp.is/en/moya/page/sc-12

14. S.Khanmohammadi, A.R Azimian, and S.Khanmohammadi, (2013) 'Exergy and exergo-economic evaluation of Isfahan steam power plant', *Int. J. Exergy*, Vol. 12, No. 2, pp.249–272.
15. *Technical document for Pttalam 1×300MW coal fired power plant project*, China National Machinery and Equipment Import and Export Corporation, Beijing, 2006, pp. 3.
16. "Boiler and Auxiliaries", *Technical document for Pttalam 1×300MW coal fired power plant project* ,Section 02, China National Machinery and Equipment Import and Export Corporation, Beijing, 2006, pp.
17. "Turbine and Auxiliaries, Thermal Cycle equipment" *Technical document for Pttalam 1×300MW coal fired power plant project* ,Section 03, China National Machinery and Equipment Import and Export Corporation, Beijing, 2006, pp.42-44
18. "CW system Design description", China National Machinery and Equipment Import and Export Corporation, Beijing, 2006, pp.1-25
19. "Operation Regulation of FGD system" China National Machinery and Equipment Import and Export Corporation, Beijing &China Huadian Power plant operation Co,Ltd, 2010, pp 1-4
20. "Central Control Operation Regulation" China National Machinery and Equipment Import and Export Corporation & Beijing,China Huadian Power plant operation Co,Ltd, 2010, pp 7-10
21. "Key World Energy Statistic 2012".Internet: www.iea.org/publications/free_publications,[2014.08.21]
22. "International Energy outlook 2010" Internet: www.eia.gov/index/html ,[2014.08.21]
23. "International Energy outlook 2011" Internet: www.eia.gov.iea , [2014.08.23]
24. John B. Kitto and Steven C. Stultz. *Steam its generation and use*, ohio, USA: Babcock & Wilcox Company,2005, pp 22
25. "World coal classification" internet : www.manicore.com,[2014.0821]

APPENDIX A: Contract Price Table of Puttlam Coal Power Project

Contract Price Table Phase I Puttlam Coal Power Project				
Item No.	Description	Plant & Material	Service	Total Amount
Section 1: Unit 1 the 300MW unit plus related common works				
1	Unit 1, the 300MW unit plus related common works			
1.1	Main Power Block (MPB)			
1.1.1	Boiler and Auxiliaries	53'308'000	9'717'000	63'025'000
1.1.2	Steam Turbine & Generator and Auxiliaries	49'550'000	5'000'000	54'550'000
1.1.3	Steam & Water Piping System	6'400'000	2'958'000	9'358'000
1.1.4	Insulation, Lagging and Painting	2'500'000	1'757'000	4'257'000
1.1.5	Electrical System	39'000'000	4'817'000	43'817'000
1.1.6	Communication System	960'000	103'000	1'063'000
1.1.7	Instrument and Control System	9'550'000	2'510'000	12'060'000
1.1.8	Chemical System	2'500'000	752'000	3'252'000
1.1.9	Civil Work for Main Power Block	5'814'000	45'050'000	50'864'000
1.1.10	Spare Parts (Supplied with equipment)			
	Total (MPB)	169'582'000	72'462'000	242'044'000
1.2	Balance of Plant (BOP)			
1.2.1	Coal Handling System	4'976'000	576'000	5'552'000
1.2.2	Fuel-Oil System	100'000	10'000	110'000
1.2.3	FGD	16'985'000	4'000'000	20'985'000
1.2.4	Ash Handling System	2'956'000	320'000	3'276'000
1.2.5	Water Treatment System	3'700'000	970'000	4'670'000
1.2.6	Water Supply System	15'075'000	9'502'000	24'577'000
1.2.7	Waste Water Treatment System	100'000	50'000	150'000
1.2.8	Air System	1'400'000	10'000	1'410'000
1.2.9	Asph. Work	5'140'000	1'300'000	6'440'000
1.2.10	Construction for Balance of Plant	3'984'000	58'100'000	60'084'000
1.2.11	Spare Parts (Supplied with Equipment)			0
	Total BOP	54'396'600	72'838'000	127'234'600
1.3	Site Development	150'000	300'000	450'000
1.4	Logistics		18'500'000	18'500'000
1.5	Engineering Survey, Design and Drawing		7'000'000	7'000'000
1.6	Equipment Supervision & Inspection (Contractor & Employer)		2'000'000	2'000'000
1.7	Commissioning, Trial Operation till TOC		6'000'000	6'000'000
1.8	Training Cost Borne by Contractor		3'500'000	3'500'000
		150'000	37'300'000	37'450'000
	Total (Section 1)	224'128'600	182'600'000	406'728'600


APPENDIX B: Standard Molar Chemical Exergy of Selected Substances

Standard Molar Chemical Exergy, \bar{e}^{ch} (kJ/kmol), of Selected Substances at 298 K and p_0

Substance	Formula	Model I ^a	Model II ^b
Nitrogen	N ₂ (g)	640	720
Oxygen	O ₂ (g)	3,950	3,970
Carbon dioxide	CO ₂ (g)	14,175	19,870
Water	H ₂ O(g)	8,635	9,500
Water	H ₂ O(l)	45	900
Carbon (graphite)	C(s)	404,590	410,260
Hydrogen	H ₂ (g)	235,250	236,100
Sulfur	S(s)	598,160	609,600
Carbon monoxide	CO(g)	269,410	275,100
Sulfur dioxide	SO ₂ (g)	301,940	313,400
Nitrogen monoxide	NO(g)	88,850	88,900
Nitrogen dioxide	NO ₂ (g)	55,565	55,600
Hydrogen sulfide	H ₂ S(g)	799,890	812,000
Ammonia	NH ₃ (g)	336,685	337,900
Methane	CH ₄ (g)	824,350	831,650
Ethane	C ₂ H ₆ (g)	1,482,035	1,495,840
Methyl alcohol	CH ₃ OH(g)	715,070	722,300
Methyl alcohol	CH ₃ OH(l)	710,745	718,000
Ethyl alcohol	C ₂ H ₅ OH(g)	1,348,330	1,363,900
Ethyl alcohol	C ₂ H ₅ OH(l)	1,342,085	1,357,700

APPENDIX C: Property Report of Unloaded Coal

187, Wimala Street,
 Colombo 7,
 Sri Lanka.
 Tel: (94) 11 252674/252675/254123
 Fax: (94) 11 252676
 E-mail: info@lscs.lk


 Page: 01 of 02
 04th November 2011
 Job Order No. 20110310

INSPECTION REPORT

In pursuance of an order received from and on behalf of M/s. LANKA COAL COMPANY, we attended to the inspection of captioned goods and report as under:

VESSEL : MLV PREM VIDYA
CARGO DESCRIBED AS : Steam Coal in Bulk
QUANTITY : 82403.700 MT
PLACE & DATE OF ATTENDANCE : At Puttalam Coal Power Plant
 From 08/10/2011 to 23/10/2011
WEATHER CONDITION : Partly - Sunny/Cloudy/Rainy

SAMPLING : Bulk was sampled using mechanical sampler installed on Conveyor system by Ceylon Electricity Board as per ASTM standard procedure. The sample was sealed in plastic seal.
ANALYSIS : Bulk wide samples were analyzed separately at our in house laboratory as per ASTM standards and the weighted average results are as follows.

ANALYSIS (ON AIR DRIED BASIS)

Inherent Moisture %	4.40 (Four decimal four-zero)
Ash %	15.15 (Fifteen decimal one-five)
Volatile Matter %	40.51 (Forty decimal five-one)
Fixed Carbon %	39.94 (Thirty-nine decimal nine-four)
Sulphur %	0.60 (Zero decimal six-zero)

GCV (Gross Caloric value) Kcal/kg : 6314 (Six thousand three hundred fourteen)

ANALYSIS (ON DRY BASIS)

Ash %	15.85 (Fifteen decimal eight-five)
Volatile Matter %	42.37 (Forty-two decimal three-seven)
Fixed Carbon %	41.78 (Forty-one decimal seven-eight)
Sulphur %	0.63 (Zero decimal six-three)

GCV (Gross Caloric value) Kcal/kg : 6605 (Six thousand six hundred five)

COSTING SHEET OF WATER TREATMENT SYSTEM (Operation)

Desalinated. (Rs/m ³)			Service water. (Rs/m ³)			Potable system. (Rs/m ³)			Dematerialized water. (Rs/m ³)		
Chemical cost	Electrical cost	Total cost	Chemical cost	Electrical cost	Total cost	Chemical cost	Electrical cost	Total cost	Chemical cost	Electrical cost	Total cost
38.30	44.55	82.85	38.30	50.90	89.20	66.44	86.75	153.19	66.44	90.39	156.83

Desalinated water	
Chemicals	Cost (Rs./m ³)
NaoCl	8.04
HCl	6.15
Reductant	5.76
Scale	14.78
NaOH	-
PAC	1.82
PE	1.75
Total	38.30

Potable and Demineralized water	
Chemicals	Cost (Rs./m ³)
NaoCl	10.57
HCl	9.15
Reductant	8.52
Scale	32.90
NaOH	-
PAC	2.70
PE	2.60
Total	66.44