

improvement of current operation (Case 1), the FIRR of Case 2 is ostensibly low.

The result of the analyses shows that the project is viable at the economic coal value of 6,086.0 Tg/t under the current taxation regimes. In Case 3, fixed assets revaluation brings about little impact on the project, however, under the current inflation, fixed assets revaluation is desirable for mine management and also consumers to lower a coal sale price.

(4) Leverage

In order to assess the effects of leverage (borrowed money), FIRRs on equity for Case 3 at 6,086.0 Tg/t have been calculated as illustrated in Table 8.9 for reference. Around a 95% debt, FIRRs on equity for every foreign loan interest rate become an infinite, while the amount of loan unrepaid at the end of the project life will unfavourably increase.

8.3.5 Financial sensitive analysis

(1) Coal sale prices and financial soundness

Relationships between coal sale prices and financial soundness of the project examined on Case 3 by the amount of loan unrepaid at the end of the project life are illustrated in Table 8.10 (fixed assets revaluation basis).

Comparisons made on an after corporate tax basis are as follows;

- debt/equity 0.001/0.999, 0.8/0.2, 0.999/0.001
- Coal sale prices
 - (a) price at no loan unrepaid on a 99.9% debt
 - (b) price at the economic value of 6,086.0 Tg/t
 - (c) price at a 10% FIRR on equity on a 80% debt
 - (d) price at no loan unrepaid on a 80% debt
 - (e) price at a 8% FIRR on equity on a 80% debt
- foreign loan interest rates 1%, 2%, 3%, 5%, 8%, 10%

The findings are as follows:

1) on a 0.1% debt case

FIRR on equity at 6,086.0 Tg/t is 10.5% and loan repayment is always fulfilled for every price level. FIRRs, however, are low due to almost no leverage.

2) on a 80% debt case

A reasonable sale price in a 80% debt case will be at the price of no loan unrepaid, which is 5,139.8, 5,181.7, 5,223.6, 5,307.5, 5,433.4, 5,517.3 (Tg/t) for a interest rate of 1%, 2%, 3%, 5%, 8%, 10% respectively.

3) on a 99.9% debt

The amount of loan unrepaid at the end of the project life is prohibitive at the price of a 10% FIRR on equity on a 80% debt for all the foreign interest rates. Even in a 1% interest case, the amount of coal equivalent to the amount of loan unrepaid is 6.7 million tons by the current price of 2,200 Tg/t. This cannot be called a healthy operation.

(2) Financial sensitivity analyses for other factors

Financial sensitivity analyses have been conducted to evaluate the impact of changes in the base case assumptions in which two cases on a fixed assets revaluation basis are included, one for sensitivity on an FIRR on the total project for Case 1, Case 2 and Case 3 and the other for sensitivity on an FIRR on equity for Case 3 on a 80% debt with a 2% foreign loan interest rate.

The changes evaluated are as follows:

- foreign exchange rate;
- capital costs;
- operating costs; and
- total excavation with no changes in coal production.

The range of changes is $\pm 20\%$ every 5% step for all the items.

1) FIRR on the total project

The results of the sensitivity analyses at the economic coal value of 6,086.0 Tg/t are presented on Table 8.11 in terms of after tax FIRR on the total project.

FIRR on the total project for Case 3 is 10.5%. A 15% change in operating costs and total excavation cannot keep a 8% FIRR on the total project. A 15% change in capital costs can keep a 8% FIRR on the total project. A change in foreign exchange rate brings about little impact on the project. The project can stand 10% changes in all independent items studied

here.

2) FIRR on equity

The results of the sensitivity analyses on a 80% debt with a 2% foreign loan interest rate at the economic value of 6,086.0 Tg/t in Case 3 are presented on Table 8.12 in terms of FIRR on equity. Resulting from leverage, FIRR on equity is 23.6% with no loan unrepaid, shifted from an original 10.5% FIRR. No case for every change show loan unrepaid at the end of the project life.

The results of the sensitivity analyses on a 80% debt with a 2% foreign loan interest rate in Case 3 at 5,181.7 Tg/t, which is a critical price of loan repaid at the end of the project life, are presented on Table 8.13 in terms of FIRR on equity. The amounts of loan unrepaid for a 5% change in operating costs, total excavation and capital costs are 1,116.2, 1,044.8, 319.0 (106 Tg) respectively. This level of loan unrepaid can be manageable; however, the amount of loan unrepaid at a 10% change in operating costs, which is $3,526.9 \times 10^6$ Tg equivalent to 1.6 million tons by the current sale price of 2,200 Tg/t, will create difficulty in financial terms.

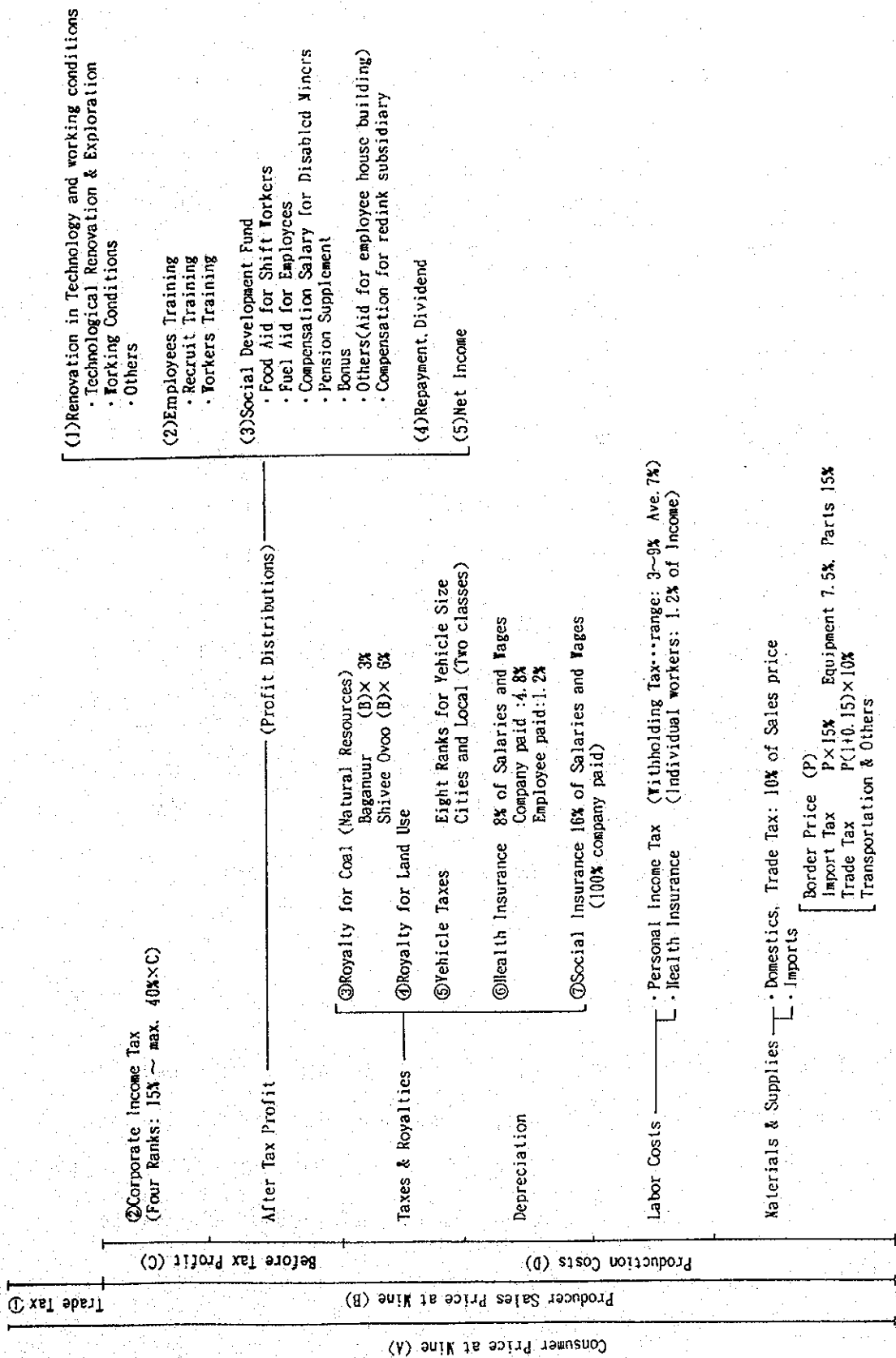


Figure 8.1 Tax System and Coal Price Structure

Table 8.1 Datong Coal (thermal) Exported to Japan

Year	Quantity (1,000ton)	FOB price (US\$)	Heating Value (kcal/kg)
1985	2,285	40.44 ** (39.85)	6,900
1986	2,308	36.51	6,800
1987	2,421	29.51	6,800
1988	2,405	35.10	6,800
1989	2,484	38.90	6,800
1990	2,546	40.45	6,800
1991	* 2,700	39.45	6,800
1992	2,641	38.59	6,800
1993	* 2,540	35.90	6,800
1994	* 2,660	32.60	6,800
Average	—————	36.627	6,800

(AD)

* Contract Basis

** 6,800kcal/kg equivalent

Datong Coal Specification

Total Moisture	(%)	≤ 8
Inherent Moisture	(%)	≤ 4
Volatile Matter	(%)	≥ 26
Ash	(%)	≤ 12
Sulphur	(%)	≤ 1.0
Size	(mm)	≤ 50

Calculation Example

Unit price on a dry-ash free basis.

$$6,800 \div (1 - (0.04 + 0.12)) = 8,095$$

$$3,662.7 \phi \div 8,095 = 0.4525 \phi / \text{kcal}$$

Table 8.2 Russian Coal (thermal) Exported to Japan

Quantity

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992
1,000t	774	963	892	954	1,788	2,469	2,729	2,278	1,522

FOB Prices (US\$)

Brand	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Neryungri-SS	30/ 31.5	30.25	24.5	25.0	30.5	33/ 33.5	33.2/ 33.5	32.2	30.2	28.0
Kuznetskey-SS								33.75 33.5	30.75/ 31.0	28.5
Kuznetskey-G6		38.5	35.5	37.0	42.5	43.0	41.6	41.5	39/ 39.5	36.0
Kuznetskey-GK	39.0	37.5	34.25	35.0	40.5	43/ 43.5	43/ 43.5	42/ 42.5	40/ 40.5	37.5
Tugnui									28.5/ 29	27.5

Specification

Brand		Neryungri-SS	Kuznetskey-SS	Kuznetskey-G6	Kuznetskey-GK	Tugnui
Heating Value (Basis)	kcal/kg	6,500 (AR)	8,050 (DAF)	7,200 (AD)	8,150/8,200 (DAF)	6,100/6,200 (AD)
Total Moisture (As received:AR)	(%)	8.0	8~13	10.0	9.0	11.0
Inherent Moisture (Air Dry:AD)	(%)	—	—	2.3	—	—
Ash (AD)	(%)	16.0	15.0	10.1	9.0	16.0
Volatile Matter	(%)	20.0 (DAF)	20~30 (DAF)	36.2 (AD)	37~41 (DAF)	45 (DAF)
Fixed Carbon (AD)	(%)	—	—	51.4	—	—
Total Sulphur (AD)	(%)	0.30	0.30	0.40	0.60	0.60
H.C.I. (AD)		60	—	61	65	—
A.F.T. (Flow)	(°C)	1,450	—	1,450	1,350	—
Heating Value (DAF)	(kcal/kg)	8,553	8,050	8,219	8,175	?

Table 8.3 FOB Unit Price (Dry-Ash-Free Basis)

US \$ /100kcal/kg

	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Total	Average
[CHINA]												
Datong	49.23	45.10	36.45	43.36	48.05	49.97	47.50	47.67	44.35	40.27	451.95	45.20
[RUSSIA]												
Neryungri-ss	35.95	35.37	28.64	29.23	35.66	38.88	38.99	37.65	35.31	32.74	348.42	34.84
Kuznetsky-ss	—	—	—	—	—	—	41.93	41.46	38.35	35.40	157.14	39.28
Kuznetsky-G6	—	46.84	43.19	45.02	51.71	52.32	50.61	50.49	47.76	43.80	431.74	47.97
Kuznetsky-GK	47.71	45.87	41.90	42.81	49.54	52.91	52.91	51.68	49.24	45.87	480.44	48.04
Russian Average	—	—	—	—	—	—	—	—	—	—	—	42.53
Overall Average	—	—	—	—	—	—	—	—	—	—	—	43.86

Table 8.4 DCF Cash Flow and Foreign & Local Currency Requirement of Case 3

EQUIPMENT NOW REVALUATION OF ASSETS	ECONOMIC ANALYSIS (REMOVAL COSTS)												
	1988	1987	1986	1985	1984	1983	1982	1981	2014	2015	2017	2018	TOTAL
A. Coal	738.6	738.6	738.6	738.6	738.6	738.6	738.6	738.6	738.6	738.6	738.6	738.6	738.6
Overhead	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7	2,587.7
Stripping Ratio (1987)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B. Coal	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9	3,919.9
Overhead	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4	4,448.4
Stripping Ratio (1987)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
C. Coal	718.9	718.9	718.9	718.9	718.9	718.9	718.9	718.9	718.9	718.9	718.9	718.9	718.9
Overhead	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7	2,517.7
Stripping Ratio (1987)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
D. Coal	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9	2,346.9
Overhead	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8	3,727.8
Stripping Ratio (1987)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
(EXPENSES)													
Material & Energy	611.8	611.8	611.8	611.8	611.8	611.8	611.8	611.8	611.8	611.8	611.8	611.8	611.8
Parts	189.2	189.2	189.2	189.2	189.2	189.2	189.2	189.2	189.2	189.2	189.2	189.2	189.2
Gas & Lub.	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7	42.7
Electricity	182.9	182.9	182.9	182.9	182.9	182.9	182.9	182.9	182.9	182.9	182.9	182.9	182.9
Employees	74.5	74.5	74.5	74.5	74.5	74.5	74.5	74.5	74.5	74.5	74.5	74.5	74.5
M & E Others	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.5
Labor Costs	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2	141.2
Shareholder & Taxes	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3
Social Insurance	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1
Others	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1	66.1
Partitions & Charges	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8	1,452.8
Parities Interest													
Depreciation													
Tax Depreciation													
Additional Investment													
Total Operating Costs	1,311.4	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7
PROFIT (1987)	1,311.4	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7
Before Tax Profit(Loss)	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Corporate Income Tax (85)	1,311.4	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7
After Tax Profit(Loss)	181.5	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7
Retained Earnings(Loss)	1,149.9	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1
INVESTMENT (1987)	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4
Existing Eq. Replacement													
Additional Investment													
Total Capital Cost	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4	673.4
CASH FLOW (1987)	1,149.9	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1	1,113.1
Before Tax Profit(Loss)	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9	8.9
Corporate Income Tax (85)	1,311.4	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7	1,257.7
After Tax Profit(Loss)	181.5	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7	164.7
Less: Working Capital	446.8	446.8	446.8	446.8	446.8	446.8	446.8	446.8	446.8	446.8	446.8	446.8	446.8
Payable Interest													
Cash Flow	27.3	5,433.5	7,488.6	5,412.6	1,297.8	1,211.8	1,119.8	1,024.1	921.8	824.9	725.1	628.3	529.6
Discount Rate (%)													

Salvage
Devaluation
Less Depreciation
Increase Capital
Equipment
TOTAL

Table 8.4 Cont.(1) DCF Cash Flow and Foreign & Local Currency Requirement of Case 3

DESCRIPTION OF COSTS	SWITZ FRCS CHAL. SIKK. DEMONSTRATIVE FINANCE												TOTAL				
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985					
OPERATING COSTS																	
Material & Energy	10.5	12.1	13.7	15.3	16.9	18.5	20.1	21.7	23.3	24.9	26.5	28.1	29.7	31.3	32.9	34.5	36.1
Electricity	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4
Water	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other Utilities	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other Operating Costs	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
INVESTING COSTS																	
Plant	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Equipment	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Other Investing Costs	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FINANCING COSTS																	
Interest on Debt	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Interest on Equity	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other Financing Costs	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TOTAL COSTS																	
Operating Costs	12.8	15.6	18.4	21.2	24.0	26.8	29.6	32.4	35.2	38.0	40.8	43.6	46.4	49.2	52.0	54.8	57.6
Investing Costs	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Financing Costs	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
TOTAL	24.5	27.3	30.1	32.9	35.7	38.5	41.3	44.1	46.9	49.7	52.5	55.3	58.1	60.9	63.7	66.5	69.3

Table 8.5 Economic Sensitivity Analyses

Unit: EIRR %

Variation Factor	Price (1.00: 6,057.1 Tg/t)			Exchange Rate (1.00: 400Tg/US\$)			Capital Costs			Operating Costs			Total Excavation (No changes in coal)			
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	(S/R) *1
1.20 (7,303.2)**2	34.3	NA *3	NA	26.5	73.8	NA	21.2	48.8	NA	22.7	48.3	NA	22.8	48.9	48.9	(4.4)
1.15 (6,998.9)	32.3	NA	NA	26.4	72.2	NA	22.3	47.8	NA	23.5	52.1	NA	23.6	52.6	52.6	(4.2)
1.10 (6,694.6)	30.2	NA	NA	26.3	70.5	NA	23.4	52.7	NA	24.3	56.4	NA	24.4	56.8	56.8	(3.9)
1.05 (6,390.3)	28.1	91.5	NA	26.1	68.9	NA	24.6	58.8	NA	25.1	61.3	NA	25.2	61.5	61.5	(3.7)
1.00 (6,086.0)	25.9	67.1	NA	25.9	67.1	NA	25.9	67.1	NA	25.9	67.1	NA	25.9	67.1	67.1	(3.5)
0.95 (5,781.7)	23.7	53.8	NA	25.7	65.3	NA	27.4	79.7	NA	26.7	74.3	NA	26.7	73.9	73.9	(3.3)
0.90 (5,477.4)	21.5	44.1	NA	25.5	63.4	NA	28.9	135.4	NA	27.5	84.1	NA	27.5	83.0	83.0	(3.1)
0.85 (5,173.1)	19.1	36.3	NA	25.3	61.4	NA	30.6	NA	NA	28.3	101.4	NA	28.2	97.9	97.9	(2.9)
0.80 (4,868.8)	16.7	29.7	NA	25.0	59.3	NA	32.5	NA	NA	29.1	NA	NA	29.0	NA	NA	(2.6)

Base Case is at the economic coal value of 6,086.1 Tg/t

Case 1: Existing Operation
Case 2: Expansion
Case 3: Combination

*1 S/R : Stripping ratio
*2 (): EIRRs are all not available. () shows a coal price.
*3 NA : Not available

Table 8.6 General Inflation

Consumer Price Index

Year-Month-Date	1991-1-16	1994-5	Monthly (%)
Food, beverages and tobacco	100	2,853.27	8.5
Clothing and footwear	100	1,620.96	7.0
Rent and utilities	100	1,182.83	6.2
Household goods	100	2,741.50	8.4
Medical care	100	1,933.93	7.5
Transport and communication	100	1,683.07	7.1
Education and recreation	100	2,827.33	8.5
Other goods and services	100	2,141.17	7.8
Overall indexes	100	2,291.47	7.9

Table 8.7 Economic Indices

Various Prices and Indices Related to Coal Mining

Year		1990	1991	1992	1993	1994	Remarks
Consumer Price Index		100	153	650	1,839	2,293 (2Q)	
Exchange Rate	(Tg/US\$)	5.48	25.51	40.00	299.3	400.0	
Coal Price	(Tg/t)	31.87	83	180	1,723	2,396	
Coal Production Cost	(Tg/t)	27.30	38.4	150	779	1,545	
Explosives	(1,000Tg/t)	2.26	6.52	20.8	108.7	210.0	
Detonator	(Tg/each)	0.57	4.05	4.05	4.87	150.0	
Dragline 10/70 Bit	(1,000Tg/each)	0.81	0.81	13.5	18.25	81.25	(168)
Dragline 20/90 Bit	(1,000Tg/each)	0.52	0.52	13.5	76.0	131.25	
Wire Rope	(1,000Tg/t)	19.20	33.2	33.2	132.3	200.0	(480)
Cable	(1,000Tg/km)	85.0	460.0	600.0	2,625.0	6,700.0	
Sleeper	(Tg/each)	245.0	245.0	500.0	957.0	1,500.0	
Diesel Oil	(1,000Tg/t)	1.13	2.14	11.8	50.0	144.0	
Gasoline	(1,000Tg/t)	1.1	2.2	18.0	42.0	130.0	
Lubricant	(1,000Tg/t)	37.5	37.5	62.0	240.0	375.6	
Electricity	(Tg/kwh)	0.18	0.35	0.35	4.4	13.2	
Heat	(Tg/Gcal)	37.0	55.0	110.0	1,971.0	3,862.0	
Water (Potable)	(Tg/m ³)	1.40	4.50	9.40	38.90	54.0	
Water (Industrial)	(Tg/m ³)	1.40	4.50	9.40	41.25	54.0	
Mine Average Salary	(1,000Tg/man · yr)	8.8	29.5	N.A.	253.30	533.10	
Parts							
Truck Tires	(1,000Tg/each)	11.0	11.0	45.0	235.0	535.5	
Mining Equipment							
Shovel 5A	(1,000Tg/unit)	—	1,944.7	—	1,944.7	126,000	
Diesel Loco T3M-2	(1,000Tg/unit)	1,840	—	—	—	160,000	(480,000)
Drill CbP-160	(1,000Tg/unit)	1,425.0	—	—	—	37,600	
Haul Truck Belaz 40t	(1,000Tg/unit)	829.2	829.2	829.2	—	21,200	(46,312)
Dozer Det-250	(1,000Tg/unit)	700	700	696.1	—	60,000	
Dragline 20/90	(1,000Tg/unit)	22,900	—	—	—	2,400,000	(Quotation)
Rail Tariff (B.N-U.B)	(Tg/t)	12.43	31.14	106.87	376.71	376.71	

() shows the offer price.

Table 8.8 Economic Indices

Escalation

Year	1990	1991	1992	1993	1994	Remarks
Consumer Price Index	1.00	1.53	6.50	18.39	22.93	
Exchange Rate	1.00	4.66	7.30	54.62	72.99	
Coal Price	1.00	2.60	5.65	54.06	75.18	
Coal Production Cost	1.00	1.41	5.49	28.53	56.59	
Explosives	1.00	2.88	9.20	48.10	92.92	
Detonator	1.00	7.10	7.10	8.54	263.16	
Dragline 10/70 Bit	1.00	1.00	16.67	22.53	100.31	
Dragline 20/90 Bit	1.00	1.00	25.96	146.15	252.40	
Wire Rope	1.00	1.73	1.73	6.89	10.42	
Cable	1.00	5.41	7.06	29.71	78.82	
Sleeper	1.00	1.00	2.04	3.91	6.12	
Diesel Oil	1.00	1.89	10.44	44.25	127.43	
Gasoline	1.00	2.00	16.36	38.18	118.18	
Lubricant	1.00	1.00	1.65	6.40	10.02	
Electricity	1.00	1.94	1.94	24.44	73.33	
Heat	1.00	1.49	2.97	53.27	104.38	
Water (Potable)	1.00	3.21	6.71	27.79	38.57	
Water (Industrial)	1.00	3.21	6.71	29.46	38.57	
Mine Average Salary	1.00	3.35	N.A.	28.78	60.58	
Parts						
Truck Tires	1.00	1.00	4.09	21.36	48.68	
Mining Equipment						
Shovel 5A	—	1.00	—	1.00	64.79	
Diesel Loco T3M-2	1.00	—	—	—	86.96	
Drill CbP-160	1.00	—	—	—	26.39	
Haul Truck Belaz 40t	1.00	1.00	1.00	—	25.57	
Dozer Det-250	1.00	1.00	1.00	—	85.71	
Dragline 20/90	1.00	—	—	—	(104.80)	(Quotation)
Rail Tariff (B.N-U.B)	1.00	2.51	2.51	30.31	30.31	

Table 8.9 FIRR on Equity at 6,086 Tg/t for Case 3

Debt (%)	Equity (%)	Foreign Loan Interest Rate											
		1%		2%		3%		5%		8%		10%	
		FIRR*	Unrepaid*2	FIRR	Unrepaid	FIRR	Unrepaid	FIRR	Unrepaid	FIRR	Unrepaid	FIRR	Unrepaid
0.00	100.00	10.5	0.0	10.5	0.0	10.5	0.0	10.5	0.0	10.5	0.0	10.5	0.0
5.00	95.00	10.8	0.0	10.8	0.0	10.7	0.0	10.7	0.0	10.7	0.0	10.7	0.0
10.00	90.00	11.1	0.0	11.0	0.0	11.0	0.0	10.9	0.0	10.8	0.0	10.7	0.0
15.00	85.00	11.4	0.0	11.3	0.0	11.3	0.0	11.1	0.0	11.0	0.0	10.9	0.0
20.00	80.00	11.7	0.0	11.6	0.0	11.5	0.0	11.4	0.0	11.1	0.0	11.0	0.0
25.00	75.00	12.1	0.0	12.0	0.0	11.9	0.0	11.6	0.0	11.3	0.0	11.1	0.0
30.00	70.00	12.5	0.0	12.3	0.0	12.2	0.0	11.9	0.0	11.5	0.0	11.3	0.0
35.00	65.00	12.9	0.0	12.8	0.0	12.6	0.0	12.3	0.0	11.8	0.0	11.5	0.0
40.00	60.00	13.4	0.0	13.2	0.0	13.0	0.0	12.6	0.0	12.0	0.0	11.6	0.0
45.00	55.00	14.0	0.0	13.7	0.0	13.5	0.0	13.0	0.0	12.3	0.0	11.8	0.0
50.00	50.00	14.6	0.0	14.3	0.0	14.0	0.0	13.4	0.0	12.6	0.0	12.1	0.0
55.00	45.00	15.3	0.0	15.0	0.0	14.6	0.0	13.9	0.0	12.9	0.0	12.3	0.0
60.00	40.00	16.2	0.0	15.8	0.0	15.4	0.0	14.5	0.0	13.4	0.0	12.7	0.0
65.00	35.00	17.4	0.0	16.8	0.0	16.3	0.0	15.3	0.0	13.9	0.0	13.1	0.0
70.00	30.00	18.9	0.0	18.2	0.0	17.6	0.0	16.3	0.0	14.7	0.0	13.7	0.0
75.00	25.00	21.1	0.0	20.2	0.0	19.4	0.0	17.8	0.0	15.8	0.0	14.7	0.0
80.00	20.00	24.9	0.0	23.6	0.0	22.3	0.0	20.1	0.0	17.5	0.0	16.0	0.0
85.00	15.00	30.2	0.0	28.1	0.0	26.3	0.0	23.3	0.0	19.7	0.0	17.7	0.0
90.00	10.00	NA*3	0.0	NA	0.0	NA	0.0	90.0	0.0	27.2	0.0	23.1	0.0
95.00	5.00	NA	0.0	NA	0.0	NA	0.0	NA	0.0	NA	3.0	NA	32.0
99.99	0.01	NA	0.0	NA	0.0	NA	15.6	NA	49.6	NA	636.0	NA	1,559.1

*1 FIRR : Financial rate of return on equity (fixed assets revaluation basis) (unit: %)
 *2 Unrepaid: Loan unrepaid at the end of the project life (unit: 10⁴Tg)
 *3 NA : Not Available

Table 8.10 Relationship between Coal Prices and Operations Soundness in Case 3

F.L.I.R.* ¹	Price	%	Tg/t	Note	Debt/Equity 0.001/0.999		Debt/Equity 0.800/0.200		Debt/Equity 0.999/0.001	
					FIRR* ²	Unrepaid* ³	FIRR	Unrepaid	FIRR	Unrepaid
1.0	6,086.0	a	10.5	0.0	24.9	0.0	NA * ⁴	0.0		
	6,027.0	b	10.2	0.0	23.7	0.0	NA	(CR) 0.0		
	5,261.1	c	5.6	0.0	10.0	0.0	NA	14,731.9		
	5,139.8	d	4.9	0.0	* ⁶ 8.1	* ⁵ (CR) 0.0	NA	19,115.7		
	5,134.3	e	4.9	0.0	8.0	1.2	NA	19,326.9		
2.0	6,086.0	a	10.5	0.0	23.6	0.0	NA	0.0		
	6,076.5	b	10.5	0.0	23.4	0.0	NA	(CR) 0.0		
	5,304.5	c	5.9	0.0	10.0	0.0	NA	14,686.6		
	5,181.7	d	5.2	0.0	8.1	(CR) 0.0	NA	19,110.3		
	5,175.4	e	5.1	0.0	8.0	1.4	NA	19,366.7		
3.0	6,126.0	a	10.7	0.0	23.2	0.0	NA	(CR) 0.0		
	6,088.0	b	10.5	0.0	22.3	0.0	NA	13.7		
	5,347.9	c	6.2	0.0	10.0	0.0	NA	14,657.8		
	5,223.6	d	5.4	0.0	8.1	(CR) 0.0	NA	19,191.7		
	5,216.6	e	5.4	0.0	8.0	1.5	NA	19,476.6		
5.0	6,225.2	a	11.3	0.0	22.7	0.0	NA	(CR) 0.0		
	6,086.0	b	10.5	0.0	20.1	0.0	NA	47.6		
	5,434.7	c	6.7	0.0	10.0	0.0	NA	14,641.9		
	5,307.5	d	5.9	0.0	8.1	(CR) 0.0	NA	19,365.6		
	5,298.9	e	5.9	0.0	8.0	1.8	NA	19,706.6		
8.0	6,374.0	a	12.1	0.0	22.2	0.0	NA	(CR) 0.0		
	6,086.0	b	10.5	0.0	17.5	0.0	NA	583.2		
	5,565.0	c	7.5	0.0	10.0	0.0	NA	14,865.0		
	5,433.4	d	6.7	0.0	8.2	(CR) 0.0	NA	20,049.4		
	5,422.5	e	6.6	0.0	8.0	2.3	NA	20,489.6		
10.0	6,473.3	a	12.7	0.0	21.8	0.0	NA	(CR) 0.0		
	6,086.0	b	10.5	0.0	16.0	0.0	NA	1,505.9		
	5,652.0	c	8.0	0.0	10.0	0.0	NA	15,231.4		
	5,517.3	d	7.2	0.0	8.2	(CR) 0.0	NA	20,576.5		
	5,505.0	e	7.1	0.0	8.0	2.6	NA	21,070.7		

- #1 F.L.I.R. : Foreign loan interest rate
- #2 FIRR : FIRR on equity on a fixed assets revaluation basis (unit: %)
- #3 Unrepaid : Loan unrepaid at the end of the project life (unit: 10⁶ Tg)
- #4 NA : Not available
- #5 (CR) : Critical point of no loan unrepaid
- #6 . : Reasonable Price Level

Note: Coal price presented on the table are including a 10% trade tax.
a: price at no loan unrepaid on a 99.9% debt
b: price at the economic value of 6,057.1 Tg/t
c: price at no loan unrepaid on a 80% debt
d: price at a 10% FIRR on equity on a 80% debt
e: price at a 8% FIRR on equity on a 80% debt

Table 8.11 Financial Sensitivity Analyses at 6,086.0 Tg/t (ROI)

*1Unit: FIRR %

Variation Factor	Exchange Rate (1.00: 400Tg/US\$)			Capital Costs			Operating Costs			Total Excavation (No changes in coal)			
	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	Case 1	Case 2	Case 3	*2(S/R)
1.20	23.2	8.5	11.3	14.5	5.9	7.7	9.9	5.4	6.5	10.3	5.5	6.6	(4.4)
1.15	22.6	8.4	11.1	15.8	6.4	8.3	12.2	6.1	7.5	12.5	6.1	7.6	(4.1)
1.10	21.9	8.3	10.9	17.2	6.9	9.0	14.7	6.8	8.5	14.9	6.8	8.6	(3.9)
1.05	21.2	8.2	10.7	18.8	7.5	9.7	17.4	7.4	9.5	17.5	7.4	9.5	(3.7)
1.00	20.5	8.1	10.5	20.5	8.1	10.5	20.5	8.1	10.5	20.5	8.1	10.5	(8.3)
0.95	19.7	7.9	10.3	22.4	8.7	11.4	24.1	8.7	11.5	23.9	8.7	11.5	(3.3)
0.90	18.8	7.8	10.0	24.6	9.5	12.3	28.3	9.4	12.5	27.9	9.3	12.5	(3.1)
0.85	17.8	7.6	9.7	27.1	10.2	13.3	33.6	10.0	13.6	32.8	10.0	13.5	(2.9)
0.80	16.6	7.4	9.3	29.9	11.1	14.5	39.4	10.7	14.6	38.3	10.6	14.5	(2.6)

*1 FIRR: FIRR on the total project on a fixed assets revaluation basis.

*2 S/R : Stripping Ratio

Base Case at the economic value of 6,086.0 Tg/t

Table 8.12 Financial Sensitivity Analyses on Case 3 at 6,086.0 Tg/t (ROE)
(80% debt with 2% foreign loan interest rate)

Unit: FIRR

Variation Factor	Exchange Rate (1.00: 400Tg/US\$)		Capital Costs		Operating Costs		Total Excavation	
	Unrepaid*1	FIRR *2	Unrepaid	FIRR	Unrepaid	FIRR	Unrepaid	FIRR (S/R)*3
1.20	0.0	26.5	0.0	15.0	0.0	10.8	0.0	11.1 (4.4)
1.15	0.0	25.9	0.0	16.7	0.0	13.5	0.0	13.8 (4.1)
1.10	0.0	25.2	0.0	18.6	0.0	16.4	0.0	16.6 (3.9)
1.05	0.0	24.5	0.0	20.8	0.0	19.7	0.0	19.8 (3.7)
1.00	0.0	23.6	0.0	23.6	0.0	23.6	0.0	23.6 (3.5)
0.95	0.0	22.6	0.0	27.0	0.0	28.0	0.0	27.8 (3.3)
0.90	0.0	21.4	0.0	31.3	0.0	33.1	0.0	32.7 (3.1)
0.85	0.0	20.1	0.0	36.4	0.0	39.0	0.0	38.3 (2.9)
0.80	0.0	18.9	0.0	42.6	0.0	45.4	0.0	44.4 (2.6)

*1 Unrepaid: Loan unrepaid at the end of the project life (unit: 10⁶ Tg)

*2 FIRR : FIRR on equity at the economic coal price of 6,086 Tg/t on a fixed assets revaluation basis (unit: %)

*3 (S/R) : Stripping ratio

Table 8.13 Financial Sensitivity Analyses on Case 3 at 5.181.7 Tg/t (ROE)
(80% debt with 2% foreign loan interest rate)

Unit: FIRR

Variation Factor	Exchange Rate (1.00: 400Tg/US\$)		Capital Costs		Operating Costs		Total Excavation	
	Unrepaid*1	FIRR *2	Unrepaid	FIRR	Unrepaid	FIRR	Unrepaid	FIRR (S/R)*3
1.20	0.0	10.4	4,404.8	2.8	9,217.3	(-5.8)	8,841.2	(-5.0) (4.4)
1.15	0.0	9.9	2,826.8	4.1	6,258.8	(-0.8)	5,996.2	(-0.4) (4.1)
1.10	0.0	9.3	1,509.2	5.4	3,526.9	2.6	3,352.2	2.8 (3.9)
1.05	0.0	8.7	319.0	6.7	1,116.2	5.4	1,044.8	5.5 (3.7)
1.00	0.0	8.1	0.0	8.1	0.0	8.1	0.0	8.1 (3.5)
0.95	8.4	7.4	0.0	9.6	0.0	10.9	0.0	10.8 (3.3)
0.90	223.4	6.6	0.0	11.3	0.0	13.8	0.0	13.6 (3.1)
0.85	638.5	5.8	0.0	13.2	0.0	16.9	0.0	16.6 (2.9)
0.80	1,213.7	4.8	0.0	15.4	0.0	20.3	0.0	19.8 (2.6)

*1 Unrepaid: Loan unrepaid at the end of the project life (unit: 10⁶ Tg)

*2 FIRR : FIRR on equity at the critical coal price for loan unpaid of 5.181.7 Tg/t on a fixed assets revaluation basis (unit:%)

*3 (S/R) : Stripping ratio

9 Conclusions and Recommendation

1) Issues of present Shivee Ovoo coal mine

The biggest issue of Shivee Ovoo coal mine is low quality in terms of high moisture content, low calorific value, and contamination of rock and metals.

- Moisture content is too high due to delay of dewatering work and lacks of moisture management system and equipment
- Calorific value is too low due to mining of the oxidized coal near the outcrop and high moisture content in coal

Another issue is low efficiency of dump trucks due to lack of spare parts and maintenance specialist together with no workshop in the coal mine.

2) Recommended mining system for renovation

Overall mining system was reviewed and the followings were selected for renovation, taking flexibility for overburden removal into account:

- | | |
|---------------------|-----------------------------|
| Overburden removal | : One medium-size dragline |
| Interburden removal | : Existing shovel and truck |
| Coal excavation | : Existing shovel and truck |

Necessary surface facilities such as workshop, dewatering system, coal quality control system, crushing plant, etc. are also planned.

3) Environmental impact

Environmental impact of renovation was studied in all environmental aspects, however, any limitation on renovation for 2 million t/y was not recognized. To preserve the environment, installation of a water treatment system of groundwater is required and included in the renovation cost.

4) Major equipment and facilities

Major equipment is as follows:

Equipment	Existing	Expansion	Major services
Dragline	0	1	Overburden removal
Shovel	4	0	Excavation (overburden & coal)
Truck	15	0	Transportation (")
Bulldozer	4	1	Supporting & multi-services
Grader	0	1	Road maintenance

Most of the surface facilities such as workshop for maintenance, sizing and loading system for size control and coal analyzing system for quality control are not yet installed at present and therefore urgent installation is required.

5) Quality Control System

At present, there is no coal quality management section in Shivee Owoo coal mine and whole Shivee Owoo coal is sent to the users without quality inspection. Issues of coal quality are low calorific value, high moisture content and contamination of rock, metal and large coal block.

To improve coal quality, the concept of "management for coal quality control" must be introduced into whole managers, staffs, and labors as well as installation of quality control equipment.

Note 1: Installation of coal drying system at Shivee Owoo coal mine is desirable; however, dried lignite may cause spontaneous combustion during storage and transportation. Therefore, installation of the coal drying system at the coal user site is recommended.

2: Washability test was carried out to investigate the effect of ash removal from raw coal. The results show that Seam I is relatively easy while Seam II is rather difficult. In conclusion, selective coal mining is recommended to decrease ash content rather than installation of a coal washing plant.

6) Capital and Operating Costs

Capital and operating costs for 23 years (1996-2018) of the project life, which consist of initial cost and replacement cost, are as follows:

	Capital cost	Operating cost	Total
Existing improvement	43	97	140
Expansion	82	139	221
Total for renovation	125	236	361

(Unit : million US \$)

Foreign currency portion of capital and operating costs for the first three years (1996-1998) is as follows:

	Capital cost	Operating cost	Total
Existing improvement	6.4	6.3	12.7
Expansion	35.9	0	35.9
Total for renovation	42.3	6.3	48.6

(Unit : million US\$)

7) Results of economic evaluation

Economic evaluation proves that the renovation project of Shivee Ovoo coal mine is advantageous in terms of Mongolian economy and has the sufficient economic feasibility.

Economic value of Shivee Ovoo coal with 3,580 kcal/kg is evaluated to be 6,086 Tg/t as a calorific parity border price of the import substitute from Russia.

EIRR on the total project is as high as 67.1% at the economic coal value of 6,086 Tg/t. The coal price to gain 10% EIRR is 3,729 Tg/t and is cheaper than 4,743 Tg/t of Baganuur coal.

	Economic price at 10% EIRR(Tg/t)	EIRR at 6,086 Tg/t(%)
Case 1	3,290	∞
Case 2 *1	4,082	25.9
Case 3	3,728	67.1

Note *1: All capital cost of the surface facilities is included in Case 2.

The economic sensitivity analysis illustrates that $\pm 20\%$ changes in base case assumptions do not give a serious impact on the economic feasibility.

8) Results of financial analysis

Under heavy Mongolian taxation system, the renovation project of Shivee Ovoo coal mine is critical in the financial feasibility.

FIRR on the total project (debt/equity = 0/100), which represents the investor's point of view, is a critical level of 10.5% at the economic coal value of 6,086 Tg/t.

	Financial price at 10% FIRR(Tg/t)	FIRR at 6,086 Tg/t(%)
Case 1	5,265	20.5
Case 2 *1	6,546	8.1
Case 3	5,998	10.5

Note *1: All capital cost of the surface facilities is include in Case 2.

The sale price (financial coal price) to gain 10% FIRR on the total project is 6,000 Tg/t and as high as 160% of the economic coal price of 3,728 Tg/t, which illustrates the heavy taxation regimes.

Results of the above-mentioned analyses show that the project is critically viable at the sale price of economic value of 6,086 Tg/t under the current taxation regimes.

To improve the financial feasibility of Shivee Ovoo coal mine as well as to decrease the coal sale price from the level of the economic value of 6,086 Tg/t, introduction of low cost loan and/or amendment of Mongolian taxation rates will be necessary.

Relation between FIRR, debt/equity ratio and interest rate illustrates that introduction of low cost loan can improve FIRR on equity by the effect of leverage, while debt/equity ratio must be lower than 95% to avoid loan unrepaid.

Debt (%)	Equity (%)	Foreign loan interest rate (%)				
		1	2	5	8	10
0	100	10.5	10.5	10.5	10.5	10.5
50	50	14.6	14.3	13.4	12.6	12.1
80	20	24.9	23.6	20.1	17.5	16.0
95*1	5	∞	∞	∞	(unrepaid)	(unrepaid)

Note *1: FIRR on equity is higher than 100, while, in the range of more than 95 % debt/equity

ratio, financial unsoundness is unfavorably increased by the amount of loan unrepaid.

For reference, the effect of tax exemption in the case of renovation of Baganuur coal mine is shown on Table 8.12 of Chapter I.

9) Financial sensitivity analysis

Impact of changes in coal sale price was evaluated by the amount of loan unrepaid.

The reasonable lowest sale price of Shivee Ovoo coal under assumed financial conditions (debt/equity = 80/20) is differed by foreign loan interest rate from 5,180 Tg/t at 2% to 5,430 Tg/t at 8%.

In the case of 80% debt at 6,086 Tg/t, which FIRR on equity of 23.6% is shifted from an original 10.5% resulting from leverage, $\pm 20\%$ of changes in assumed conditions will not give a serious impact on the financial feasibility.

Above-mentioned examinations indicate that the desired financial conditions for renovation project of Shivee Ovoo coal mine are as follows:

- Project financing of 80% debt and 20% equity
- Foreign loan of low interest rate
- Fixed assets revaluation
- Tax deductible of accumulated operation loss
- Tax reduction:
 - Import tax for equipment and spare parts
 - Trade tax for equipment and spare parts

If the Mongolian government plans to promote the privatization, it is recommended to crete similar conditions in effect described above.

10) Improvement of management system

Improvement of management system in the following sections is recommended:

- Maintenance section:

The section takes responsibilities for the maintenance of equipment including stock of spare parts.

Development of maintenance capability is the top urgent subject of the new maintenance section.

- Coal quality control section:

The section takes actions in resolving coal quality troubles and hold good communication with the coal users on coal quality issues.

- Environmental section:

The section preserves the environment through implementation of the monitoring plan and the proposed countermeasures.

- Coal sales section:

The section sale the product, to negotiate the price, manage the claims from users and prepare the sales plan in short and long terms.



Appendix - Shivee Ovoo Coal Mine



Appendix 1 Time Study

Time study was carried out on 29th November, 1993 to find cycle time of loading and hauling of overburden and coal. Purpose of time study was to get real operating data which are required to project real production capacity of Shivee Ovoo coal mine. Collected data are summarized as follow;

1.1 Overburden - Shovel (loading)

- Shovel : EKG 5A
- Rear Dump Truck : Belaz 548 (40 t)

Table 1.1 Cycle Time of Overburden Loading by Shovel

Activities	min:sec		
	1	2	Average
1st path	0:30	0:30	0:30
2nd Path	0:27	0:25	0:26
3rd Path	0:25	0:24	0:24
4th Path	0:26	0:25	0:26
5th Path	0:27	0:27	0:27
Total Cycle Time	2 min 15 sec	2 min 11 sec	2 min 13 sec

1.2 Overburden - Truck (hauling)

- Hauling distance : 1.2 - 1.4 km
- Rear Dump Truck : Belaz 548 (40 t)

Table 1.2 Cycle Time of Overburden Hauling by Truck

Activities	min:sec		
	1	2	Average
Loading	1:52	1:47	1:50
Travel (loaded)	3:06	3:09	3:07
Maneuvering	0:10	0:13	0:12
Dumping	0:46	0:52	0:49
Travel (empty)	2:25	2:30	2:27
Waiting to load	1:50	0:20	1:05
Maneuvering	0:20	0:15	0:17
Total Cycle Time	10:29	9:06	9:48

1.3 Coal - Shovel (loading)

- Shovel : EKG 5A
- Rear Dump Truck : Belaz 548 (40 t)

Table 1.3 Cycle Time of Coal Loading by Shovel

Activities					min:sec
	1	2	3	4	Average
1st Path	0:25	0:19	0:25	0:26	0:24
2nd Path	0:35	0:29	0:28	0:25	0:29
3rd Path	0:23	0:25	0:54	0:39	0:35
4th Path	1:01	0:28	0:40	0:26	0:39
5th Path	0:42	0:32	0:57	0:36	0:42
Total Cycle Time	3:06	2:13	3:24	2:32	2:49

1.4 Coal - Truck (hauling)

- Hauling distance : 2 - 2.4 km
- Rear Dump truck : Belaz 548 (40 t)

Table 1.4 Cycle Time of Coal Hauling by Shovel

Activities					min:sec
	1	2	3	4	Average
Loading	2:47	2:25	2:37	2:15	2:31
Travel (loaded)	4:45	4:50	4:50	4:40	4:46
Maneuvering	0:20	0:15	0:15	0:20	0:18
Dumping	0:45	0:45	0:50	0:47	0:47
Travel (empty)	4:05	4:15	4:50	4:20	4:22
Waiting to load	0:00	0:25	3:35	0:00	1:20
Maneuvering	0:00	0:15	0:15	0:00	0:15
Total Cycle Time	12:42	13:10	17:12	12:22	14:19

Appendix 2 Estimation of Production Cost

2 Estimation of Production Cost

This appendix describes details of calculation method utilized for estimation of production cost in Cases 1, 2 and 3.

2.1 Required numbers of mining equipment

In addition to the present mining equipment utilized at Shivee Owoo coal mine at present, the following numbers of additional and new equipment by each option are required to increase production capacity to 2 million tons per year .

Table 2.1 Required Number of Mining Equipment

Case 1	Unit	Case 2	Unit	Case 3	Unit	Case 4	Unit
EKG - 5A	4	FEL (10 m ³)	2	D/L (29 m ³)	1	D/L (20m ³)	2
Belaz 548	22	D/T (80 t)	8	Dozer	1	Dozer	2
Wheel Doser	2	Wheel Doser	1	Grader	1	Grader	1
Grader	2	Grader	1				

EKG 5A	- Electric Rope Shovel (5 m ³)
Belaz 548	- Rear Dump Truck (40 t)
FEL (10 m ³)	- Front End Loader (10 m ³)
D/T (80 t)	- Rear Dump Truck (80 t)
Wheel Dozer	- Wheel Dozer (230 kW)
D/L(29)	- Walking Dragline with bucket capacity of 29 m ³
D/L(20)	- Walking Dragline with bucket capacity of 20 m ³
Dozer	- Bulldozer (388 kW)
Grader	- Motor Grader (205 kW)

2.2 Price of mining equipment and capital cost

Price of mining equipment on CIF Ulaanbaatar, which was provided by suppliers of mining equipment, is utilized for estimation of capital cost for each option.

Table 2.2 Price of Mining Equipment and Capital Cost

Case 1					US\$
Item	Unit Price	Duty & Tax	Capital Cost	Units	Total Costs
EKG - 5A	876,000	175,200	1,051,200	4	4,204,800
Belaz 548	80,000	16,000	96,000	22	2,112,000
W Dozer	357,000	71,400	428,400	2	856,800
Grader	426,000	85,200	511,200	2	1,022,400

Case 2					US\$
Item	Unit Price	Duty & Tax	Capital Cost	Units	Total Costs
FEL	1,200,000	204,000	1,224,000	2	2,448,000
D/T	633,000	126,600	759,600	8	6,076,800
W Doser	357,000	71,400	428,400	1	428,400
Grader	426,000	85,200	511,200	1	511,200

Case 3					US\$
Item	Unit price	Duty & Tax	Capital Cost	Unit	Total Costs
D/L(29)	16,615,000	3,323,000	19,938,000	1	19,938,000
Dozer	616,000	123,200	739,200	1	739,200
Grader	426,000	85,200	511,200	1	511,200

Case 4					US\$
Item	Unit price	Duty & Tax	Capital Cost	Unit	Total Costs
D/L(20)	12,171,000	2,434,200	14,605,200	2	29,210,400
Dozer	616,000	123,200	739,200	2	1,478,400
Grader	426,000	85,200	511,200	1	511,200

2.3 Operating life of mining equipment

Operating life of mining equipment is based on operating life expected in the western world, excepting EKG 5A and Belaz 548.

Table 2.3 Operating Life of Mining Equipment

Case 1	Life	Case 2	Life	Case 3	Life	Case 4	Life
EKG - 5A	6	FEL (10 m ³)	6	D/L (29 m ³)	30	D/L (20m ³)	30
Belaz 548	3	D/T (80 t)	6	Dozer	6	Dozer	6
Wheel Doser	6	Wheel Doser	6	Grader	6	Grader	6
Grader	6	Grader	6				

2.4 Depreciation

Straight Line Method for depreciation is adopted with no residual values at the end of operating life of each mining equipment and interests on capital cost were not considered.

Table 2.4 Depreciation of Mining Equipment

Case 1			US\$
Item	Capital Cost	Life	Depreciation
EKG - 5A	1,051,200	6	175,200
Belaz 548	96,000	3	632,000
Wheel Dozer	428,400	6	71,400
Grader	511,200	6	85,200

Case 2			US\$
Item	Capital Cost	Life	Depreciation
FEL (10 m ³)	1,224,000	6	204,000
D/T (80 t)	759,600	6	126,600
Wheel Dozer	428,400	6	71,400
Grader	511,200	6	85,200

Case 3			US\$
Item	Capital Cost	Life	Depreciation
D/L (29 m ³)	19,938,000	30	664,600
Dozer	739,200	6	123,200
Grader	511,200	6	85,200

Case 4			US\$
Item	Capital Cost	Life	Depreciation
D/L (20 m ³)	14,605,200	30	486,840
Dozer	739,200	6	123,200
Grader	511,200	6	85,200

2.5 Capital cost

(1) Capital cost

Annual capital cost for each option is shown in Table 2.5.

Table 2.5 Capital Cost of Mining Equipment

Case 1			US\$
Item	Depreciation	Unit	Fixed Cost
EKG - 5A	175,200	4	700,800
Belaz 548	32,000	22	700,400
Wheel Doser	71,400	2	142,800
Grader	85,200	2	170,400
Total			1,718,000

Case 2			US\$
Item	Depreciation	Unit	Fixed Cost
FEL (10 m ³)	204,000	2	408,000
D/T (80 t)	126,600	8	1,012,800
Wheel Dozer	71,400	1	71,400
Grader	85,200	1	85,200
Total			1,577,400

Case 3			US\$
Item	Depreciation	Unit	Fixed Cost
D/L (29 m ³)	664,600	1	664,600
Dozer	123,200	1	123,200
Grader	85,200	1	85,200
Total			873,000

Case 4			US\$
Item	Depreciation	Unit	Fixed Cost
D/L (20 m ³)	486,8400	2	973,680
Dozer	123,200	2	246,400
Grader	85,200	1	85,200
Total			1,305,280

(2) Capital cost/tonne

As a result of calculation on real production capacity in the Chapter 3.4.2, production capacity of coal at Shivee Ovoo coal mine is estimated to be 800,000 t/y. Therefore, the required amount of production expansion is 1,200,000 tons per year to establish 2 million tons per year. Annual depreciation cost divided by the required amount of production expansion is capital cost per tonne of coal.

Table 2.6 Capital Cost/tonne

Option	Fixed Cost (US\$)	Capital cost/tonne
Case 1	1,718,000	1.43
Case 2	1,577,400	1.31
Case 3	873,000	0.73
Case 4	1,305,280	1.09

2.6 Operating cost

(1) Labor cost

1) Additional labor to be employed

Numbers of additional operators and maintenance personnel required to be employed at Shivee Owoo coal mine for expansion of production capacity to 2 million tons per year on each option are shown in Table 2.7.

Table 2.7 Additional Employment of Operator and Maintenance Personnel

Case 1	Men	Case 2	Men	Case 3	Men	Case 4	Men
EKG - 5A	16	FEL (10 m ³)	4	D/L (29 m ³)	6	D/L (20m ³)	12
Belaz 548	44	D/T (80 t)	16	Doser	2	Dozer	4
Wheel Doser	4	Wheel Dozer	2	Grader	2	Grader	2
Grader	4	Grader	2				
Operator	68		24		10		18
Maintenance	28		12		6		12
Subtotal	96		36		16		30
Attendance	0.83		0.83		0.83		0.83
Total	116		43		19		36

2) Labor cost

Labor cost is calculated on the basis of 70,000 Tg/month earned by operator of shovel which was given to us during the last site investigation in December, 1993.

Exchange rate is 400 Tg/US\$.

Table 2.8 Labor Cost of Additional Employment

Option	Labor cost (tg)	Labor cost (US\$)	US\$/tone
Case 1	97,440,000	243,600	0.20
Case 2	36,120,000	90,300	0.08
Case 3	15,960,000	39,900	0.03
Case 4	30,240,000	75,600	0.06

(2) Maintenance cost

1) Repair parts

The required annual cost of repair parts, consumable and overhaul is estimated by applying simple method which is well utilized on feasibility study in the western world.

Repair parts = Capital Cost x 0.05%

Consumable = Unit Capital cost x 0.00001 x Operating hours/year

Operating hour = Scheduled Hours x Utilization

Overhaul = Capital cost x 0.15%

Once every 8 years for Dragline

Once every 2 years for other mining equipment

Table 2.9 Repair Cost of Mining Equipment

Case 1			US\$
Item	Repair Parts	Consumable	Overhauls
EKG - 5A	175,200	148,429	262,800
Belaz 548	88,000	74,554	132,000
Wheel Dozer	35,700	30,245	53,550
Grader	42,600	36,091	63,900
Subtotal	341,500	289,319	512,250
Duty & Tax	119,525	101,262	179,288
Total			1,943,217

Case 2			US\$
Item	Repair Parts	Consumable	Overhauls
FEL (10 m ³)	102,000	86,414	153,000
D/T (80 t)	253,200	214,511	379,800
Wheel Dozer	17,850	15,123	26,775
Grader	21,300	180,045	31,950
Subtotal	394,350	334,093	591,525
Duty & Tax	138,023	116,933	207,034
Total			1,605,058

Case 3			US\$
Item	Repair Parts	Consumable	Overhauls
D/L (29 m ³)	830,750	703,811	311,531
Dozer	30,800	260,094	46,200
Grader	21,300	18,045	31,950
Subtotal	882,850	747,951	389,681
Duty & Tax	308,998	261,783	136,388
Total			2,727,650

Case 4			US\$
Item	Repair Parts	Consumable	Overhauls
D/L (20 m ³)	1,217,100	1,031,126	456,412
Dozer	61,600	26,095	92,400
Grader	21,300	18,045	31,950
Subtotal	1,300,000	1,075,266	580,762
Duty & Tax	455,000	376,343	203,267
Total			3,990,638

Please note that overhaul of Rear Dump Truck Belaz 548 is not carried out due to operating life of 3 years in accordance with information obtained during the last site investigation in Mongolia.

2) Repair cost/tonne

Table 2.10 Repair Cost/tonne

Option	Maintenance Cost	US\$/tonne
Case 1	1,943,217	1.62
Case 2	1,605,058	1.34
Case 3	2,727,650	2.27
Case 4	3,990,638	3.33

(3) Energy and other cost (running cost)

1) Output of mining equipment

Usage of energy cost is calculated on the basis of output of mining equipment. Output of mining equipment described in specifications is as follows;

Table 2.11 Output of Mining Equipment

Item	Diesel Engine (kW)	Electric Motor (kW)
EKG - 5A		250
Belaz 548	373	
Wheel Dozer	231	
Grader	205	
FEL (10 m ³)	515	
D/T (80 t)	649	
D/L (29 m ³)		2,611
D/L (20 m ³)		2,500
Dozer	388	

2) Usage of energy and other costs

A simple method utilized for feasibility study in the western world is applied for estimating usage of electricity, diesel, lubricant and tire as follows;

$$\text{Electricity (KWH)} = \text{Peak Power (KW)} \times 0.6 \times \text{Operating hour}$$

$$\text{Diesel (Litter)} = \text{Engine (KW)} \times k \times \text{Operating hours}$$

$$\text{D/T} \quad k = 0.055$$

$$\text{FEL} \quad k = 0.105$$

$$\text{Wheel Doser} \quad k = 0.14$$

$$\text{Doser} \quad k = 0.14$$

$$\text{Grader} \quad k = 0.14$$

$$\text{Lubricant} = \text{Diesel (Litter)} \times .15$$

$$\text{Tire} = \text{No. of tires per unit} \times \text{cost of tire} \times \text{operating hour/life of tire}$$

Unit cost = Diesel : 77.7 c/l
 = Petroleum : 6.78 c/kWh
 = Electricity : 13 Tg/kwh

Tire : Belaz 548

= Price : US\$3,500
 = No. of tires : 6
 = Operating life : 4,000 hours

: Front End Loader

= Price : US\$24,000
 = No. of Tire : 4
 = Operating life : 4,000 hours

: Rear Dump Truck

= Price : US\$12,000
 = No. of Tire : 6
 = Operating life : 4,000 hours

: Wheel Doser

= Price : US\$5,000
 = No. of Tire : 4
 = Operating life : 4,000 hours

Total of import duty and tax is 35 % for spare parts and tires imported from overseas.

Table 2.12 Tire Cost

Item	Unit cost	Duty &Tax	Tire cost	No of Tire	x 1000 US\$
					Total
Belaz 548	3,500	1,225	4,725	6	28,350
FEL	24,000	8,400	32,400	4	129,600
D/T	12,000	4,200	16,200	6	97,200
W Dozer	5,000	1,750	6,750	4	27,000
Grader	5,000	1,750	6,750	6	40,500

Table 2.13 Usages of Electricity, Diesel, Lubricant and Tire

Case 1					x 1000 US\$
Item	Electricity	Diesel	Lubricant	Tire	
EKG - 5A	2,542				
Belaz 548		1,912		132	
Wheel Dozer		205		8	
Grader		182		12	

Case 2					x 1000 US\$
Item	Electricity	Diesel	Lubricant	Tire	
FEL (10 m ³)		611		8	
D/T (80 t)		1,210		48	
Wheel Dozer		103		4	
Grader		91		6	

Case 3					x 1000 US\$
Item	Electricity	Diesel	Lubricant	Tire	
D/L (29 m ³)	6,636				
Dozer		230			
Grader		91		6	

Case 4					x 1000 US\$
Item	Electricity	Diesel	Lubricant	Tire	
D/L (29 m ³)	12,708				
Dozer		460			
Grader		91		6	

3) Cost of energy and others

Table 2.14 Energy and Other Costs of Mining Equipment

Case 1					x 1000 US\$
Item	Electricity	Diesel	Lubricant	Tire	
EKG - 5A	172				
Belaz 548		1,485	223	624	
Wheel Doser		160	24	54	
Grader		142	21	81	
Subtotal	172	1,787	268	759	
Total				2,987	

Case 2					x 1000 US\$
Item	Electricity	Diesel	Lubricant	Tire	
FEL (10 m ³)		475	71	259	
D/T (80 t)		940	141	778	
Wheel Doser		80	12	27	
Grader		71	11	41	
Subtotal		1,565		1,104	
Total				2,904	

Case 3					x 1000 US\$
Item	Electricity	Diesel	Lubricant	Tire	
D/L (29 m ³)	450				
Dozer		179	27		
Grader		71	11	41	
Subtotal	450	250	37	41	
Total				778	

Case 4					x 1000 US\$
Item	Electricity	Diesel	Lubricant	Tire	
D/L (20 m ³)	862				
Dozer		356	54		
Grader		71	11	41	
Subtotal	862	427	65	41	
Total				1,395	

4) Energy and other cost per tone

Table 2.15 Energy and Other Cost per Tone of Mining Equipment

Option	Energy Cost, etc (US\$)	US\$/tone
Case 1	2,985,901	2.49
Case 2	2,904,256	2.42
Case 3	777,508	0.65
Case 4	1,395,000	1.16

2.7 Production cost

For each option, production cost to increase production capacity to 2 million tons per year is estimated as follows;

(1) Production cost

Table 2.16 Production Cost

Item	US\$			
	Case 1	Case 2	Case 3	Case 4
Capital Cost				
Depreciation	1,718,000	1,577,400	873,000	1,305,280
Operating Cost				
Labor Cost	243,600	90,300	39,900	75,600
Material Cost	1,943,217	1,605,058	2,727,650	3,990,638
Energy, etc	2,985,901	2,904,256	777,508	1,395,000
Total	6,890,718	6,177,014	4,418,058	6,766,518

(2) Production cost per tone

Table 2.17 Production Cost per Tone

Option	US\$/ton			
	Case 1	Case 2	Case 3	Case 4
Capital Cost				
Depreciation	1.43	1.31	0.73	1.09
Operating Cost				
Labor	0.23	0.08	0.03	0.06
Materials	1.62	1.34	2.27	3.33
Energy, etc	2.49	2.42	0.65	1.16
Total	5.74	5.15	3.68	5.64

2.8 Selection of option

On this interim report at present, Case 3 has the lowest production cost per tone. Diesel and tire cost in Cases 1 and 2 are substantially higher than Cases 3 and 4. Diesel and tire have to be imported by spending hard currency. Additional mining equipment to be introduced in Case 1 is made in Russia. It is the fact that availability of these Russian equipment are lower than these made in the western countries. Electricity required in Cases 3 and 4 is domestically produced in Mongolia. Considering these factors, it is tentatively recommended that Case 3 should be selected as the best option for Mongolia. Case 3 is an option of introduction of a new medium dragline.

Production cost of the present mining equipment utilized at Shivee Owoo coal mine and replacement costs are common cost in all options. Similarly, capital cost required for construction of Crushing and Screening plant, Stockyard, Train Loading Facilities, etc in establishing the capacity of production to 2 million tons per year and operating costs of these mine infrastructures are common cost in all options.

Production cost was estimated for each option. The following issues should be carefully considered on selection of option which is the most advantageous for the national interest of Mongolia. Mongolia has to make a decision on selection of the source of energy for mining equipment whether the electrical energy generated in Mongolia should be consumed, or diesel

which was purchased by the hard currency should be utilized as an energy. For example, case 2 (introduction of new medium truck and front end loader) requires diesel as a source of energy while case 3 (introduction of a new medium dragline) requires the electricity which is generated in Mongolia. Use of electrical energy produced in Mongolia is recommended.

Appendix 3 Alternative Proposal for Control of Coal Quality

For the purpose of solving problems on quality control of coal at Shivee Ovoo coal mine, the crushing and screening plant, stacker and reclaimer, coal stockyard and train loading facilities are proposed as the alternative methods of control of coal quality. The attached flow chart is a result of a preliminary investigation and further detailed feasibility study is required. Proposed flow chart on crushing, screening, coal stockyard and train loading is shown in Figure 3.1. Conceptual drawing of stacker and reclaimer is shown in Figure 3.2.

1 Basic Parameters

1.1 Location of installation

Present area of train loading.

1.2 Characteristics of coal

Density : 1.21 tone/m^3 (loose density = 0.7 - 0.8 tone/m^3)
Total moisture : Max 40%(frozen coal in the winter season)
Size distribution : It is assumed to be under 500 mm

1.3 Annual coal production

0 - 200 mm : 400,000 ton (transportation by truck)
0 - 50 mm : 1,600,000 ton (loading out by train)
Annual coal production : 2,000,000 ton

1.4 Working conditions

Working days : 300 day/year
Working hours : 24 hours/day (3 shifts per day)

1.5 Train loading

Unit train : 29 wagons
Capacity of wagon : 74 m^3 /wagon (65 ton/wagon)

2 Examination of The Capacity

2.1 Capacity of primary crushing (truck dump station - primary vibrating screen)

(1) Annual handling volume

$$2,000,000 \text{ ton} : 2,860,000 \text{ m}^3 \text{ (loose density} = 0.7 \text{ ton/m}^3)$$

(2) Daily handling volume

$$2,860,000 \text{ m}^3/300 \text{ days} = 9530 \text{ m}^3/\text{day} = 9,600 \text{ m}^3/\text{day}$$

(3) Work efficiency

$$0.8$$

(4) Processing capacity

$$9,600 \text{ m}^3/\text{day}/(0.8 \times 24 \text{ hours}) = 500 \text{ m}^3/\text{hour}$$

$$Q = 500 \text{ m}^3/\text{hour} \times 0.8 \text{ ton/m}^3 = 400 \text{ ton/hour (nominal capacity)}$$

2.2 Capacity of secondary crushing (primary vibrating screen - stockyard)

(1) 0 - 200 mm line

$$500 \text{ m}^3/\text{hour} \times 20\% = 100 \text{ m}^3/\text{hour}$$

$$Q = 100 \text{ m}^3/\text{hour} \times 0.8 \text{ ton/m}^3 = 80 \text{ ton/hour (nominal capacity)}$$

Please note;

As belt conveyor underneath of the primary vibrating screen has possibility to exceed 80 ton/hour, the capacity of belt conveyor is decided to be 160 ton/hour. (2 x 80 ton/hour = 160 ton/hour)

(2) 0 - 50 mm line

$$500 \text{ m}^3/\text{hour} \times 80\% = 400 \text{ m}^3/\text{hour}$$

$$Q = 400 \text{ m}^3/\text{hour} \times 0.8 \text{ ton/m}^3 = 320 \text{ ton/hour (nominal capacity)}$$

Please note;

With considering over size (25 %) of the secondary vibrating screen, the capacity of over size return line is decided to be 80 ton/hour (320 ton/hour x 0.25) and the capacity of the secondary roll crusher and the secondary vibrating screen is decided to be 400 ton/hour

(320 tone/hour + 80 ton/hour).

(3) Stockyard

1) 0 - 200 mm Clean Coal

Size of the stockyard is to hold clean coal for daily loading out.

$$\begin{aligned} 2,860,000 \text{ m}^3 \times 20\% \times 1/300 &= 1,910 \text{ m}^3/\text{day} \\ &= 2,000 \text{ m}^3 \text{ (Stockyard)} \end{aligned}$$

2) 0 - 50 mm clean coal

Size of the stockyard is to hold clean coal for daily loading out.

$$\begin{aligned} 2,860,000 \text{ m}^3 \times 80\% \times 1/300 &= 7630 \text{ m}^3/\text{day} \\ &= 8,000 \text{ m}^3 \text{ (stockyard)} \end{aligned}$$

(Please note that size of stockyard must be discussed with MFE)

(4) Capacity of train loading facilities

1) Transportation Capacity of a Unit Train

$$\begin{aligned} 74 \text{ m}^3/\text{wagon} \times 2 \text{ wagons} &= 2,146 \text{ m}^3 \\ &= 2,200 \text{ m}^3 \text{ (say)} \end{aligned}$$

2) Capacity of daily loading out

$$8,000 \text{ m}^3$$

3) Required number of unit trains

$$\begin{aligned} 8,000 \text{ m}^3/2,200 \text{ m}^3 &= 3.64 \\ &= 4 \text{ (say)} \end{aligned}$$

4) Loading time of unit train

$$24 \text{ hours} \times 1/4 - 2 \text{ hours (allowance, etc)} = 4 \text{ hours}$$

5) Capacity of train loading

$$2,200 \text{ m}^3/4 \text{ hours} = 550 \text{ m}^3/\text{hour}$$

$$Q = 550 \text{ m}^3/\text{hour} \times 0.8 \text{ ton/m}^3 = 440 \text{ ton/hour (nominal capacity)}$$

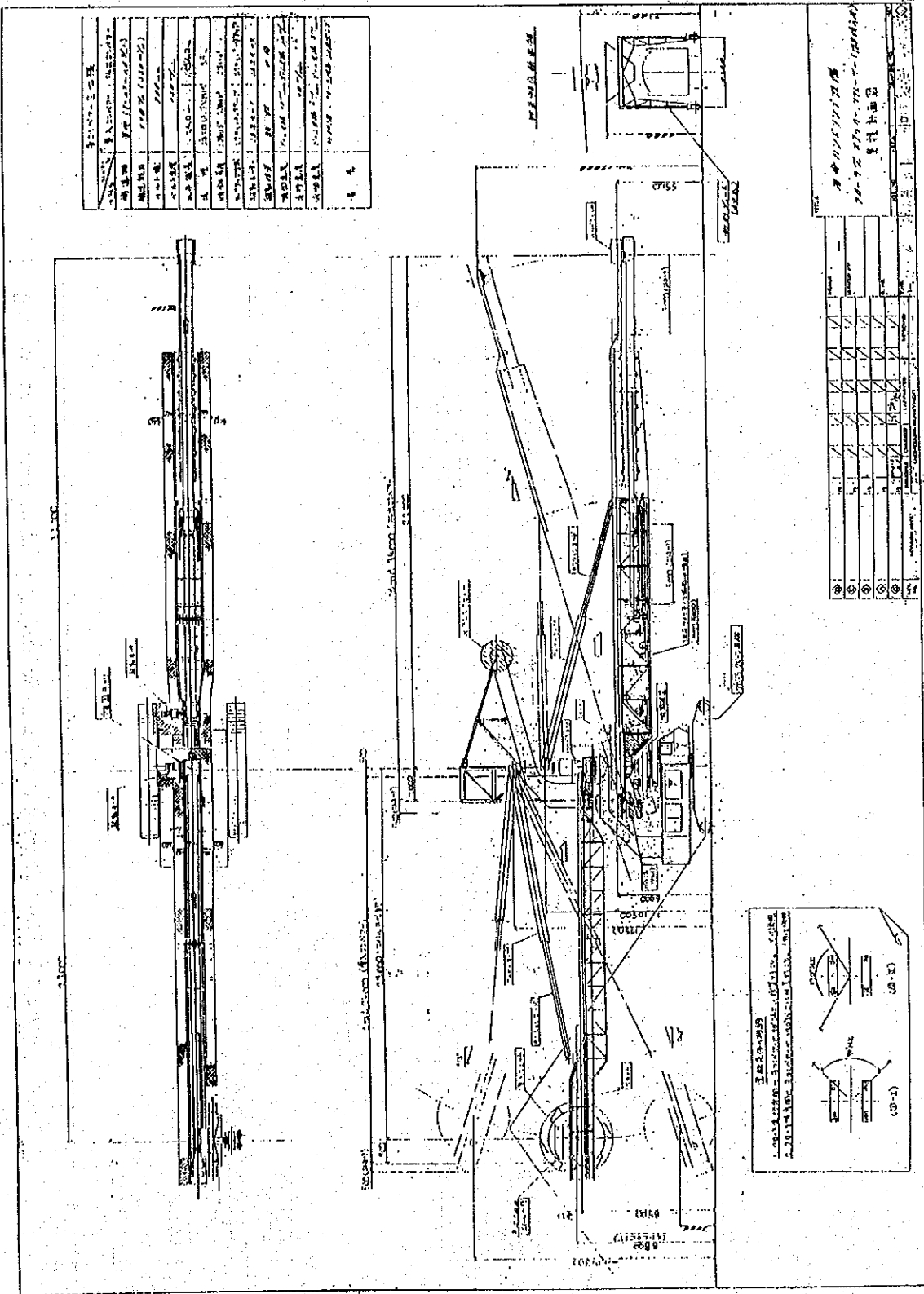


Figure 3.2 Conceptual Drawing of Stacker and Reclaimer

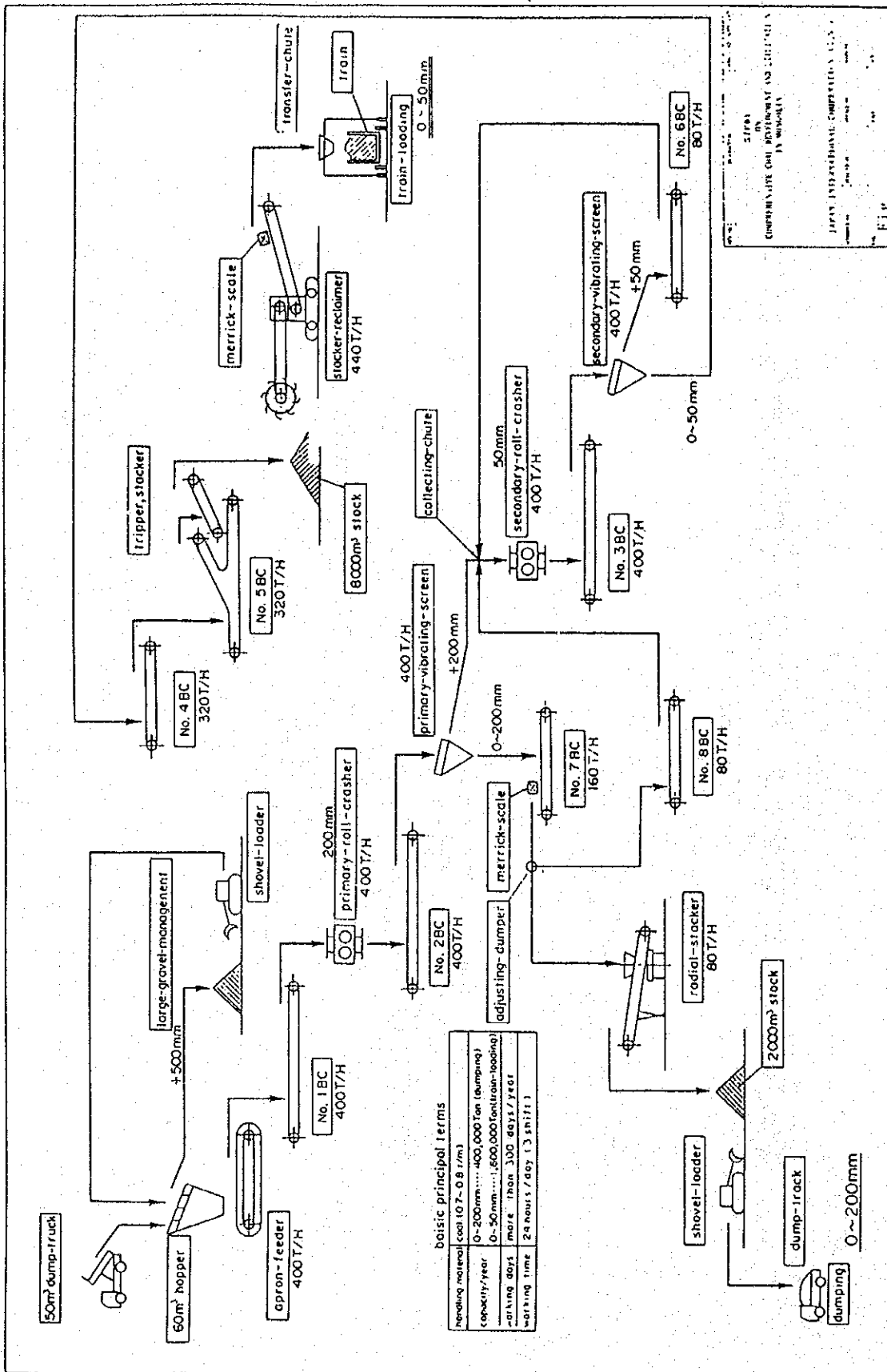


Figure 3.1 Flow Chart of Crushing, Screening, Stockyard and Train Loading

Appendix 4 Salary and Wage Variance

Salary and Wage Variance

Case	I	II
	Existing Equipment	Additional Equipment
TBCM Standard Norm (10 ³ BCM)	3, 200	5, 500
Standard Number of Workers		
Engineers	14	32
Adm. clerks	14	11
skilled	222	227
Unskilled	17	16
Total	267	286
TBCM Performance (10 ³ BCM)	X	X
Variance Factor	$\left[A = \frac{X - 3, 200}{3, 200} \right]$	$\left[A = \frac{X - 5, 500}{5, 500} \right]$
Engineers	(1+0.17A) ×	(1+0.35A)
Adm. clerks	(1+0.06A) ×	(1+0.29A)
skilled	(1+0.11A) ×	(1+0.49A)
Unskilled	(1+0.20A) ×	(1+1.43A)

Note: Variance factors here are taken from those in Baganuur coal mine.

Appendix 5 Economic and Financial Evaluation

1. Conceptual Methodology and Terminology of DCF Analysis.

See Appendix 8 of Chapter I.

2. Tables for Economic Evaluation

2.1 Economic cash flow analyses

An economic coal price at a 10% EIRR for every scenario is evaluated. The results, DCF cash flows and foreign & local currency requirements, are presented as follows:

	<u>Case 1</u>	<u>Case 2</u>	<u>Case 3</u>
Cash Flow	Table 5.1(1)	Table 5.2(1)	Table 5.3(1)
Foreign Currency Requirements	Table 5.1(2)	Table 5.2(2)	Table 5.3(2)

EIRRs on the total project examined at the economic coal value of 6,086.0 Tg/t are as follows:

	<u>Case 1</u>	<u>Case 2</u>	<u>Case 3</u>
Cash Flow	Table 5.4	Table 5.5	Table 5.6

2.2 Economic sensitivity analyses

Since the project, of which EIRR is 67.1% in Case 3 at 6,086 Tg/t, is highly advantageous in terms of national economy, only the severest changes are presented as follows:

Price	(-20%)	Table 5.7 (DCF Cash Flow)
Exchange Rate	(-20%)	Table 5.8 (DCF Cash Flow)
Capital Costs	(+20%)	Table 5.9 (DCF Cash Flow)
Operating Costs	(+20%)	Table 5.10(DCF Cash Flow)
Total Exaction	(+20%)	Table 5.11(DCF Cash Flow)

2.3 Coal price VS EIRR

A coal price VS EIRR is presented on Table 5.12.

2.4 Discount rate vs net present value

A discount rate vs net present value at 6,086.0 Tg/t is presented on Table 5.13.

3. Tables for Financial Analyses

3.1 Financial cash flow analyses

A financial coal price at a 10% FIRR for every scenario is evaluated. The results, DCF cash flows and foreign & local currency requirements, are presented as follows:

	DCF C.F. *1	F.C.F. *2	F&L*3 Requirements
Case 1 No Fixed Assets Revalued	Table 5.14(1)	Table 5.14(2)	Table 5.14(3)
Case 2	Table 5.15(1)	Table 5.15(2)	Table 5.15(3)
Case 3 No Fixed Assets Revalued	Table 5.16(1)	Table 5.16(2)	Table 5.16(3)

*1 DCF C.F. : DCF Cash Flow

*2 F.C.F. : Financial Cash Flow

*3 F&L Requirements : Foreign and Local Currency Requirements

FIRRs on the total project examined at the economic coal value of 6,086.0 Tg/t are as follows:

	DCF C.F. *1	F.C.F. *2
Case 1 No Fixed Assets Revalued	Table 5.17(1)	Table 5.17(2)
Case 2	Table 5.18(1)	Table 5.18(2)
Case 3 No Fixed Assets Revalued	Table 5.19(1)	Table 5.19(2)

*1 DCF C.F. : DCF cash Flow

*2 F.C.F. : Financial Cash Flow

3.2 Leverage

After tax FIRRs on equity at 6,086.0 Tg/t for Case 3 with fixed assets revalued have been evaluated and part of the results are presented as follows:

Debt	Equity		Foreign Loan Interest Rate		
			3%	5%	8%
0.10	0.90	DCF Cash Flow	Table 5.20(1)	Table 5.21(1)	Table 5.22(1)
		Financial Cash Flow	Table 5.20(2)	Table 5.21(2)	Table 5.22(2)
0.80	0.20	DCF Cash Flow	Table 5.23(1)	Table 5.24(1)	Table 5.25(1)
		Financial Cash Flow	Table 5.23(2)	Table 5.24(2)	Table 5.25(2)
0.90	0.10	DCF Cash Flow	Table 5.26(1)	Table 5.27(1)	Table 5.28(1)
		Financial Cash Flow	Table 5.26(2)	Table 5.27(2)	Table 5.28(2)
0.9999	0.001	DCF Cash Flow	Table 5.29(1)	Table 5.30(1)	Table 5.31(1)
		Financial Cash Flow	Table 5.29(2)	Table 5.30(2)	Table 5.31(2)

3.3 Coal sale price and operation soundness

DCF and financial cash flows at 2% foreign loan interest for Case 3 with fixed assets revalued are presented as follows:

Price (Tg/t)		Debt(0.001)	Debt(0.800)	Debt(0.999)
(1) 6,086.0	DCF C.F. *1	Table 5.32(1)	Table 5.33(1)	Table 5.34(1)
	F.C.F. *2	Table 5.32(2)	Table 5.33(2)	Table 5.34(2)
(2) 6,076.5	DCF C.F.	Table 5.35(1)	Table 5.36(1)	Table 5.37(1)
	F.C.F.	Table 5.35(2)	Table 5.36(2)	Table 5.37(2)
(3) 5,304.5	DCF C.F.	Table 5.38(1)	Table 5.39(1)	Table 5.40(1)
	F.C.F.	Table 5.38(2)	Table 5.39(2)	Table 5.40(2)
(4) 5,181.7	DCF C.F.	Table 5.41(1)	Table 5.42(1)	Table 5.43(1)
	F.C.F.	Table 5.41(2)	Table 5.42(2)	Table 5.43(2)
(5) 5,175.4	DCF C.F.	Table 5.44(1)	Table 5.45(1)	Table 5.46(1)
	F.C.F.	Table 5.44(2)	Table 5.45(2)	Table 5.46(2)
(6) 5,189.6	DCF C.F.	Table 5.47(1)	Table 5.48(1)	Table 5.49(1)
	F.C.F.	Table 5.47(2)	Table 5.48(2)	Table 5.49(2)

*1 DCF C.F.: DCF Cash Flow

*2 F.C.F. : Financial Cash Flow

(1) Economic coal value

(2) Critical price of loan repaid on a 99.9% debt

(3) 10% FIRR on equity on a 80% debt

(4) Critical price of loan repaid on a 80% debt

(5) 8% FIRR on equity on a 80% debt

(6) Critical price of loan repaid on a 80% debt (without fixed assets revalued)

Table 5.3 (2)

EQUIPMENT:
NON EVALUATION OF COSTS

SITVEZ ORO DALL HINE REMEDIATION PROJECT

FINANCIAL ANALYSIS
FRENCH'S LOCAL CHEMISTRY
(REMEDIATION COSTS)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	TOTAL	
FRENCH CHEMISTRY (100%)																													
Materials & Energy	145.5	107.1	87.8	66.2	1,201.2	1,165.7	871.5	1,077.1	515.8	0.0	538.2	371.5	273.5	1,478.1	140.8	0.0	493.2	127.7	1,721.3	697.0	66.0	528.9	14,452.4						
Overhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Contractor's Profit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sub-Total	145.5	107.1	87.8	66.2	1,201.2	1,165.7	871.5	1,077.1	515.8	0.0	538.2	371.5	273.5	1,478.1	140.8	0.0	493.2	127.7	1,721.3	697.0	66.0	528.9	14,452.4						
Materials & Energy	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Overhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Contractor's Profit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sub-Total	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Materials & Energy	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Overhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Contractor's Profit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sub-Total	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Materials & Energy	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Overhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Contractor's Profit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sub-Total	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Materials & Energy	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Overhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Contractor's Profit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sub-Total	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Materials & Energy	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Overhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Contractor's Profit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sub-Total	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Materials & Energy	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Overhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Contractor's Profit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sub-Total	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Materials & Energy	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						
Overhead	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Contractor's Profit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Sub-Total	68.4	48.4	38.4	28.4	1,047.3	1,011.8	750.9	967.9	450.8	0.0	471.3	325.5	237.3	1,307.8	124.8	0.0	444.8	107.7	1,503.3	593.9	56.0	449.9	40,841.5						

Table 5.12 Coal Price VS EIRR

Shivee Ovoo Coal Mine

Price (Tg/t)	EIRR (%)	Price (Tg/t)	EIRR (%)
3,000	-1.3	5,000	31.5
100	0.3	100	33.6
200	1.8	200	35.8
300	3.3	300	38.1
400	4.8	400	40.5
500	6.3	500	43.1
600	7.8	600	45.8
700	9.3	700	48.8
800	10.8	800	52.0
900	12.4	900	55.0
4,000	13.9	6,000	59.4
100	15.5	100	63.7
200	17.1	200	68.7
300	18.7	300	74.7
400	20.4	400	82.1
500	22.1	500	92.5
600	23.8	6,600	136.9
700	25.7		
800	27.5		
900	29.5		

Table 5.13 Discount Rate VS Net Present Value at 6,086.0 Tg/t

Shivee Ovoo Coal Mine

D/R (%)	6,086.0 Tg/t	D/R (%)	6,086.0 Tg/t
0	123,670.3	25	6,093.6
1	105,539.0	26	5,535.9
2	90,468.8	27	5,032.8
3	77,885.1	28	4,578.1
4	67,329.9	29	4,166.5
5	58,436.6	30	3,793.3
6	50,910.8	35	2,376.4
7	44,514.9	40	1,475.9
8	39,056.6	45	890.5
9	34,379.5	50	504.1
10	30,356.0	55	247.0
11	26,881.4	60	75.5
12	23,869.8	65	-38.1
13	21,250.2		
14	18,963.6		
15	16,961.2		
16	15,202.1		
17	13,651.9		
18	12,281.9		
19	11,067.8		
20	9,989.0		
21	9,027.9		
22	8,169.8		
23	7,401.7		
24	6,712.8		

