15.3 Analysis and Evaluation of Financial Statement

15.3.1 Assumption of analysis and evaluation of financial statement

The financial analysis is made on the basis of the following assumptions:

(1) Minimum cash requirement

Minimum cash requirement is retained in the account. The said amount is assumed to be 3 % of the annual sales amount during a period of the financial projection years.

(2) Accounts receivable

The amount of the accounts receivable is assumed to be 4 % of the annual sales amount (0.5 month of sales amount) during a period of the financial projection years.

(3) Inventories

1) Raw materials and manufacturing supplies
12.5 % of the amount of raw materials to be consumed in next year (1.5 months' consumption) is assumed as the year end inventories of raw materials.

25 % of the amount of manufacturing supplies to be consumed in next year (3 months' consumption) is assumed as the year end inventories of raw materials.

2) Finished products and semi-finished products
4 % of the annual sales amount (0.5 month of sales amount) during a period of financial projection is assumed as the year end inventories of finished products and semi-finished products.

(4) Account payable

Account payable is taken into consideration in the account payable which is indicated as the net amount where the account payable is offset.

(5) Corporate income tax payable

Corporate income tax incurred in a year is assumed to be paid in the following year.

15.3.2 Methodology for the evaluation of the investment fund efficiency

The investment fund efficiency is evaluated in terms of internal rate of return (IRR) by using the discounted cash flow method (DCF method).

(1) Definition of IRR using DCF method

The general formula is expressed as follows:

$$\sum_{t=0}^{n} \frac{It}{(1+R)^t} = \sum_{t=0}^{n} \frac{St}{(1+R)^t}$$

where, in the case of return of investment (ROI)

R : IRR

It : Amount of total investment in the t-th year

St : Cash flow (Return) in the t-th year

Cash flow means profit after tax + depreciation cost + amortization cost of deferred asset + interest expense on long-term loan and short-term loan + book value of fixed asset and inventory asset at the projection year end + working capital at the projection year end - yearly additional working capital.

Note: The fixed assets and inventories assets remaining at the projection year end are assumed to be sold at the book value.

15.3.3 Financial analysis for the Original Case

Based on the above-mentioned assumptions and data, the financial analysis is made for the Original Case hereunder.

(1) Financial statements

1) Cost of products

The costs of products consisting of production cost described in Chapter 14 ESTIMATION OF PRODUCTION COST and non-operating expenses (NOE) are summarized as shown in Table 15-3-1.

Table 15-3-1 Cost of Products per Ton (Original Case)

(US$ per ton of steel bars)

	5th year	10th year
Iron oxide	74.7	74.7
Energy (gas & electricity)	53.6	53.6
Other materials	50.5	50.5
Variable cost	178.8	178.8
Fixed cost	79.8	76.5
Total production cost	268.6	255.3
NOE	30.4	2.7
Total cost	299.0	258.0

2) Profit and loss statement

The profit & loss statement by year for the Original Case is shown in Table 15-3-3. As shown in the following table (Table 15-3-2), the Steel Complex will suffer from cumulative loss until the 4th operational year.

Table 15-3-2 Profit and Loss (Original Case)

(US$ million)

Year	1	2	3	4	5	10
Sales Amount	253	326	356	356	356	362
Net Profit	(-) 32	(-) 7	8	14	20	62
Profit/sales (%)			(2%)	(4%)	(6%)	(17%)
Cumulative profit	(-) 32	(-) 39	(-) 31	(-) 17	3	232

3) Cash flow

Cash flow projection by year for the Original Case is shown in Table 15-3-4.

4) Balance sheet

Balance sheet by year for the Original Case is shown in Table 15-3-5.

5) Key financial ratios

The key financial ratios in balance sheet such as debt equity ratio and current ratio are as follows:.

Year	1	2	3	4	5	10
debt-equity	73:27	74:26	70:30	66:34	60:40	0:100
current ratio	-	1.1	0.9	0.8	0.8	-
debt service coverage ratio	1.27	1.41	0.86	0.89	0.86	1.54

Notes: (1) Debt equity ratio --- Debt/(Debt + Equity) x 100 : Equity/(Debt + Equity) x 100

(2) Current ratio -- Current assets/Current liabilities x 100

(3) Debt service coverage ratio --- Debt service (repayment + interest payment)/ (net profit + interest)

6) IRR

IRR of the Original Case is as follows:

	(after tax base)	(before tax base)
IRR (on Investment):	11.0%	11.2%
IRR (on Equity):	11.3%	11.6%

In comparison with the assumed interest of 9% p.a. for finance and also projected profit & loss as well as projected cash flow it is difficult to judge that this Steel Complex Project in the Original Case is feasible commercially.

Especially, the debt service coverage ratio is less than 1.0 until the 7th operational year.

Judging from the above profit and loss projection and IRR, it will be very difficult to invite and organize financing as a commercial project.

The calculation of IRR is shown in Table 15-3-6.

7) Sensitivity analysis

Sensitivity analysis is made against the Original Case in the following conditions:

Capital Investment	IRR (on Investment)
Base	11.0%
10% up	9.9%
10% down	12.3%

Pellet Price	
Base	11.0%
10% up	9.9%
10% down	12.1%

Sales Price of Bar	
Base	11.0%
5% up	13.1%
5% down	8.8%

Natural Gas	
Base (US$ 0.8/MMBTU)	11.0%
US$ 0.5	11.5%
US$ 0.6	11.4%
US$ 0.7	11.2%

Electricity	
Base (US$ 0.0416/kWh)	11.0%
US$ 0.02	14.1%
US$ 0.025	13.4%
US$ 0.03	12.7%

Interest rate of long-term loans	IRR (on investment)	IRR (on equity)
Base (9% p.a.)	11.0%	11.3%
8.0 % p.a.	11.0%	12.1%
8.5 % p.a.	11.0%	11.7%

Table 15-3-3 Profit and Loss Statement (Original Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sales Revenue	253.2	326.3	356.4	356.4	356.4	356.4	356.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4
Variable Cost	145.7	190.0	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1	208.1
Marginal Profit	107.5	136.2	148.3	148.3	148.3	148.3	148.3	154.2	154.2	154.2	154.2	154.2	154.2	154.2	154.2	154.2	154.2	154.2	154.2	154.2
Labour Cost	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Depreciation	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1			
Amortization	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2					
Maintenance	8.1	10.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
other Fixed Costs	19.7	20.8	21.3	20.0	20.0	18.6	18.6	17.4	16.1	16.1	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
Total Fixed Cost	89.2	92.8	94.3	92.9	92.9	91.6	91.6	90.4	89.1	89.1	86.4	86.4	86.4	86.4	86.4	80.2	80.2	41.1	41.1	41.1
Operating Profit	18.2	43.4	54.0	55.3	55.3	56.6	56.6	63.8	65.1	65.1	67.8	67.8	67.8	67.8	67.8	74.0	74.0	113.1	113.1	113.1
Interest	50.0	50.0	46.5	41.0	35.4	29.2	22.2	15.5	9.3	3.1										
Profit before Tax	-31.8	-6.6	7.5	14.4	19.9	27.5	34.4	48.3	55.9	62.0	67.8	67.8	67.8	67.8	67.8	74.0	74.0	113.1	113.1	113.1
Tax											5.1	5.1	5.1	5.1	5.1	5.5	5.5	8.5	8.5	8.5
Net Profit	-31.8	-6.6	7.5	14.4	19.9	27.5	34.4	48.3	55.9	62.0	62.7	62.7	62.7	62.7	62.7	68.4	68.4	104.6	104.6	104.6
Cumulative Profit	-31.8	-38.4	-30.9	-16.5	3.4	30.9	65.3	113.7	169.6	231.6	294.3	357.0	419.7	482.4	545.0	613.5	681.9	786.5	891.2	995.8

Table 15-3-4 Cash Flow (Original Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Uses Of Funds																				
Minimum Cash in Hand	7.6	9.8	10.7	10.7	10.7	10.7	10.7	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Increase in Working Capital	26.5	8.3	2.5					0.5												
Loan (long) Repayment			81.9	81.9	81.9	81.9	81.9	81.9	81.9	81.9										
Loan (short) Repayment																				
Interest (L-Loans)	59.0	59.0	55.3	47.9	40.6	33.2	25.8	18.4	11.1	3.7										
Interest (S-Loan)																				
Corporate Tax												7.4	7.4	7.4	7.4	7.4	7.9	7.9	11.4	11.4
Total	93.1	77.1	150.4	140.5	133.2	125.8	118.4	111.7	103.8	96.5	10.9	18.2	18.2	18.2	18.2	18.2	18.8	18.8	22.3	22.3
Sources of Funds																				
Cash & Deposit (begin.)	7.6	11.1	67.8	66.8	76.9	94.4	120.7	154.2	201.9	258.7	322.9	475.3	620.4	765.5	910.6	1,055.7	1,200.8	1,345.3	1,489.9	1,630.9
Equity Capital																				
Loan (long-term)																				
Loan (short-term)																				
Operating Profit	34.6	69.7	84.3	85.6	85.6	86.9	86.9	94.1	95.4	95.4	98.0	98.0	98.0	98.0	98.0	105.1	105.1	152.4	152.4	152.4
Depreciation	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4			
Amortization	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0					
Total	96.6	135.1	206.5	206.8	216.9	235.8	262.0	302.7	351.7	408.5	475.3	627.8	772.9	917.9	1,063.0	1,208.1	1,353.2	1,497.8	1,642.3	1,783.3
Surplus/Deficit	3.5	58.0	56.1	66.2	83.7	110.0	143.6	191.0	247.8	312.0	464.5	609.5	754.6	899.7	1,044.8	1,189.9	1,334.5	1,479.0	1,620.0	1,761.0
Cash & Deposit	11.1	67.8	66.8	76.9	94.4	120.7	154.2	201.9	258.7	322.9	475.3	620.4	765.5	910.6	1,055.7	1,200.8	1,345.3	1,489.9	1,630.9	1,771.9

Table 15-3-5 Balance Sheet (Original Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Assets																				
Cash & Deposit	7.6	25.0	10.7	10.7	10.7	10.7	10.7	34.6	67.2	106.0	219.1	327.2	435.2	543.2	651.2	759.2	866.8	974.3	1,078.9	1,183.6
Account Receivable	21.1	27.2	29.7	29.7	29.7	29.7	29.7	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2
Inventories	23.3	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6
Fixed Assets	625.9	586.8	547.6	508.5	469.4	430.3	391.2	352.1	312.9	273.8	234.7	195.6	156.5	117.4	78.2	39.1				
Deferred Assets	86.9	80.7	74.5	68.3	62.1	55.9	49.7	43.5	37.3	31.1	24.8	18.6	12.4	6.2						
Total	764.9	745.3	688.1	642.8	597.5	552.2	506.8	485.9	473.2	466.7	534.5	597.1	659.8	722.5	785.2	854.1	922.5	1,030.1	1,134.7	1,239.3
Liabilities & Capital																				
Account Payable																				
Tax Payable											5.1	5.1	5.1	5.1	5.1	5.5	5.5	8.5	8.5	8.5
Short-term Loan	13.0		3.9	12.8	16.1	11.9	0.7													
Long-term Loan	548.6	548.6	480.0	411.4	342.9	274.3	205.7	137.1	68.6											
Capital	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1
Cumulative Profit	-31.8	-38.4	-30.9	-16.5	3.4	30.9	65.3	113.7	169.6	231.6	294.3	357.0	419.7	482.4	545.0	613.5	681.9	786.5	891.2	995.8
Total	764.9	745.3	688.1	642.8	597.5	552.2	506.8	485.9	473.2	466.7	534.5	597.1	659.8	722.5	785.2	854.1	922.5	1,030.1	1,134.7	1,239.3

Table 15-3-6 Calculation of IRR (Original Case)

(Post-Tax Basis)

IRR(%)= 11.02 (Unit:1,000US$)

(ON INVESTMENT) *(EXCLUDING IDC,INCLUDING WC)*

YEAR	INVESTMENT	CASH INFLOW	NET FLOW	NET PV
-3	170,250		-170,250	-170,250
-2	271,000		-271,000	-244,099
-1	273,651		-273,651	-222,019
1		63,559	63,559	46,448
2		88,748	88,748	58,418
3		99,332	99,332	58,894
4		100,652	100,652	53,753
5		100,652	100,652	48,417
6		101,972	101,972	44,183
7		101,972	101,972	39,797
8		109,140	109,140	38,366
9		110,460	110,460	34,975
10		110,460	110,460	31,503
11		108,017	108,017	27,749
12		108,017	108,017	24,994
13		108,017	108,017	22,513
14		108,017	108,017	20,278
15		108,017	108,017	18,265
16		107,551	107,551	16,381
17		107,551	107,551	14,755
18		104,617	104,617	12,928
19		104,617	104,617	11,645
20		104,617	104,617	10,489
RESIDUAL		17,901	17,901	1,617
(TOTAL)	714,901	2,073,885	1,358,984	0

IRR(%)= 11.28 (Unit:1,000US$)

(ON EQUITY)

YEAR	INVESTMENT	CASH INFLOW	NET FLOW	NET PV
-3	58,769		-58,769	-58,769
-2	117,539		-117,539	-105,625
-1	58,769		-58,769	-47,460
1		0	0	0
2		17,404	17,404	11,350
3		-14,307	-14,307	-8,385
4		0	0	0
5		0	0	0
6		0	0	0
7		0	0	0
8		23,913	23,913	8,213
9		32,632	32,632	10,072
10		38,803	38,803	10,762
11		113,100	113,100	28,190
12		108,017	108,017	24,194
13		108,017	108,017	21,742
14		108,017	108,017	19,538
15		108,017	108,017	17,558
16		108,017	108,017	15,778
17		107,551	107,551	14,118
18		107,551	107,551	12,687
19		104,617	104,617	11,090
20		104,617	104,617	9,966
RESIDUAL		58,157	58,157	4,979
(TOTAL)	235,078	1,234,121	999,043	0

15.3.4 Financial analysis for the Recommended Case

In consideration of the commercially difficult feasibility of the Original Case and based on the above-mentioned assumptions and data, the financial analysis is made for the Recommended Case hereunder.

(1) Financial statements

1) Cost of products

The costs of products consisting of production cost described in Chapter 14 ESTIMATION OF PRODUCTION COST and non-operating expenses (NOE) are summarized as shown in Table 15-3-7.

Table 15-3-7 Cost of Products per Ton (Recommended Case)

(US$ per ton of steel bars)

	5th year	10th year
Iron oxide	74.7	74.7
Energy (gas & electricity)	33.7	33.7
Other materials	50.5	50.5
Variable cost	158.9	158.9
Fixed cost	79.8	76.5
Total production cost	238.7	235.4
NOE	29.2	2.7
Total cost	267.9	238.1

2) Profit and loss statement

The profit and loss statement by year for the Recommended Case is shown in Table 15-3-9.

As shown in the table (Table 15-3-8), the Steel Complex will enjoy a substantial net profit from the second operational year, while suffering from deficit in the first year due to lower operation rate on the way of the learning curve.

Table 15-3-8 Profit and Loss Statement (Recommended Case)

(US$ million)

Year	1	2	3	4	5	10
Sales Amount	253	326	356	356	356	362
Net Profit	(-) 14	15	30	38	44	85
Profit/Sales (%)		(5%)	(8%)	(10%)	(12%)	(23%)
Cumulative Profit	(-) 14	1	31	69	113	460

3) Cashflow

Cashflow projection by year for the Recommended Case is shown in Table 15-3-10.

4) Balance sheet

Balance sheet by year for the Recommended Case is shown in Table 15-3-11.

5) Key financial ratios

The key financial ratios in balance sheet such as debt equity ratio and current ratio are as follows:.

Year	1	2	3	4	5	10
debt-equity	71:29	70:30	64:36	57:43	49:51	0:100
current ratio	-	1.7	1.8	2.0	2.3	-
debt service coverage ratio	1.62	2.23	1.07	1.14	1.21	1.30

Notes: (1) Debt equity ratio --- Debt/(Debt + Equity) x 100 : Equity/(Debt + Equity) x 100

(2) Current ratio --- Current assets/Current liabilities x 100

(3) Debt service coverage ratio --- Debt service (repayment + interest payment)/ (net profit + interest)

6) IRR

IRR of the Recommended Case is as follows:

	(after tax base)	(before tax base)
IRR (on Investment):	13.7%	13.9%
IRR (on Equity):	16.1%	16.4%

In comparison with the assumed interest of 9% p.a. for finance and also projected profit & loss as well as projected cash flow it is judged that this Steel Complex Project

is feasible and deserve to take further steps for its materialization.

The debt service coverage ratio is kept always at more than 1.0.

The calculation of IRR is shown in Table 15-3-12.

7) Sensitivity analysis

Sensitivity analysis is made against the Recommended Case in the following conditions:

Capital Investment	IRR (on Investment)
Base	13.7%
10% up	12.5%
10% down	15.1%
Pellet Price	
Base	13.7%
10% up	12.7%
10% down	14.7%
Sales Price of Bar	
Base	13.7%
5% up	15.6%
5% down	11.7%
Natural Gas	
Base (US$ 0.6/MMBTU)	13.7%
US$ 0.65	13.6%
US$ 0.70	13.5%
US$ 0.75	13.3%
US$ 0.80	13.2%
Electricity	
Base (US$ 0.025/kWh)	13.7%
US$ 0.02	14.3%
US$ 0.03	13.0%
US$ 0.03	12.7%

Interest rate of long-term loans

	IRR (on investment)	IRR (on equity)
Base (9% p.a.)	13.7%	16.1%
8.0 % p.a.	13.7%	17.0%
8.5 % p.a.	13.7%	16.6%

Table 15-3-9 Profit and Loss Statement (Recommended Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sales Revenue	253.2	326.3	356.4	356.4	356.4	356.4	356.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4
Variable Cost	129.5	168.9	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0
Marginal Profit	123.7	157.4	171.4	171.4	171.4	171.4	171.4	177.4	177.4	177.4	177.4	177.4	177.4	177.4	177.4	177.4	177.4	177.4	177.4	177.4
Labour Cost	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Depreciation	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1			
Amortization	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2					
Maintenance	8.1	10.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
other Fixed Costs	19.7	20.8	21.3	20.0	20.0	18.6	18.6	17.4	16.1	16.1	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4	13.4
Total Fixed Cost	89.2	92.8	94.3	92.9	92.9	91.6	91.6	90.4	89.1	89.1	86.4	86.4	86.4	86.4	86.4	80.2	80.2	41.1	41.1	41.1
Operating Profit	34.5	64.6	77.2	78.5	78.5	79.8	79.8	87.0	88.3	88.3	90.9	90.9	90.9	90.9	90.9	97.2	97.2	136.3	136.3	136.3
Interest	49.4	49.4	46.3	40.1	33.9	27.8	21.6	15.4	9.3	3.1										
Profit before Tax	-14.9	15.2	30.9	38.4	44.6	52.0	58.2	71.6	79.0	85.2	90.9	90.9	90.9	90.9	90.9	97.2	97.2	136.3	136.3	136.3
Tax											6.8	6.8	6.8	6.8	6.8	7.3	7.3	10.2	10.2	10.2
Net Profit	-14.9	15.2	30.9	38.4	44.6	52.0	58.2	71.6	79.0	85.2	84.1	84.1	84.1	84.1	84.1	89.9	89.9	126.1	126.1	126.1
Cumulative Profit	-14.9	0.3	31.2	69.6	114.1	166.2	224.4	295.9	375.0	460.2	544.3	628.4	712.6	796.7	880.8	970.7	1,060.5	1,186.6	1,312.6	1,438.7

Table 15-3-10 Cash Flow (Recommended Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Uses Of Funds																				
Minimum Cash in Hand	7.6	9.8	10.7	10.7	10.7	10.7	10.7	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Increase in Working Capital	26.5	8.3	2.5					0.5												
Loan (long) Repayment			68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6										
Loan (short) Repayment																				
Interest (L-Loans)	49.4	49.4	46.3	40.1	33.9	27.8	21.6	15.4	9.3	3.1										
Interest (S-Loan)																				
Corporate Tax												6.8	6.8	6.8	6.8	6.8	7.3	7.3	10.2	10.2
Total	83.5	67.5	128.1	119.4	113.2	107.0	100.9	95.4	88.7	82.5	10.9	17.7	17.7	17.7	17.7	17.7	18.2	18.2	21.1	21.1
Sources of Funds																				
Cash & Deposit (begin.)	7.6	11.5	63.7	68.8	83.9	105.3	134.1	169.0	216.9	272.7	334.6	470.9	600.4	729.8	859.3	988.7	1,118.2	1,247.1	1,376.1	1,502.2
Equity Capital																				
Loan (long-term)																				
Loan (short-term)																				
Operating Profit	34.5	64.6	77.2	78.5	78.5	79.8	79.8	87.0	88.3	88.3	90.9	90.9	90.9	90.9	90.9	97.2	97.2	136.3	136.3	136.3
Depreciation	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1	39.1			
Amortization	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2					
Total	87.4	121.4	186.2	192.6	207.8	230.4	259.2	301.3	350.5	406.3	470.9	607.2	736.6	866.1	995.5	1,125.0	1,254.4	1,383.4	1,512.4	1,638.4
Surplus/Deficit	3.9	53.9	58.1	73.3	94.6	123.4	158.3	206.0	261.8	323.8	460.0	589.5	718.9	848.4	977.8	1,107.3	1,236.3	1,365.3	1,491.3	1,617.4
Cash & Deposit	11.5	63.7	68.8	83.9	105.3	134.1	169.0	216.9	272.7	334.6	470.9	600.4	729.8	859.3	988.7	1,118.2	1,247.1	1,376.1	1,502.2	1,628.2

Table 15-3-11 Balance Sheet (Recommended Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Assets																				
Cash & Deposit	11.5	63.7	68.8	83.9	105.3	134.1	169.0	216.9	272.7	334.6	470.9	600.4	729.8	859.3	988.7	1,118.2	1,247.1	1,376.1	1,502.2	1,628.2
Account Receivable	21.1	27.2	29.7	29.7	29.7	29.7	29.7	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2
Inventories	23.3	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6
Fixed Assets	625.9	586.8	547.6	508.5	469.4	430.3	391.2	352.1	312.9	273.8	234.7	195.6	156.5	117.4	78.2	39.1				
Deferred Assets	86.9	80.7	74.5	68.3	62.1	55.9	49.7	43.5	37.3	31.1	24.8	18.6	12.4	6.2						
Total	768.7	783.9	746.3	716.1	692.0	675.5	665.2	668.1	678.6	695.3	786.2	870.3	954.5	1,038.6	1,122.7	1,213.0	1,302.9	1,431.9	1,557.9	1,684.0
Liabilities & Capital																				
Account Payable																				
Tax Payable											6.8	6.8	6.8	6.8	6.8	7.3	7.3	10.2	10.2	10.2
Short-term Loan																				
Long-term Loan	548.6	548.6	480.0	411.4	342.9	274.3	205.7	137.1	68.6											
Capital	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1	235.1
Cumulative Profit	-14.9	0.3	31.2	69.6	114.1	166.2	224.4	295.9	375.0	460.2	544.3	628.4	712.6	796.7	880.8	970.7	1,060.5	1,186.6	1,312.6	1,438.7
Total	768.7	783.9	746.3	716.1	692.0	675.5	665.2	668.1	678.6	695.3	786.2	870.3	954.5	1,038.6	1,122.7	1,213.0	1,302.9	1,431.9	1,557.9	1,684.0

Table 15-3-12 Calculation of IRR (Recommended Case)

(Post-Tax Basis)

IRR(%)= 13.71 (Unit:1,000US$)

(ON INVESTMENT) *(EXCLUDING IDC,INCLUDING WC)*

YEAR	INVESTMENT	CASH INFLOW	NET FLOW	NET PV
-3	170,250		-170,250	-170,250
-2	271,000		-271,000	-238,323
-1	273,651		-273,651	-211,636
1		79,779	79,779	54,260
2		109,904	109,904	65,735
3		122,504	122,504	64,436
4		123,824	123,824	57,277
5		123,824	123,824	50,371
6		125,144	125,144	44,769
7		125,144	125,144	39,371
8		132,311	132,311	36,606
9		133,631	133,631	32,514
10		133,631	133,631	28,593
11		129,451	129,451	24,359
12		129,451	129,451	21,421
13		129,451	129,451	18,838
14		129,451	129,451	16,567
15		129,451	129,451	14,569
16		128,985	128,985	12,766
17		128,985	128,985	11,227
18		126,051	126,051	9,649
19		126,051	126,051	8,485
20		126,051	126,051	7,462
RESIDUAL		17,901	17,901	932
(TOTAL)	714,901	2,510,972	1,796,072	0

IRR(%)= 16.09 (Unit:1,000US$)

(ON EQUITY)

YEAR	INVESTMENT	CASH INFLOW	NET FLOW	NET PV
-3	58,769		-58,769	-58,769
-2	117,539		-117,539	-101,246
-1	58,769		-58,769	-43,606
1		3,865	3,865	2,470
2		52,216	52,216	28,747
3		5,134	5,134	2,435
4		15,139	15,139	6,184
5		21,310	21,310	7,498
6		28,802	28,802	8,730
7		34,973	34,973	9,131
8		47,817	47,817	10,754
9		55,803	55,803	10,810
10		61,975	61,975	10,341
11		136,271	136,271	19,587
12		129,451	129,451	16,027
13		129,451	129,451	13,806
14		129,451	129,451	11,892
15		129,451	129,451	10,244
16		129,451	129,451	8,824
17		128,985	128,985	7,573
18		128,985	128,985	6,523
19		126,051	126,051	5,491
20		126,051	126,051	4,730
RESIDUAL		56,419	56,419	1,824
(TOTAL)	235,078	1,677,048	1,441,971	0

15.4 Supplement Studies

In this section, the financial analyses for the following three cases are presented.

1) Alternative Case with own power plant

2) Optimum scenario of Original Case

Sales price of steel bars	:	provable market price under the recovered and improved steel market
Other assumptions and conditions	:	same as of the Original Case

3) Optimum scenario of Recommended Case

Sales price of steel bars	:	provable market price under the recovered and improved steel market
Other assumptions and conditions	:	same as of the Recommended Case

15.4.1 Alternative case with own power plant

In this case, it is assumed that the Steel Complex have its own power plant and generate electricity as per the following assumption.
The other conditions and assumptions are same as of the Recommended Case.

(1) Assumption of own power plant

1) Plant construction cost
In consideration of actual construction cost of US$ 600/kW capacity in the past, projected cost of gas-fired CCGT (combined-cycle gas turbine) by OECD/IEA, and small scale of this power plant, the construction cost of the power plant (200 MW CCGT) is at US$ 140 million. (US$ 700/kW capacity)

(" Gas-fired CCGT overnight capital costs are lower than US$ 800/kW in both OECD and non-OECD countries." according to Projected Costs of Generating Electricity - Update 1998 issued by OECD/IEA)

2) Cost of natural gas
The unit consumption of natural gas is assumed 10,100 BTU/kWh. (heat efficiency: approx. 34%)

3) Operating and maintenance cost

It is assumed that the annual operating and maintenance cost is 5% of the plant construction cost.

(2) Results of financial analysis

The results of the financial analysis show;

1) Total investment cost and fund requirement

The estimated total investment cost and fund raising is as follows:

Table 15-4-1 Total Investment Cost & Finance Plan (Alternative Case)

(unit: US$ million)

Fund Demand	
Capital Investment	805
Pre-production cost	32
IDC	74
Initial working capital	25
Total	936
Fund raising	
Long-term loans	655
Equity capital	281
Total	936

2) Profit and loss projection

The projected profit and loss for this case is as shown hereunder.

Table 15-4-2 Profit and Loss (Alternative Case)

(US$ million)

Year	1	2	3	4	5	10
Sales Amount	253	326	356	356	356	362
Net Profit	(-) 23	11	29	38	45	91
(%)		(3%)	(8%)	(11%)	(13%)	(25%)

The details of Profit & Loss Projection, Cashflow and Balance Sheet are shown in Table 15-4-3, Table 15-4-4 and Table 15-4-5.

3) IRR

IRR of this case is as follows:

	(after tax base)	(before tax base)
IRR (on Investment):	12.8%	13.0%
IRR (on Equity):	14.7%	15.0%

In this case, the Steel Complex may attain a certain level of profit and IRR.
However, the total investment cost is US$ 936 million, much larger than US$ 783 million of the Recommended Case.

Table 15-4-3 Profit and Loss Statement (Alternative Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Sales Revenue	253.2	326.3	356.4	356.4	356.4	356.4	356.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4	362.4
Variable Cost	113.3	147.7	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8	161.8
Marginal Profit	139.9	178.5	194.6	194.6	194.6	194.6	194.6	200.5	200.5	200.5	200.5	200.5	200.5	200.5	200.5	200.5	200.5	200.5	200.5	200.5
Labour Cost	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Depreciation	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4			
Amortization	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0					
Maintenance	8.1	10.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
other Fixed Costs	26.7	27.8	28.3	27.0	27.0	25.6	25.6	24.4	23.1	23.1	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
Total Fixed Cost	105.3	108.9	110.3	109.0	109.0	107.7	107.7	106.5	105.1	105.1	102.5	102.5	102.5	102.5	102.5	95.5	95.5	48.1	48.1	48.1
Operating Profit	34.6	69.7	84.3	85.6	85.6	86.9	86.9	94.1	95.4	95.4	98.0	98.0	98.0	98.0	98.0	105.1	105.1	152.4	152.4	152.4
Interest	59.0	59.0	55.3	47.9	40.6	33.2	25.8	18.4	11.1	3.7										
Profit before Tax	-24.4	10.7	29.0	37.7	45.0	53.7	61.1	75.6	84.3	91.7	98.0	98.0	98.0	98.0	98.0	105.1	105.1	152.4	152.4	152.4
Tax											7.4	7.4	7.4	7.4	7.4	7.9	7.9	11.4	11.4	11.4
Net Profit	-24.4	10.7	29.0	37.7	45.0	53.7	61.1	75.6	84.3	91.7	90.7	90.7	90.7	90.7	90.7	97.2	97.2	141.0	141.0	141.0
Cumulative Profit	-24.4	-13.7	15.3	52.9	98.0	151.7	212.8	288.5	372.8	464.5	555.2	645.9	736.6	827.3	917.9	1,015.1	1,112.3	1,253.4	1,394.4	1,535.4

Table 15.4-4 Cash Flow (Alternative Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Uses Of Funds																				
Minimum Cash in Hand	7.6	9.8	10.7	10.7	10.7	10.7	10.7	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9	10.9
Increase in Working Capital	26.5	8.3	2.5					0.5												
Loan (long) Repayment			81.9	81.9	81.9	81.9	81.9	81.9	81.9	81.9										
Loan (short) Repayment																				
Interest (L-Loans)	59.0	59.0	55.3	47.9	40.6	33.2	25.8	18.4	11.1	3.7										
Interest (S-Loan)																				
Corporate Tax												7.4	7.4	7.4	7.4	7.4	7.9	7.9	11.4	11.4
Total	93.1	77.1	150.4	140.5	133.2	125.8	118.4	111.7	103.8	96.5	10.9	18.2	18.2	18.2	18.2	18.2	18.8	18.8	22.3	22.3
Sources of Funds																				
Cash & Deposit (begin.)	7.6	11.1	67.8	66.8	76.9	94.4	120.7	154.2	201.9	258.7	322.9	475.3	620.4	765.5	910.6	1,055.7	1,200.8	1,345.3	1,489.9	1,630.9
Equity Capital																				
Loan (long-term)																				
Loan (short-term)																				
Operating Profit	34.6	69.7	84.3	85.6	85.6	86.9	86.9	94.1	95.4	95.4	98.0	98.0	98.0	98.0	98.0	105.1	105.1	152.4	152.4	152.4
Depreciation	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4	47.4			
Amortization	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0					
Total	96.6	135.1	206.5	206.8	216.9	235.8	262.0	302.7	351.7	408.5	475.3	627.8	772.9	917.9	1,063.0	1,208.1	1,353.2	1,497.8	1,642.3	1,783.3
Surplus/Deficit	3.5	58.0	56.1	66.2	83.7	110.0	143.6	191.0	247.8	312.0	464.5	609.5	754.6	899.7	1,044.8	1,189.9	1,334.5	1,479.0	1,620.0	1,761.0
Cash & Deposit	11.1	67.8	66.8	76.9	94.4	120.7	154.2	201.9	258.7	322.9	475.3	620.4	765.5	910.6	1,055.7	1,200.8	1,345.3	1,489.9	1,630.9	1,771.9

Table 15-4-5 Balance Sheet (Alternative Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Assets																				
Cash & Deposit	11.1	67.8	66.8	76.9	94.4	120.7	154.2	201.9	258.7	322.9	475.3	620.4	765.5	910.6	1,055.7	1,200.8	1,345.3	1,489.9	1,630.9	1,771.9
Account Receivable	21.1	27.2	29.7	29.7	29.7	29.7	29.7	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2
Inventories	23.3	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6
Fixed Assets	757.6	710.3	662.9	615.6	568.2	520.9	473.5	426.2	378.8	331.5	284.1	236.8	189.4	142.1	94.7	47.4				
Deferred Assets	98.7	91.6	84.6	77.5	70.5	63.4	56.4	49.3	42.3	35.2	28.2	21.1	14.1	7.0						
Total	911.8	922.5	869.6	825.3	788.4	760.2	739.4	733.2	735.6	745.4	843.4	934.1	1,024.8	1,115.5	1,206.2	1,303.9	1,401.1	1,545.7	1,686.7	1,827.7
Liabilities & Capital																				
Account Payable																				
Tax Payable											7.4	7.4	7.4	7.4	7.4	7.9	7.9	11.4	11.4	11.4
Short-term Loan																				
Long-term Loan	655.4	655.4	573.4	491.5	409.6	327.7	245.8	163.8	81.9											
Capital	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9	280.9
Cumulative Profit	-24.4	-13.7	15.3	52.9	98.0	151.7	212.8	288.5	372.8	464.5	555.2	645.9	736.6	827.3	917.9	1,015.1	1,112.3	1,253.4	1,394.4	1,535.4
Total	911.8	922.5	869.6	825.3	788.4	760.2	739.4	733.2	735.6	745.4	843.4	934.1	1,024.8	1,115.5	1,206.2	1,303.9	1,401.1	1,545.7	1,686.7	1,827.7

15.4.2 Optimum scenario of Original Case

The Optimum scenario of the Original Case adopts a provable market price under the recovered and improved steel market, while a rather conservative market price is applied for the Original Case in Chapter 15.3.3 " Financial Analysis for the Original Case" .
The other assumptions and conditions except sales price of steel bars are same as of the Original Case.

(1) Sales price and sales plan

In this scenario, C&F price of imported steel bars is assumed at US$ 305 per ton against US$ 300 per ton for the Original Case.

In addition, location advantage is assumed at US$ 15 per ton against US$ 10 for the Original Case.

Sales prices assumption

Domestic

	(US$/ton)	
CIF price of imported steel bars	305	
Import duty (5%)	15	
Location advantage	15	
Transportation cost to Dhofar area	(-) 3	(US$ 30/ton x 10%)
Ex-factory domestic price	332	

The location advantage represents the costs that importers would have to cover for (1) opening a letter of credit, (2) maintaining large storage yards and inventories, (3) buying reasonably large quantities to minimize unit import-related costs, and (4) handling charges before deliveries.

Export	(US$/ton)	
CIF price of imported steel bars	305	
Import duty		
(4% is accounted for GCC countries)	14	
Location advantage	15	
(applied for only UAE)		
(-) Transportation cost	- (T)	
Ex-factory export prices		
for UAE	324	
for Saudi, Kuwait, Bahrain	297	
for Yemen, Jordan, Syria, Kenya, Tanzania, Pakistan	275	
for Asia	265	
Weighted average export price	306	309.5
	(in 2005)	(in 2010)

The sales plan of the Steel Complex is summarized as follows:

Table 15-4-6 Sales Plan (Optimum Scenario)

Year	1st year			2nd year			3 - 7 year		
	Tonnage ('000 tons)	@ (US$/T)	Amount (mill. US$)	Tonnage ('000 tons)	@ (US$/T)	Amount (mill. US$)	Tonnage ('000 tons)	@ (US$/T)	Amount (mill. US$)
Domestic	400	332	132.8	400	332	132.8	400	332	132.8
Export	356.6	306	109.1	662.7	306	202.8	764	306	233.8
Total	756.6	319.7	241.9	1,062.7	315.8	335.6	1,164	314.9	366.6

Year	8th year and after		
	Tonnage ('000 tons)	@ (US$/T)	Amount (mill. US$)
Domestic	570	332	189.3
Export	594	309.5	183.8
Total	1,164	321	373.1

(2) Financial analysis

The results of the financial analysis are as follows:

1) Profit and loss projection

The projected profit and loss for this case is as shown hereunder.

Table 15-4-7 Profit and Loss (Optimum Scenario of Original Case)

(US$ million)

Year	1	2	3	4	5	10
Sales Amount	260	336	367	367	367	373
Net Profit	(-) 24	3	18	25	31	73
Profit/sales (%)		(1%)	(5%)	(7%)	(8%)	(20%)
Cumulative profit	(-) 24	(-) 21	(-)4	21	52	335

2) IRR

IRR of this case is as follows:

(after tax base)

IRR (on Investment) : 12.2%

IRR (on Equity) : 13.4%

In this case, the Steel Complex may enjoy higher profitability and IRR comparing with the Original Case. However, it might be difficult to rely on this Optimum scenario, which is not expected to realize at an earlier time, for the purpose to invite and convince possible investors and financiers.

Therefore, this case is presented for reference in this Study Report.

15.4.3 Optimum Scenario of Recommended Case

The Optimum scenario of the Recommended Case adopts a provable market price under the recovered and improved steel market, while is the same as of the Optimum Scenario of Original Case.

The other assumptions and conditions except sales price of steel bars are same as of the Recommended Case.

(1) Sales price and sales plan

The sales plan of the Steel Complex is summarized as follows:

Table 15-4-8 Sales Plan (Optimum Scenario of Recommended Case)

Year	1st year			2nd year			3 - 7 year		
	Tonnage ('000 tons)	@ (US$/T)	Amount (mill. US$)	Tonnage ('000 tons)	@ (US$/T)	Amount (mill. US$)	Tonnage ('000 tons)	@ (US$/T)	Amount (mill. US$)
Domestic	400	332	132.8	400	332	132.8	400	332	132.8
Export	356.6	306	109.1	662.7	306	202.8	764	306	233.8
Total	756.6	319.7	241.9	1,062.7	315.8	335.6	1,164	314.9	366.6

Year	8th year and after		
	Tonnage ('000 tons)	@ (US$/T)	Amount (mill. US$)
Domestic	570	332	189.3
Export	594	309.5	183.8
Total	1,164	321	373.1

(2) Financial analysis

The results of the financial analysis are as follows:

1) Profit and loss projection

The projected profit and loss for this case is as shown hereunder.

Table 15-4-9 Profit and Loss (Optimum Scenario of Recommended Case)

(US$ million)

Year	1	2	3	4	5	10
Sales Amount	260	336	367	367	367	373
Net Profit	(-) 7	24	41	48	54	96
(%)		(7%)	(11%)	(13%)	(15%)	(26%)
Cumulative profit	(-) 7	17	58	106	160	558

(2) IRR

IRR of this case is as follows:

		(after tax base)
IRR (on Investment)	:	14.8%
IRR (on Equity)	:	18.2%

In this case, the Steel Complex may enjoy higher profitability and IRR comparing with the Recommended Case. However, it might be difficult to rely on this Optimum scenario, which is not expected to realize at an earlier time, for the purpose to invite and convince possible investors and financiers.
Therefore, this case is presented for reference in this Study Report.

Chapter 16. NATIONAL ECONOMIC ANALYSIS

The expected effects of the Steel Complex are as follows:

1) to develop related and supporting industries
2) to increase employment opportunities directly and indirectly
3) to accelerate human resource development
4) to increase the GNP of Oman: value added
5) to save and earn foreign currencies

(1) Development of the related and supporting industries

By constructing the Steel Complex and operating the Steel Complex, various business activities, related & supporting industries will be encouraged and developed.

These industries include
- transportation industry
- stores and warehouse
- port related services
- maintenance and repair
- energy industries including IPP

In future, this Steel Complex Project leads to more development of other steel industries producing wire rods, higher grade steel bars and flat steel products, which can be part of the basis of industrialization and economic development of Oman.

(2) Creation of employment opportunities

This Project will create 1,239 jobs only for the operation of the Steel Complex.
During construction of the Steel Complex, a large number of jobs will be created.
For the indirect benefits, the number of employment opportunities could be several times of the said direct employment, when the effects on related industries are taken into account.

(3) Acceleration of human resource development

The Steel Complex requires various kind of technologies, skills and abilities for operation and management which will be developed through the actual operation and transferred from the technical and managerial cooperation of experienced steel companies in the initial operational

years.

For smooth and successful technology transfer, it is considered to be essential to arrange and develop the education and basic training systems in Oman.

(4) Increase of GNP

Through the operation of the Steel Complex, the GNP of Oman will be increased.

The expected added value of the Steel Complex is as follows:

Table 16-1-1 Expected Increase of GNP (value added)

(US$ million)

Year	1	2	3	4	5	10	20 year total
GNP	47.2	76.5	92.2	99.7	105.9	146.2	2,592.0

average: 129.6/year

Note: added value = profit before tax + depreciation + amortization + labour cost

In addition, the added value to Oman will be further increased by the effects on related industries.

For reference, in Japan the metal industries creates 1.4 - 1.5 times of its GNP additionally.

(5) Foreign currency earning and saving

The Project will earn foreign currencies directly and also save foreign currencies by substituting imports of steel bars.

On the other hand, foreign currencies will pay for the purchase of plant equipment and raw materials and supplies for the operation of the Steel Complex.

The estimated foreign currency earning and saving is US$ 3,259 million during twenty years as shown in Table 16-1-2.

(Note): The figures for the expected increase of GNP and foreign currency earning & saving are based on the Recommended Case.

Table 16-1-2 Foreign Currency Saving and Earning (Recommended Case)

(Unit: US$ million)

YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Foreign currency earning																				
Export of bars	106.3	197.5	227.7	227.7	227.7	227.7	227.7	178.8	178.8	178.8	178.8	178.8	178.8	178.8	178.8	178.8	178.8	178.8	178.8	178.8
Foreign currency payment																				
Raw materials & supplies	82.2	115.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5	126.5
Maintenance	7.3	9.5	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
Other fixed cost	14.3	15.4	15.9	14.6	14.6	13.2	13.2	12.0	10.7	10.7	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Repayment of loan			68.6	68.6	68.6	68.6	68.6	68.6	68.6	68.6										
Repayment of interest	49.4	49.4	46.3	40.1	33.9	27.8	21.6	15.4	9.3	3.1										
Total of FC payment	153.2	189.9	267.8	260.3	254.1	246.6	240.4	233.0	225.6	219.4	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0	145.0
Net foreign currency earning	-46.9	7.6	-40.1	-32.6	-26.4	-18.9	-12.7	-54.2	-46.8	-40.6	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8	33.8
Foreign currency saving																				
Domestic sale of bars	128.8	128.8	128.8	128.8	128.8	128.8	128.8	128.8	183.5	183.5	183.5	183.5	183.5	183.5	183.5	183.5	183.5	183.5	183.5	183.5
Total FC earning & saving	81.9	136.4	88.7	96.2	102.4	109.9	116.1	74.6	136.7	142.9	217.3	217.3	217.3	217.3	217.3	217.3	217.3	217.3	217.3	217.3

20 years total: 3,259.4

Chapter 17. CONCLUSION AND RECOMMENDATION

This feasibility study has been conducted to examine the feasibility of construction of a new Direct Reduction Plant Based Steel Complex using natural gas at Sohar in the Sultanate of Oman. The study was executed for the period of twelve months from January 1998 to January 1999, during which four field surveys were made in Oman. The results of those field surveys were supplemented by additional study in Japan. The conclusion is as follows.

Total investment cost for the Steel Complex (without power generation plant) will reach US$ 783 million as estimated including construction cost, pre-operation cost, initial working capital and interest during construction.
The ROI of 13.7 % at the Recommended Case will be acceptable for investors and financiers. As a result, it can be said that the Steel Complex Project at the Recommended Case is feasible and effective in terms of capital investment.

However, financial conditions for the Steel Complex are easily influenced by its surroundings such as change of interest and foreign currency exchange rate, especially in a case where the plant is constructed in a developing country. Therefore, in order to ensure stable management, to expedite the establishment of the private entity to promote and implement this Steel Complex Project and to expedite required equity participation by local and foreign companies, it is recommended that the Government assists the Project by exempting import duties and sales tax on the plant equipment. The Government is also required to waive such taxes as income tax and sales tax during a certain period after start-up of the plant. In addition to the above, the government is requested to assist to organize a private sector by whom power generation plant will be constructed to supply electricity to aluminum smelter project, petrochemical project and the Steel Complex Project at Sohar area.

Considering the effects on the national economy of Oman, construction and operation of the Steel Complex requires considerable amounts of construction materials, raw materials such as limestone and scrap, utilities and also generates employment opportunities not only at the Steel Complex itself but also among supporting industries.

The Steel Complex Project is planned to export more than 65% of its production and to deliver to the domestic market in Oman approximately 34% of products which are import substitutes. The Steel Complex will contribute foreign currency earning & saving of US$ 3,259 million over twenty years.

Therefore, materialization of the Steel Complex Project will have beneficial effects on promoting expanded employment opportunities and development of supporting industries in Oman as well as

improvement of the international balance of foreign currency with utilization of national resources such as natural gas and limestone.

Consequently, it can be concluded that construction of the Steel Complex in Oman is recommended, and it will contribute to the development of the Omani economy as a whole.

APPENDIXES

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
14-Feb-98	Embassy of Japan	H.E.Tadatsuna Koda	Ambassador extraordinary and plenipotentiary	All members
		Mr.Keiichi Matsumoto	First Secretary	
		Mr.Mihara	Second Secretary	
	Ministry of Commerce & Industry	H.E. Ali Masoud Al-Sunaidy	Undersecretary	All members
	Steering Committee;			
	Ministry of Commerce & Industry	Dr.Hamed H. Al-Dhahab	Chairman / Director General of Industry	
	Ministry of Commerce & Industry	Dr.Faisal Mohamed Elamir	Technical Adviser	
	Sultan Qaboos University	Dr.Saeed Ali Al-Araimi	Assistant Professor	
	Ministry of Foreign Affairs	Ms Khadija Hassan	Deputy Chief of Economic & Technical Co-operation Department	
	Ministry of National Economy	Mr.Hussain Yousuf Al-Balushi	Director of Macro-planning & Studies	All members
	Ministry of National Economy	Ms Munira M.Al-Batrani	Economic Researcher	
	Ministry of Communication	Mr.Hassan Sulaiman	Director of Port Affairs	
	Ministry of Communication	Dr.Kazuo Kudo	Adviser to the Minister (Port Affairs)	
	Ministry of Oil & Gas	Mr.Adnan Ali Al-Mudailwy	Directorate General of Gas & Petroleum Industry	
	Ministry of Electricity & Water	Mr.Saleh Al-Rashdy		
	Ministry of Commerce & Industry	Mr.Nabil Mubarak Al-Mukhaini	Economic Researcher,Directorate General of Industry	
21-Feb-98	Ministry of Commerce & Industry	Mr.Abdullah Nasser Al-Ghassani	Director General	
	Salalah Branch	Mr.Taher Abdullah Ibrahim	Adviser	
		Mr.Sami Al-Zubaidi	Director of Industry	
		Mr.Abdullah Al-Mamari	Financial Analysis	All members
		Mr.Mohamed Ramadhan Jumman	Head of Industrial Development Section	
		Mr.Said Salim Ali	Tourism Department	
		Mr.Salim Ghamem Al-Rawaj	Manager of Commerce Department	
	Ministry of Communication, Directorate General of Ports & Maritime Affairs	Mr.Abdullah Bin Salem Abdul Qader	Acting General Manager, Port Raysut	All members
		Mr.Hassan Bukhit Agham Fadal	Director of Engineering & Maintenance	
22-Feb-98	Raysut Cement Company	Mr.Said Bin Ahmed Al Rawas	Managing Director	All members
24-Feb-98	Dhofar Municipality	H.E. Abdullah Aqeel	Chairman of Dhofar Municipality	Leader + 3
	Dhofar Governorate	H.E.Musallam Bin Ali Al-Busaidi	Minister of State & Governor of Dhofar	Leader + 6

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
25-Feb-98	Ministry of Commerce & Industry Salalah Branch	Mr.Abdullah Nasser Al-Ghassani Mr.Taher Abdullah Ibrahim	Director General Adviser	
		Mr.Sami Al-Zubaidi Mr.Abdullah Al-Mamari Mr.Mohamed Ramadhan Jumman	Director of Industry Financial Analysis Head of Industrial Development Section	Leader + 10
28-Feb-98	Embassy of Japan	H.E. Tadatsuna Koda Mr.K. Matsumoto	Ambassador First Secretary	Leader + 2
	Steering Committee; Ministry of Commerce & Industry Ministry of Foreign Affairs Ministry of Communication Ministry of Oil & Gas Ministry of National Economy Ministry of Electricity & Water Ministry of Commerce & Industry Ministry of Commerce & Industry Ministry of Commerce & Industry	 Dr.Hamed H. Al-Dhahab Ms Khadija Bint Hassan Dr.Kazuo Kudo Mr.Adnan Ali Al-Mudailwy Mr.Hameed Bin Abdullah Al-Sadi Mr.Saleh Bin Hamoud Al-Rashidy Ms Manal Mohammad Al-Abdawani Mr.Nabil Mubarak Al-Mukhaini Mr.Majed Bin Al-Mahroqi	 Chairman / Director General of Industry Deputy Chief of Economic & Technical Co-operation Department Adviser to the Minister (Port Affairs) Directorate General of Gas & Petroleum Industry Directorate of Development Planning Director General of Planning and Follow-up Economic Researcher,Directorate General of Industry Directorate of Industry	All members
1-Mar-98	Sohar Industrial Estate Buraimi Industrial Estate Ministry of Commerce & Industry	Eng.Hamad Bin salem Al-Mahdali Eng.Ahmed Nasser Al Bulushi Mr. Nabil Mubarak Al-Mukhaini	Estate Director Supervisor Economic Researcher, D.G. of Industry	All members
	Sohar Municipality Ministry of Commerce & Industry	H.E.Sheik Ahmed Bin Abdullah Al-K Mr. Nabil Mubarak Al-Mukhaini	Wali of Sohar Economic Researcher, D.G. of Industry	Leader + 2
2-Mar-98	Oman Mining Company LLC Ministry of Commerce & Industry	Mr.Ali Said Abdullah Al-Waily Mr. Nabil Mubarak Al-Mukhaini	Deputy General Manager Economic Researcher, D.G. of Industry	All members
	Sharq Sohar Steel Rolling Mills LLC Ministry of Commerce & Industry	Mr.Sundeep Rao Mr. Nabil Mubarak Al-Mukhaini	 Economic Researcher, D.G. of Industry	All members
	Sohar Industrial Estate Ministry of Commerce & Industry	Mr.Abdul Nabi Ahmed Al-Baloushi Mr. Nabil Mubarak Al-Mukhaini	Director General of Industrial Estate Economic Researcher, D.G. of Industry	Leader + 1

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
7-Mar-98	Ministry of Commerce & Industry	Mr.Hamed H. Al-Dhahab	Chairman of Steering Committee	Leader
9-Mar-98	Ministry of Commerce & Industry	H.E.Maqbool Bin Ali Sultan	Minister of Commerce & Industry	All members
	Ministry of Commerce & Industry	Dr.Hamed H. Al-Dhahab	Director General of Industry	All members
9-Mar-98	Ministry of Commerce & Industry	Dr.Faisal Mohamed Elamir	Technical Adviser	All members
		Mr.Nabil Mubarak Al-Mukhaini	Economic Researcher, Directorate General of Industry	
		Mr.Majed Bin Al-Mahroqi	Directorate of Industry	
	Ministry of Foreign Affairs	H.E. Yousuf Bin Alawi Bin Abdullah	Minister of Foreign Affairs	Leader + 2
		Mr. H.B.Nasser B.Mansoor Al Tobi	Chief of Asian Department	
		Mr.Awadi B.Badr B.Maree Al Shanfar	Chief of Economic & Technical Cooperati	
	Embassy of Japan	H.E. Tadatsuna Koda	Ambassador	
		Mr.K. Matsumoto	First Secretary	
10-Mar-98		H.E.Mohammed Bin Al Zubair Bin Al	His Majesty the Sultan's Adviser for Economic Planning Affairs, President of Sultan Qaboos University	Leader +2
	Embassy of Japan	H.E. Tadatsuna Koda	Ambassador of Japan	
		Mr.K. Matsumoto	First Secretary	
11-Mar-98	Steering Committee	Dr.Hamed H. Al-Dhahab and other members	Chairman / Director General of Industry	Leader + 9
14-Mar-98	Steering Committee	Dr.Hamed H. Al-Dhahab and other members	Chairman / Director General of Industry	Leader + 9
15-Mar-98	Embassy of Japan	H.E. Tadatsuna Koda	Ambassador of Japan	Leader + 9
		Mr.K. Matsumoto	First Secretary	

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey - Gr.-A)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
Mar. 04	Ministry of Oil & Gas	Mr. Adnan A. Al-Mudaiwy	Directorate General of Gas	
		Mr. Suleiman S. Al Balushi	Deputy Director General of Gas & Petroleum Industry	
		Mr. Adnan. Dhaher	Advisor of Gas Project	
		Mr. Paul C. Den. Reijer	Government Gas Studies Team Leader AEG/1 POD	
		Mr. Kevin J. Pascoe	Head of Government Gas Operation & Engineering AGG PDO	
Mar. 07	Muscat Municipality	Mr. Said Mohammed Al-Qasimi	Director of Health Engineering Dept. Muscat Municipality	
		Mr. Salem Al-Sheedy	Engineer of Health Engineering Dept. Muscat Municipality	
		Mr. Majed Al-Mahrogi	MOCI	
	Telegraph & Telephones General Telecommunications	Mr. Abdullah Issa Salim Al-Rawahy	Directorate General Strategic Planning and Projects	
		Mr. Majed Al-Mabrogi	MOCI	

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey - Gr.-B)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
Feb. 17	Ministry of Finance	Mr. Ali Mohd. Redha Jafar	Director- Loan Department	
	Ministry of Finance	Ms. Saif Al-Shemly	Director General of Income Tax Dept.	
Feb. 18	Ministry of Commerce & Industry	Mr. Salah Mohamed Abd	Industrial Engineering Expert	
	Central Bank of Oman	Mr. Ali Hamdan Al-Raesi	Manager, Research & Statistics	
	Ministry of Finance	Mr. Raji	Tax Expert, Income Tax Dept.	
	Ministry of Finance	Mr. Sultan	Director, Custom Duty	
Feb. 23	MOCI Salalah Branch	Mr. Sami Al-Zubaidi	Director of Industry	
	Hamdan Trading Group	Mr. Thomas Jacob	Supervisor	
Mar. 3	Amiantit Oman	Mr. C. N. Raorane	General Manager	Manufacturer
	Al-Khoudh Steel Furniture Industrial Co.	Mr. Thomas Joseph	General Manager	Manufacturer
	Chain link Fencing Co.	Mr. Subash Kumar. P. T.	Production Engineer	Manufacturer
	Muscat Industry Company	Mr. Ravi K. Toprani	General Manager	Manufacturer
Mar. 4	Ministry of National Economy	Mr. Mahmood Al Bahlan	Acting Director General	
	Ministry of National Economy	Mr. Hussain Yousuf Al Balushi	Director of Macroplanning & Studies	
	Ministry of National Economy	Dr. R. L. Chawla	Consultant	
	Ministry of National Economy	Dr. Mahmoud El Sayed Mahgoub	Economic Consultant	
	Ministry of National Economy	Mr. Al Bahlani	Macro Economy	
	Ministry of National Economy	Mr. Humaid Al Saadi	Macro Economy	
	Ministry of National Economy	Mr. Said Mohammed Al Masoud	Director of Natural Resource	
	Ministry of National Economy	Mr. Khalid Al Zakwani	Director of Manpower Planning	
	Ministry of National Economy	Eng. Khamis A Al Shanddoudi	Director of Regional Development & Infrastructure	
	Ministry of National Economy	Mr. Ali M. Hassan	Director of Social Statistics	
	Suhail & Saud Bahwan Building Materials	Mr. Ajay Aggarwal	General Manager	
	Oman Cans Industry LLC	Mr. Afroz Hadi	Sales Manager	
	Oman Cans Industry LLC	Mr. S. V. Sanil	Plant Engineer	

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey - Gr.-C)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
16-Feb-98	Ministry of Communications Directorate General of Port & Maritime	Mr. Jamal T. Aziz Mr. Hussan Slaman Dr. Kazuo Kudo Mr. Masataka Oyadomari	Director General Manager Adviser to the Minister (JICA)	
17-Feb-98	Ministry of Communications Directorate General of Port & Maritime	Mr. Jamal T. Aziz Dr. Kazuo Kudo Mr. Masataka Oyadomari	Director General Adviser to the Minister (JICA) Adviser to the Minister (JICA)	Leader + C
18-Feb-98	Ministry of Communications Directorate General of Port & Maritime	Dr. Kazuo Kudo Mr. Masataka Oyadomari	Adviser to the Minister (JICA) Adviser to the Minister (JICA)	
21-Feb-98	Ministry of Communications, Raysut Port Directorate General of Communications	Mr. Abudullah Bin Salem Abdul Qader Mr. Hassan Bukit Agham Fadal	AG Manager, Port Raysut Director of Engineering & Maintenance	Leader + C
22-Feb-98	Ministry of Housing Physical Planning Section	Mr. Ahmed Ali Alhabshi Mr. Abdul Manan A. Jabal	Director Planning & Survey Town Planner	
	Han-Padoron Associates	Mr. John H. Rosser B. SC Mr. Jack Fernandez Mr. Gavin D. Lloyd	Resident Engineer Consulting Engineer Asst. Resident Engineer	
23-Feb-98	Han-Padoron Associates	Mr. John H. Rosser B. SC Mr. Gavin D. Lloyd	Resident Engineer Asst. Resident Engineer	
25-Feb-98	Ministry of Communications, Raysut Port Directorate General of Communications	Mr. Abudullah Bin Salem Abdul Qader Mr. Hassan Bukit Agham Fadal	AG Manager, Port Raysut Director of Engineering & Maintenance	Leader+C+E
3-Mar-98	Ministry of Communications Directorate General of Port & Maritime	Dr. Kazuo Kudo Mr. Masataka Oyadomari	Adviser to the Minister (JICA) Adviser to the Minister (JICA)	
4-Mar-98	Wimoy Alawi LLC	Mr. A.J.Barclay	Regional Quantity Surveyor	
	Galfar Engineering & Contracting LLC	Mr.Salem Saeed Hamed Al fannab Al Araimi Mr.A. Naushad	Group Chairman Business Development Manager	
7-Mar-98	Bahwan Engineering Co. LLC	Mr. Suresh K. Virmani Mr.C.K.Khanna Mr.DC.Munshi	General Manager Senior Manager Manager	

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey -Gr.-D)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
16-Feb-98	Ministry of Higher Education	Mr.Soud M. Al-Timani	Director General	
		Dr. Adnan A. Al-Haji	Director , Department of Information & Statistics	
		Dr. Taha Sultan Al-Mugheiry	Technical Expert	
		Mr.Rashid	Directorate General Institute and College	
		Mr.Nabil Mubarak Al-Mukhaini	Economic Researcher, MOCI	
17-Feb-98	Ministry of Regional Municipalities and Environment	Eng. Fatima Al-farsy	Environmental Planning Expert	
		Mr. Leszek Kuczynski	Environmental Planning Expert	
		Mr.Nabil Mubarak Al-Mukhaini	Economic Researcher, MOCI	
18-Feb-98	Caledonian College of Engineering	Dr. Raveendra K. Rao	Deputy Principal	
		Mr. A. Nizamuddin Ahmed	Chief Administrator	
		Mr.M. Madhava Rao	Head of Mechanical Engineering	
		Mr.Majed Rashed Al-Mahroqi	MOCI	
23-Feb-98	Department Salalah Airport	Mr.Mohamed Dhofar	System Manager	
		Mr. Amin Saad	MOCI, Salalah	
24-Feb-98	Environment / Governorate of Dhofar	Mr.Salim Mussdrim Ali Boit Saeed	Director General of Environment	
		Mr. Fayez Bataunch	Senior Inspector Water and Waste Pollution	
		Mr. Abdullah Seif	MOCI, Salalah	
	High Institute of Administrative and Technical Sciences	Mr.Taniyan Bin Bakheet M. Al-Ghazal	General Manager	
		Mr. Mohammad A.A.Matarnek	Dy. Manager Quality Control	
		Ms. Carys Corroran	Administration Internal Verifier	
		Mr. Abdullah Seif	MOCI, Salalah	
	Ministry of Health	Mr. Salim Hassan Ba-Alim	Director General Health Services-Dhofar	
		Mr. Abdullah Seif	MOCI, Salalah	
25-Feb-98	Ministry of Education, Salalah	Mr. Salim Ahmed Al Ghassani	Director of Planning Department	
		Mr.Mohamed Hussain Al Mashoor	Dy. Director of Planning Department	
		Mr. Abdullah Seif	MOCI, Salalah	
	Ministry of Housing, Salalah	Mr.A.Al Habshi	Director of Planning and Survey	
		Mr. Abdullah Seif	MOCI, Salalah	
3-Mar-98	Ghubrah Power and Desalination Plant	Mr. Ribhi Hamdan	Plant Manager, SOGEX	
		Mr.P.K.Mukerjee	Chief Chemist, SOGEX	
		Mr.Ahmed K.M.Kenawy	Training Officer, SOGEX	
		Mr. Mohammad Salem Al Chailani	MOEW	
		Mr.Majed Rashed Al-Mahroqi	MOCI	

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey -Gr.-D)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
4-Mar-98	Ministry of Regional Municipalities and Environment	Mr. Leszek Kuczynski	Environmental Planning Expert	
5-Mar-98	United Engineering Services	Mr.Vishwanarayan Mr. Sriram Iyer Mr.V.R.Jayarajan Mr.Pramod Balakrishnan Mr. Oswal Jacob	Manager Senior Sales Engineer Sales Engineer Financial Controller Production Manager, Grit Blasting & Planning Dept.	
7-Mar-98	Ministry of Social Affairs & Labor	Mr. Ahmed Bin Salem A. Al-shanfari Mr.Odeh El Majali Mr.Nabil Mubarak Al-Mukhaini	Director General, Vocational Training Vocational Counselor Economic Researcher, MOCI	
17-Mar-98	Hitachi Zosen, Ghubrah Power & Distribution Plant	Mr.Kunio Shigemasa	Site Manager	
	IHI, Oman Cement Co. (Rusayl Cement Works Expansion)	Mr.Takeshi Miyazawa Mr. Takeshi Kimura	Site Manager Manager	

Appendix A1-3-1 List of Authority and Personnel (The First Field Survey - Gr.-E)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
Feb. 15	Ministry of Commerce and Industry	Dr. Hamed H. Al-Dahab	Director General of Industry	Clarification of questionnaire
Feb. 17	Ministry of Commerce and Industry (MOCI)	Dr. Faisal Mohamed Elamir	Advisor	1. Explanation of preliminary conceptual study on the planned steel plant 2. Clarification of raw materials
Feb. 18	Ministry of Commerce and Industry	Dr. Hamed H. Al-Dahab Dr. Faisal Mohamed Elamir	Director General of Industry Advisor	Clarification of questionnaire
Feb. 22	Salalah Branch of MOCI	Mr. Khalid Ahmed Bamkhalif Mr. Mohammed Ishag Khalifa	General Manager of Mineral Geologist of Mineral	Clarification of burnt lime and limestone in Salalah
	Raysut Cement Co.	Mr. Said Bin Ahmed Al-Rawas	Managing Director	Hearing of cement plant
Feb. 23	Salalah Branch of MOCI	Mr. Mohammed Ishag Khalifa Mr. Said Mongher Balhaf	Geologist of Mineral Mining Engineer	Visit to the limestone deposits
Feb. 24	ASSAG ADDHABI TRADING CO.	Mr. Ameen S. Juman Mr. Omer Mohamed Fadhil with other two persons	Salalah Branch of MOCI Managing Director	Investigation of operational consumables and materials
	SHANFARI AND PARTNERS CO.	Mr. Ameen S. Juman Mr. Ahmed Bin Abdullah Mahfooz Al-Shaikh	Salalah Branch of MOCI Managing Director	Investigation of construction
Mar. 02	Oman Mining Co.	Mr. Ali Said Abdullah Al-Waily	Deputy General Manager	Hearing of copper refinery
	SHARQ SOHAR STEEL ROLLING MILLS LLC	Mr. Sundeep Rao	Engineer	Hearing of rolling mill
Mar. 03	OMAN METAL INDUSTRIES	Mr. Suresh K. Pillai Mr. Osama M. M. H. Nimer	Sr. Marketing Engineer Design Dept. Manager	Investigation of fabrication
	BILAD (OMAN) LLC	Mr. Ghassan Souki	General Manager	Investigation of fabrication
Mar. 04	OMAN STEEL CO. LLC.	Mr. V. S. Govindrajan Mr. V. V. Subramaniam Mr. R. Venkataraman	General Manager Contracts Manager Project Manager - Power Project	Investigation of fabrication
	AL MUTAHIDHA CO. LLC.	Mr. George Carr	General Manager	Investigation of transportation
	ELCO INDUSTRIAL & TRADING Co. LLC	Mr. T. Ashraf Ali A. V. Balakrshnan B. R. Srikanth	Manager (Design & Estimation) Engineering Manager Operations Manager	Investigation of fabrication
Mar. 05	United Engineering Services LLC	Mr. M. S. Vishwanarayan Mr. Sriram Iyer Mr. V. R. Jayarajan Mr. Oswald Jacob Mr. Pramod Balakrishnan	Manager Senior Sales Manager Sales Manager Production Manager Financial Controller	Investigation of fabrication

Appendix A1-3-2 List of Authority and Personnel (The Second Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
24-Jun-98	Embassy of Japan	Mr.Iwata	Councilor	All members
		Mr.Keiichi Matsumoto	First Secretary	(10 persons)
	Ministry of Commerce & Industry	Dr.Hamed H. Al-Dhahab	Director General of Industry	
		Dr.Faisal Mohamed Elamir	Technical Adviser	
		Mr.Saoud Bin Nasser Al-Khusaibi	Director of Industrial Planning & Studies	All members
		Mr.Nabil Mubarak Al-Mukhaini	Economic Researcher, Directorate General of Industry	(10 persons)
	Observer; Japan Embassy	Mr. Keiichi Matsumoto	First Secretary	
27-Jun-98	Steering Committee;			
	Ministry of Commerce & Industry	Dr.Hamed H. Al-Dhahab	Chairman / Director General of Industry	
	Ministry of Commerce & Industry	Dr.Faisal Mohamed Elamir	Technical Adviser	
	Ministry of Commerce & Industry	Mr.Saoud Bin Nasser Al-Khusaibi	Director of Industrial Planning & Studies	
	Ministry of Commerce & Industry	Mr.Nabil Mubarak Al-Mukhaini	Economic Researcher, Directorate General of Industry	All members
	Ministry of Foreign Affairs	Mr. Mabrook Mubarak Al-Hinai		(13 persons)
	Ministry of National Economy	Mr.Hussain Yousuf Al-Balushi	Director of Macro-planning & Studies	
	Ministry of Communication	Mr.Hassan Sulaiman Almugaini	Director of Port Affairs	
	Ministry of Communication	Mr. Hiroshi Sasajima	Adviser to the Minister (Port Affairs)	
	Ministry of Oil & Gas	Mr.Adnan Ali Al-Mudailwi	Directorate General of Gas & Petroleum Industry	
	Observer; Japan Embassy	Mr. Keiichi Matsumoto	First Secretary	
29-Jun-98	Ministry of Foreign Affairs	H.E. Yousuf Bin Alawi Bin Abdullah	Minister of Foreign Affairs	
		Mr. H.B.Nasser B.Mansoor Al Tobi	Chief of Asian Department	
		Mr.Awadi B.Badr B.Maree Al Shanfari	Chief of Economic & Technical Cooperation	Leader + 2
	Embassy of Japan	Mr.Iwata	Councilor	
		Mr.K.Matsumoto	First Secretary	
30-Jun-98	Sohar Industrial Estate	Eng.Hamad Bin Salem Al-Mahdali	Estate Director	
		Eng.Abdulqader Salem Al-Bulushi	Civil Engineer	
	Ministry of Commerce & Industry	Mr. Nabil Mubarak Al-Mukhaini	Economic Researcher, Directorate General of Industry	All members (13 person)
	Ministry of Commerce & Industry	Mr.Ahmed Nasser	In charge of Industry	
	Sohar Branch	Mr.Sulaiman	In charge of Tourism	
4-Jul-98	Ministry of Commerce & Industry	Mr.Abdullah Nasser Al-Ghassani	Director General	
	Salalah Branch	Mr.Abdulaziz Awad Al-Ghassani	Acting Director General	
		Mr.Taher Abdullah Ibrahim	Adviser	All members

Appendix A1-3-2 List of Authority and Personnel (The Second Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
		Mr.Sami Omar Al-Zubaidi	Director of Industry	(11 persons)
		Mr.Mohamed Ramadhan Jumman	Head of Industrial Development Section	
		Mr.Abdullah Saif Al Mamari	Financial Analyst	
		Mr.Amin Saad Jumaan	Head of Follow-up Section	
5-Jul-98	Ministry of Commerce & Industry	Mr.Abdullah Nasser Al-Ghassani	Director General	
	Salalah Branch	Mr.Taher Abdullah Ibrahim	Adviser	All members
		Mr.Sami Omar Al-Zubaidi	Director of Industry	(11 persons)
		Mr.Abdullah Al-Mamari	Financial Analyst	
		Mr.Mohamed Ramadhan Jumman	Head of Industrial Development Section	
6-Jul-98	Ministry of Commerce & Industry	Dr.Hamed H. Al-Dhahab	Chairman / Director General of Industry	
		Mr.Nabil Mubarak Al-Mukhaini	Economic Researcher,Directorate General of Industry	Leader+1
8-Jul-98	Ministry of Commerce & Industry	H.E. Ali Masoud Al-Sunaidy	Undersecretary	
	Steering Committee;			
	Ministry of Commerce & Industry	Dr.Hamed H. Al-Dhahab	Chairman / Director General of Industry	
	Ministry of Commerce & Industry	Dr.Faisal Mohamed Elamir	Technical Adviser	
	Ministry of Communications	Mr. Hiroshi Sasajima	Adviser to the Minister (Port Affairs)	All members
	Ministry of Communications	Mr.Hassan Sulaiman Almugaini	Director of Port Affairs	(13 persons)
	Ministry of Oil & Gas	Mr.Adnan Ali Al-Mudailwy	Directorate General of Gas & Petroleum Industry	
	Ministry of National Economy	Mr.Hameed Bin Abdullah Al-Sadi	Directorate of Development Planning	
	Ministry of Electricity & Water	Mr. P.C. Cherian		
	Ministry of Commerce & Industry	Mr.Saoud Bin Nasser Al-Khusaibi	Director of Industrial Planning & Studies	
	Ministry of Commerce & Industry	Mr.Nabil Mubarak Al-Mukhaini	Economic Researcher,Directorate General of Industry	
11-Jul-98	Ministry of Communications	H.E. Salim bin Abdullah al Ghazali	Minister of Communications	
	Embassy of Japan	Mr.Iwata	Councilor	Leader + 2
		Mr.K.Matsumoto	First Secretary	
12-Jul-98	Embassy of Japan	Mr.Iwamoto	Councilor	All members
		Mr.K.Matsumoto	First Secretary	(13 persons)

Appendix A1-3-2 Authority and Personnel (The Second Field Survey - Gr.-A)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
28-Jun-98	Ministry of Oil & Gas	Mr.Adnan Ali Al-Mudailwi Mr.Kevin J. Pascoe	Directorate General of Gas & Petroleum Industry Head of Government Gas Operation & Engineering AGG PDO	
29-Jun-98	Ministry of Electricity & Water Ministry of Commerce & Industry	Mr.Mohd. Redha Hassan Ali Mr.Nabil Mubarak Al-Mukhaini	Director General of Electric Economic Researcher,Directorate General of Industry	
30-Jun-98	Wadi Jizzi Power Station Ministry of Commerce & Industry	Mr.Manny Arquero Mr.Nabil Mubarak Al-Mukhaini	Head of Wadi Jizzi P/S Manager Economic Researcher,Directorate General of Industry	
1-Jul-98	Sohar Fishery Department Ministry of Commerce & Industry	Mr.Yaquob Al Ghassany Mr.Ali Al A Jami Mr.Nabil Mubarak Al-Mukhaini	Director of department of MOAF Technician of Fishery Tools Economic Researcher,Directorate General of Industry	
	Sohar Development Office Ministry of Commerce & Industry	Mr.Saleh Ali Al Hashme Mr.Mohmed Ali Al Kishri Mr. Khadeem Ali Al Omrani Mr.Nabil Mubarak Al-Mukhaini	Director General of SDO Director of Water Dept. Dy. Director of Water Dept. Economic Researcher,Directorate General of Industry	
4-Jul-98	Salalah Sanitary Drainage Services Co. SSD. Co.	Mr.Barik Saeed Ahmed Amer Al-Rawas Mr.Yusri Ali Hassan	Acting General Manager Technical Adviser	
5-Jul-98	Ministry of Electricity & Water MOCI. Salalah	Mr. Said Omar Al-Abadi Mr.Mohamed Ramadhan Jumaan	Generation Manager	Leader + A
6-Jul-98	Ministry of Regional Municipalities & Environment Ministry of Commerce & Industry	Mr.Salim Abdullah Hamid Al-Jufail Mr.Nabil Mubarak Al-Mukhaini	Head of Marine Pollution Section, Directorate General of Environment Affairs Economic Researcher,Directorate General of Industry	

Appendix A1-3-2 List of Authority and Personnel (The Second Field Survey - Gr.-B)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
1-Jul-98	Al Mutahida Transportation Co.	Mr. George Car	General Manager	
4-Jul-98	Ministry of Commerce & Industry	Dr.Faisal Mohamed Elamir	Technical Adviser	

Appendix A1-3-2 List of Authority and Personnel (The Second Field Survey - Gr.-C)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
28-Jun-98	Ministry of Communications Directorate General of Port & Maritime	Mr. Jamal T. Aziz Mr. Khalid Mirza Mr.Hiroshi Sasajima	Director General Engineer Adviser to the Minister (JICA)	
29-Jun-98	Ministry of Communications Directorate General of Port & Maritime	Mr.Hiroshi Sasajima	Adviser to the Minister (JICA)	
1-Jul-98	Oman LNG LLC. Sur Office TAISEI Corporation Chiyoda-Foster Wheeler and Co. LLC.	Mr. Ali Juma Al-Musharafi Mr.Mikio Takeda Mr.Masaru Furukawa Mr. H. Kobayashi	Head of Sur Office General Project Manager Oman LNG Proj. Adm.. Manager Oman LNG Proj. Chief Executive and Project Director	
4-Jul-98	Ministry of Communications, Raysut Port Han-Padoron Associates	Mr. Abudullah Bin Salem Abdul Qader Mr. Gavin D. Lloyd	AG Manager, Port Raysut Asst. Resident Engineer	
5 Jul. 98	Han-Padoron Associates	Mr. Gavin D. Lloyd	Asst. Resident Engineer	
8-Jul-98	Ministry of Communications Directorate General of Port & Maritime	Mr.Hiroshi Sasajima	Adviser to the Minister (JICA)	

Appendix A1-3-2 List of Authority and Personnel (The Second Field Survey - Gr.-D)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
28-Jun-98	Ministry of Regional Municipalities and Environment	Mr. Nabil Habib Al-Lawatiya Mr. Leszek Kuczynski Mr. M/S. Hashami Mr.Nabil Mubarak Al-Mukhaini	Act.Head Environment Div. Sec. Environmental Planning Expert Controller of Air Pollution Economic Researcher, MOCI	
29-Jun-98	SPECO	Mr.Ullas Mr.Morita	 Nissho Iwai	
4-Jul-98	High Institute of Administrative and Technical Sciences	Mr. George Robert Mr.Taniyan Bin Bakheet M. Al-Ghazal Mr.Amin Saad	Project Manager for HIAT General Manager MOCI, Salalah	
5-Jul-98	Salalah Technical Industrial College	Dr. Hasan M. Tantawi Dr. Ayman Al-Maaitah Mr.Amin Saad	Director Head of Engineering Dept. MOCI, Salalah	
6-Jul-98	Ministry of Regional Municipalities and Environment	Mr. Salim Abdullah Hamid Al-Jufaili	Head of Marine Pollution Section	

Appendix A1-3-2 List Of Authority and Personnel (The Second Field Survey - Gr.-E)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
June 28	MOCI (Mineral) Mr. Ahmed Nasser Khalfan	Dr. Hayat AAEQidwai Mr. Ahmed Nasser Khalfan	Geological Expert, DGM Geologist of Geological Survey Department	Clarification of questionnaire for limestone in Sohar
	MOCI	Dr. Hamed H. Al-Dahab Dr. Faisal Mohamed Elamir	Director General of Industry Advisor	Explanation of the main process facilities for the Steel Complex in INTERIM REPORT
June 29	SPECO (Scrap Processing & Earth Moving Co. LLC.)	Mr. Ullas	Officer	Hearing of steel crap in Oman
June 30	MOCI (Mineral)	Mr. Ahmed Nasser Khalfan	Geologist of Geological Survey Department	Visit to the limestone deposits in Sohar
	Oman Mining Co. (Mining Site of Limestone)	Mr. Farah	Mobile Crusher Foreman Site Quarry	Hearing of limestone in Sohar
July 01	MOCI	Dr. Hamed H. Al-Dahab Dr. Faisal Mohamed Elamir	Director General of Industry Advisor	Explanation of the main process facilities for the Steel Complex in INTERIM REPORT
July 05	Salalah Branch of MOCI (Mineral)	Mr. Khalid Musallem Rawas Mr. Mohammed Ishag Khalifa	Director of Quarries Geologist of Mineral	Hearing of limestone in Salalah
July 06	MOCI (Mineral)	Mr. Salim Omer Abdullah Ibrahim Dr. Hilal Mohammed Sultan Al Azr Dr. Hayat AAEQidwai Mr. Ahmed Nasser Khalfan Mr. Ryoichi Nobumoto	Director of Mineral Exploration Deputy Director General of Mineral Geological Expert, DGM Geologist of Geological Survey Department Directorate General of Minerals (from JICA)	Hearing of limestone in Sohar

Appendix A1-3-3 List of Authority and Personnel (The Third Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
2-Sep-98	Embassy of Japan	Mr. Yoshimasa Iwata	Minister	All members
		Mr. Kiyoshi Mihara	Special Assistant	(4 persons)
	Steering Committee;			
	Ministry of Commerce & Industry	Dr. Hamed H. Al-Dhahab	Chairman / Director General of Industry	
	Ministry of Commerce & Industry	Dr. Faisal Mohamed Elamir	Technical Adviser	
	Ministry of Commerce & Industry	Mr. Saoud Bin Nasser Al-Khusaibi	Director of Industrial Planning & Studies	
	Ministry of Commerce & Industry	Ms. Manal bint Mohammad Al-Abdawani	Director	
	Ministry of Commerce & Industry	Mr. Nabil Mubarak Al-Mukhaini	Economic Researcher, Directorate General of Ind.	
	Ministry of Commerce & Industry	Mr. Majed Al-Mahrogi	Directorate General of Industry	All members
	Ministry of Foreign Affairs	Mr.Yousef Said Al-Amri		
	Ministry of Communications	Mr. Khalid Mirza	Engineer of Port Affairs	
	Ministry of Communications	Mr. Hiroshi Sasajima	Adviser to the Minister (Port Affairs)	
	Ministry of Oil & Gas	Mr. Adnan Ali Al-Mudailwi	Directorate General of Gas & Petroleum Ind.	
	Ministry of Electricity & Water	Mr. Salem bin Hashim Al-Rashdi		
	Observer;			
	Embassy of Japan	Mr. K. Mihara	Special Assistant	
	Greeting;			
	Ministry of Commerce & Industry	H.E. Maqbool Bin Ali Sultan	Minister	
4-Sep-98	Ministry of Communications	H.E. Salim bin Abdullah al Ghazali	Minister	
		Mr. Jamal Aziz	Director General of Port & Maritime	
		Mr. Khalid Mirza	Engineer of Port Affairs	All members
		Mr. Hiroshi Sasajima	Adviser to the Minister (Port Affairs)	
	Embassy of Japan	Mr. Y. Iwata	Minister	
		Mr. K. Mihara	Special Assistant	
5-Sep-98	Ministry of Oil & Gas	H.E. Dr. Mohammad bin Hamad bin Saif al Rumhi	Minister	
		Mr. Suleiman Shambeh al Balushi	Dy. Director General of Gas Affairs & Petrol Production	All members
		Mr. Adnan Ali Al-Mudailwi	Directorate General of Gas & Petroleum Ind.	
	Embassy of Japan	Mr. Y. Iwata	Minister	
		Mr. K. Mihara	Special Assistant	
	Ministry of Foreign Affairs	H.E. Yousuf Bin Alawi Bin Abdullah	Minister	
		Mr. H.B.Nasser B.Mansoor Al Tobi	Chief of Asian Department	
		Mr. Awadi B.Badr B.Maree Al Shanfari	Chief of Economic & Technical Cooperation	All members
	Embassy of Japan	Mr. Y. Iwata	Minister	
		Mr. K. Mihara	Special Assistant	

Appendix A1-3-3 List of Authority and Personnel (The Third Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
6-Sep-98	Steering Committee;			
	Ministry of Commerce & Industry	Dr. Hamed H. Al-Dhahab	Chairman / Director General of Industry	
	Ministry of Commerce & Industry	Dr. Faisal Mohamed Elamir	Technical Adviser	
	Ministry of Communications	Mr. Hiroshi Sasajima	Adviser to the Minister (Port Affairs)	All members
	Ministry of Communications	Mr. Khalid Mirza	Engineer of Port Affairs	
	Ministry of Oil & Gas	Mr. Adnan Ali Al-Mudailwy	Directorate General of Gas & Petroleum Ind.	
	Ministry of Foreign Affairs	Mr. Yousef Said Al-Amri		
	Ministry of National Economy	Mr. Hussain Yousuf Al-Balushi	Director of Macro-planning & Studies	
	Ministry of National Economy	Mr. Humaid Al Saadi		
	Ministry of Electricity & Water	Mr. Saleh Bin Hamoud Al-Rashidy		
	Ministry of Finance	Mr. Awadh Bader Alsharfair		
	Ministry of Commerce & Industry	Mr. Saoud Bin Nasser Al-Khusaibi	Director of Industrial Planning & Studies	
	Ministry of Commerce & Industry	Mr. Nabil Mubarak Al-Mukhaini	Economic Researcher, Directorate General of Industry	
	Observer;			
	Embassy of Japan	Mr. K. Mihara	Special Assistant	
	Office of the Sultan's Adviser for Economic Planning Affairs	H.H. Mohammed Bin Al Zubair Bin Ali	His Majesty the Sultan's Adviser for Economic Planning Affairs and President of Sultan Qaboos University	All members
	Embassy of Japan	Mr. Y.Iwata	Minister	
		Mr. K. Mihara	Special Assistant	
	Ministry of Commerce & Industry	H.E. Ali Masoud Al-Sunaidy	Under Secretary	
		Dr. Hamed H. Al-Dhahab	Director General of Industry	All members
		Mr. Nabil Mubarak Al-Mukhaini	Economic Researcher,Directorate General of Industry	
	Embassy of Japan	Mr. Y.Iwata	Minister	All members
		Mr. K. Mihara	Special Assistant	

Appendix A1-3-4 List of Authority and Personnel (The Fourth Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
16-Dec-98	Embassy of Japan	Mr. Zenji Kaminaga	Ambassador	All members
		Mr. Keiichi Matsumoto	First Secretary	(8 persons)
	Steering Committee;			
	Ministry of Commerce & Industry	Dr. Hamed H. Al-Dhahab	Chairman / Director General of Industry	
		Mr. Nabil Mubarak Al-Mukhaini	Economic Researcher,Directorate General of Ind.	
	Ministry of Foreign Affairs	Ms. Khadija Hassan	Deputy Chief of Economic & Technical Co-operation Department	
	Ministry of National Economy	Mr. Husain Yousuf Al-Bulushi	Director of Macro-planning & Studies	All members
		Mr. Humaid Al Saadi		
	Ministry of Oil & Gas	Mr. Adnan Ali Al-Mudailwi	Directorate General of Gas & Petroleum Ind.	
	Ministry of Electricity & Water	Mr. Adil Hamed Al-Shuhaibi		
	Zubair Enterprise	Mr. M.A.Baqi	Manager	
	Observer; Embassy of Japan	Mr. K. Matsumoto	First Secretary	
19-Dec-98	Steering Committee;			
	Ministry of Commerce & Industry	Dr. Hamed H. Al-Dhahab	Chairman / Director General of Industry	
		Mr. Saoud Bin Nasser Al-Khusaibi	Director of Industrial Planning & Studies	
		Ms. Manal bint Mohammad Al-Abdawani	Director	
		Mr. Nabil Mubarak Al-Mukhaini	Economic Researcher,Directorate General of Ind.	
	Ministry of Foreign Affairs	Ms. Khadija Hassan	Deputy Chief of Economic & Technical Co-operation Department	All members
	Ministry of National Economy	Mr. Humaid Al Saadi		
	Ministry of Oil & Gas	Mr. Adnan Ali Al-Mudailwi	Directorate General of Gas & Petroleum Ind.	
	Ministry of Electricity & Water	Mr. Adil Hamed Al-Shuhaibi		
	Zubair Enterprise	Mr. M.A.Baqi	Manager	
20-Dec-98	Ministry of Regional Municipalities and Environment	Mr. Leszek Kuczynski	Expert	
		Mr. Nabil Murtaza Habib Al Lowatiya	Acting Head of Environment Dev. Section	
		Mr. Khamis Al-Zidi	Inspector of Air & Noise Pollution Section	Leader
		Mr. Khalaf Al-Mawali	Inspector of Air & Noise Pollution Section	&
		Mr. Salim Al-Suqri	Marine Pollution Section	5 persons
		Mr. Mohammad Saeed Al-Masrory	Water and Waste Inspector	
	Ministry of Commerce & Industry	Mr. Nabil Mubarak Al-Mukhaini	Economic Researcher,Directorate General of Ind.	
	Ministry of National Economy	Mr. Husain Yousuf Al-Bulushi	Director of Macro-planning & Studies	
		Mr. S.L. Narasimhan	Advisor Privatisation	2 persons
	Ministry of Commerce & Industry	Mr.M.R. Karmachandran	Chief Engineer Industrial Project	

Appendix A1-3-4 List of Authority and Personnel (The Fourth Field Survey - Common)

DATE	NAME OF THE ORGANIZATION	PERSON ATTENDED	TITLE	REMARKS
20-Dec-98	Ministry of Foreign Affairs	H.E. Yousuf Bin Alawi Bin Abdullah	Minister	
		Mr. Awadi B.Badr B.Maree Al Shanfari	Chief of Economic & Technical Cooperation	
		Mr. H.B.Nasser B.Mansoor Al Tobi	Chief of Asian Department	All members
	Embassy of Japan	Mr. Zenji Kaminaga	Ambassador	
		Mr. Keiichi Matsumoto	First Secretary	
21-Dec-98	Ministry of Oil & Gas	H.E. Dr. Mohammad bin Hamad bin Saif al Rumhi	Minister	All members
	Embassy of Japan	Mr. Zenji Kaminaga	Ambassador	
		Mr. Keiichi Matsumoto	First Secretary	
22-Dec-98	Ministry of Commerce & Industry	Dr. Hamed H. Al-Dhahab	Chairman / Director General of Industry	Leader
		Mr. Nabil Mubarak Al-Mukhaini	Economic Researcher,Directorate General of Ind.	3 persons
	Embassy of Japan	Mr. Zenji Kaminaga	Ambassador	All members
		Mr. Keiichi Matsumoto	First Secretary	

THE FEASIBILITY STUDY OF THE DIRECT REDUCTION PLANT BASED STEEL COMPLEX IN THE SULTANATE OF OMAN

METHODOLOGY FOR PLANT SITE SELECTION

The Scope of Work for the Feasibility Study of the Direct Reduction Plant Based Steel Complex Project was signed in September, 1997 by the Government of Oman and JICA. The Scope of Work indicates that the site for the Steel Complex is in the Salalah District. JICA Study Team made the first field survey from February 12 to March 15, 1998 based on the Scope of Work. The Government of Oman requested to JICA to study site selection of the Salalah District and the additional site of the Sohar District in March, 1998.

1. Importance of Plant Location

In the construction of the Steel Complex with production capacity of 1.2 million ton of steel products a year, a huge amount of investment will be required. Furthermore, if all infrastructure necessary for the Steel Complex such as port and port facilities, road, electric power, natural gas and industrial water supply, etc. are newly constructed simultaneously, a huge amount of the investment will be required also for such infrastructure.

Port and port facilities for unloading raw materials, scraps, and the same for shipping products and road network are dominant conditions of the site.

Energy and utilities supply such as electric power, natural gas, industrial water and waste water sewerage are also indispensable for operation of the plant.

The plant site requires 1.2 million square meters with solid soil and the regional area and geographical location influence the activities of plant operation.

Construction of the Steel Complex will facilitate new relevant industry to grow. It is necessary to assure that no deterioration of environment nor bad influence to the ecosystem are generated by construction and operation of the Steel Complex.

It is obvious that if all amount of investment for infrastructure are imposed on or borne by the Steel Complex, the project of the Steel Complex shall no longer be feasible. Dominant conditions to be investigated in selecting the appropriate site include regional development plan and implementation schedule of infrastructure.

2. Evaluation Criteria for Site Selection

In general, following nine items are considered to study for the site selection of a steel plant;

- access to the market
- facilities capability of unloading the raw materials and shipping the products
- utilities supply such as water, electric power, natural gas
- natural condition such as meteorological condition and soil condition
- supporting industries
- availability of expertise of management, technologies and skilled labors
- environmental assessment such as air, water, etc.
- investment cost
- operation cost

2.1 Flow of Site Selection

JICA Study Team made the first field survey and collected the answer to the questionnaire attached to the Inception Report and visited the Salalah District to collect the necessary information for the feasibility study of the Steel Complex.

Step 1. Additional questionnaire which are related to the above basic items for the Sohar District similar to that for the Salalah District will be sent to the Steering Committee of Oman by two weeks previous to the second field survey by the Study Team.

Step 2. Collection of the answer to the additional questionnaire and data and information necessary for the site selection both Salalah and Sohar will be done during the second field survey by the Study Team.

Step 3. The Study Team will analyze the data and information based on agreed evaluation criteria and send the site selection report in the middle of August, 1998 and visit Oman to explain and discuss with the Steering Committee of Oman in the beginning of September, 1998 and the Steering Committee will decide one site within three weeks and inform JICA Study Team of the site.

JICA Study Team will make the feasibility study of the Steel Complex on the selected site (one site only).

2.2. Evaluation Criteria

Evaluation will be made of technical evaluation and economical evaluation.

(1) Technical evaluation

Evaluation procedures are shown below.

Three columns are prepared on each item. The first column is base point depended on importance and the second and third columns are rating and scores.

Alphabetical signs and evaluation scores shall be given in the rating column and scores column.

A : Present status gives satisfactory conditions and/or situations existing or committed by the government (score range : seven to ten points). Sing " A" represents acceptable.

B : Present status is not satisfactory, but conditions and/or situations are expected to be improved in the future (score range : five to seven points). Sign " B" represents insufficient but can be improved.

C : Present status is not satisfactory conditions and/or situations or environment is not expected to be improved in the future (score range : five points and less). Sign " C" represents unacceptable.

Summary of the technical evaluation shall be indicated in Table 2-2-1.

Table 2-2-1 Summary of the Technical Evaluation

Item to be considered	Importance	Rating		Score	
		Salalah	Sohar	Salalah	Sohar
1. LAND					
1.1. Dimension and area of the site	5				
1.2. Geographical conditions	5				
1.3. Soil condition	5				
2. TRANSPORTATION					
2.1. Port and port facilities	20				
2.2. Berth and berth facilities	5				
2.3. Road	5				
3. UTILITIES					
3.1. Electric power	15				
3.2. Natural gas	15				
3.3. Industrial water and waste water sewerage	10				
4. SOCIAL CONDITION					
4.1. Supporting industries	5				
4.2. Human resources and housings	5				
4.3. Environmental and pollution	5				
TOTAL	100				

(2) Economical comparison

Data and information on energy costs, utilities costs and land purchase price and/or rental fee will be collected in addition to the port and berth tariffs. Based on these data and information, calculation shall be made site by site to figure out magnitude of the initial investment amount, and long term operation costs generated from regional differences. Then, economical comparison for both sites shall be carried out.

Table 2-2-2 Comparison in Total Amount of Initial Investment and Operation Costs by Site

Cost factors	Salalah	Sohar
1. LAND		
1.1. Acquisition of land or rental fee		
1.2. Land preparation		
1.3. Slope protection		
2. PORT AND BERTH FACILITIES		
2.1. Port and berth tariffs		
2.2. Berth		
2.3. Berth facilities		
3. FACILITIES IN PLANT		
3.1. Piping and conveyer		
3.2. Foundation		
3.3. Desalination Plant		
3.4. Waste water sewerage		
4. ENERGY AND UTILITIES COSTS		
4.1. Unit cost of electric power		
4.2. Unit cost of natural gas		
4.3. Unit cost of industrial water		
5.TRANSPORTATION COST (FINISHED PRODUCTS)		
5.1. Road		
5.2. Sea		
TOTAL		

(3) Regional conditions such as regional development plan, relevant industries and environmental restriction shall be studied as social factor. But, it is difficult to carry out by quantitative evaluation.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

THE STEERING COMMITTEE OF THE SULTANATE OF OMAN

THE FEASIBILITY STUDY ON THE DIRECT REDUCTION PLANT BASED STEEL COMPLEX PROJECT IN THE SULTANATE OF OMAN

SITE EVALUATION REPORT ON SALALAH AND SOHAR

AUGUST, 1998

KOBE STEEL, LTD.
IN ASSOCIATION WITH
NKK CORPORATION

CONTENTS

GENERAL

With regard to the Feasibility Study on the Direct Reduction Plant Based Steel Complex Project in the Sultanate of Oman, the Government of Oman and JICA agreed in May 1998 that the plant site selection of the Steel Complex was studied for Salalah and Sohar.

In accordance with " METHODOLOGY FOR PLANT SITE SELECTION" which was agreed by the Steering Committee of the Sultanate of Oman during the second field survey of JICA Study Team from June 23 to July 13, 1998, JICA Study Team made the technical evaluation and the economical comparison of Salalah and Sohar districts based on the data and information obtained in the first and second field surveys, and further study in Japan.

The result of the plant site evaluation is described in the following pages.

I. TECHNICAL EVALUATION

1. LAND

The site in Sohar is adjacent to berth facilities and there is a space for future expansion. It is flat and its soil conditions is comparatively good. However, machine foundation needs piling and soil improvement work.

On the other hand, the site in Salalah is 1 km away from berth facilities and there is no space for future expansion. It is undulating and a large-scale land preparation work is necessary. Its soil condition is very good and it does not need to pile.

The detailed technical evaluation of the conditions of two sites are tabulated below.

Table 1-1 Comparison of Two Sites

Item	SALALAH	SOHAR
Location	- About 1 km away from the berth facilities.	-Located at the adjacency of the berth facilities.
Dimension and Area	- Area : 1,200,000 m^2 (800 m x 1,500 m) - No space for expansion in the future.	-Area : 1,200,000 m^2 (800 m x 1,500 m) -There is a space for expansion in the future.
Geographical Conditions	- The site is considerably undulating (DL +5 m to +30 m), and necessary to do large-scale land preparation work. - The prepared land will have three ground levels. -The average ground level after the land preparation will be about 15 m higher than sea level, raising the cost for sea water intake. -WADI runs through the site; necessary to take measures.	-The site is almost flat but the ground level is low for most parts (+ 0~3 m.) It is necessary to raise the level by about 3 m. -Dredged soil can be used as filling materials, which can save the land preparation cost. -The site will have only one ground level after the land preparation work.
Soil Conditions	-Soft rock layer spreads underneath the thin sandy gravel layer, thus it has a very good ground condition. -Machine foundation does not need piling. It decreases the founding cost. -In land preparation, a great deal of ripping work should be done to remove rocks. It raises the land preparation cost.	- Comparatively compacted sand layer exists from the ground level to the depth of about 10 m, and alternating layers of silt stone and sandstone spreads at the deeper portion. It can be judged the site has comparatively good ground conditions. However, 3 m thick dredged soil layer will be on the ground. Machine foundation should need piling or soil improvement work. - Soft clay layer called "Sabkha" occupies a part of the site. It is necessary to be measured.

2. PORT AND ROAD

The port in Sohar is located at 250 km from Muscat and near to the market.
The port in Salalah is located at 1,000 km from Muscat and far away to the domestic and export markets.
The other conditions of both ports are not different.

The detailed technical evaluation of conditions of two ports is tabulated on the next page.

Table 2-1 Comparison of Two Ports

		SALALAH	SOHAR
Port and Port Facilities	Location	Located about 1000 km southern east of Muscat, occupying a good location on the sea route between Suez Canal and Southeast Asia. Far from domestic demand locations and from product export destinations.	Located about 250 km northern west of Muscat, occupying a good location on the sea route between GCC and Southeast Asia. Near from domestic demand locations and from product export destinations as well.
	Construction Schedule	Already opened and being used. Expansion work is underway and to be completed on November, 1998.	New port construction project is underway. The construction work is to be commenced at the end of 1998 or at the beginning of 1999 and is expected to be completed and opened in 2003.
	Approach Channel	Water depth : -16.5 m Width : 250 m	Water depth : -16 m Width : 200 m
	Turning Basin	Water depth : -16 m Diameter : 500 m	Water depth : -16 m Diameter : 600 m
	Accessible Max. Ship	100,000 DWT	100,000 DWT
	Sailing Support Facilities	The port has most required facilities such as tag, pilot, water supply, and oil supply facilities. The port is to be further enriched with completion of Container Terminal.	Contents of the development plan is still unrevealed. It is assumed that required facilities will be provided by the time of the opening of the port.
Berth and Berth Facilities	Total length of usable berths	700 m	700 m
	Max. water depth	-16 m, (100,000 DWT)	-16 m, (100,000 DWT)
	The number of berths	Raw material : One berth (-16 m) Product : Two berths (-12 m)	Raw material : One berth (-16 m) Product : Two berths (-12 m)
	Soil conditions	Very good (limestone layer)	Good (Sandstone layer)
	Cargo handling facilities	Material : two 1000-ton/hr unloaders Product : four 20-ton gantry cranes	Material : two 1000-ton/hr unloaders Product : four 20-ton gantry cranes
	Calmness rate	95 % or over.	95 % or over.
Road	Road	Near to the trunk road	Near to the trunk road

3. UTILITIES

3.1 Electric Power

It is indispensable for both sites to construct a new power plant for the Steel Complex. However, in view of short circuit capacity for operation of electric arc furnace, it needs to construct a bigger flicker compensation equipment in Salalah site than in Sohar site.

3.1.1 Power supply to Sohar

(1) Present status

No power is available for the Steel Complex at present. MOEW does not have a plan to provide required power to the Steel Complex in Sohar.

(2) Future

A capacity of 200 MW power generation plant for the Steel Complex needs to be constructed by the Steel Complex or private sector. In Sohar, other big projects such as petrochemical, oil refinery and aluminum smelter shall be planned to construct. There is a possibility that one of the big projects would have surplus electricity. In addition to the above, this power generation plant would be interconnected to the power supply grid between Muscat system and Sohar (including Wadi Jizzi power station) at 132 kV line within a couple of years by the government. If it is interconnected, the Steel Complex would be able to overcome the difficulties in the normal running load of the Steel Complex, and to obtain higher short circuit level (fault level).

Total power generation capacity supplied by network will be more than 2240 MW by the year of 2004.

(3) Evaluation

With the above measures, short circuit capacity of min. 3,000 MVA - max. 6,000 MVA could be obtained, and flicker compensation equipment to minimize voltage fluctuation could be reduced. The Steel Complex in the future could be operated without any power problem.

3.1.2 Power supply to Salalah

(1) Present status

Total power generation in Dhofar is 152 MW with diesel generators. MOEW does not have a plan to provide required power to the Steel Complex in Salalah.

(2) Future

Existing diesel generators are planned to be replaced with a new 200 MW gas turbine power station in Raysut by private sector. In addition to the above, a capacity 200 MW or larger power station for the Steel Complex needs to be constructed by the Steel Complex.

(3) Evaluation

However, short circuit level (fault level) by the above measures (total generation capacity :400 MW) may be max. 1,400 - 1,500 MVA. It is rather small. It is the reason why the Steel Complex needs to construct a bigger flicker compensation equipment to minimize voltage fluctuation. To make matters worse, it would be difficult to operate the power generation plant smoothly because of power fluctuation by heavy load of the EAF. This means that the Steel Complex could not be operated continuously. To avoid this problem, a power generator of larger capacity of more than 200 MW needs to be installed to make total capacity of 1,000 MW or large. We think it would not be an economical investment.

Remarks:

1)The short circuit level (fault level) of the electricity supply system is generally required to be more than 70 times of the arc furnace transformer capacity in order to prevent voltage disturbance from causing flicker phenomena during operation of an arc furnace.

2)Flicker level determines the short circuit level of the electricity supply system.
If the short circuit level is small, the flicker level becomes large and also the flicker compensation equipment needs large capacity.

3)Short circuit level at the point of common coupling determines reactance figures of the power supply system such as total connection capacity of generators, transformers and wires / cables. Large capacity of power generation obtains large short circuit level.

4)Formula of Flicker (Voltage fluctuation) dV and Short circuit level

$dV = r * dP / 10 + x * dQ / 10 \fallingdotseq x * dQ / 10$ (%) (in case $r < x$) at 10 MVA base

r : Resistance, x : Reactance, dP : Active power fluctuation, dQ : Reactive power fluctuation

Short circuit level (Fault level) = $10 * (100 / x)$ (MVA) at 10 MVA base

From the above formula, if x is small, dV becomes small and short circuit level makes large.

3.2 Natural Gas

There is not much difference between Salalah site and Sohar site. Although the construction of gas pipeline to both sites is included in Fifth Five-Year Plan, the total length of pipeline to Salalah site is longer by 400 km than that to Sohar site.

(1) Requirement of natural gas for the Steel Complex

DR-based integrated Steel Complex and power station for the Steel Complex under study will require natural gas indicated in Table 3-2-1.

Table 3-2-1 Required Quantity and Quality of Natural Gas for the Steel Complex

	The Steel Complex	Power station for the Steel Complex
Supply capacity	Max. 66,000 Nm^3/h Av. 54,000 Nm^3/h 396,000,000 Nm^3/year 14,700,000 MMBTU/year	Max. 50,000 Nm^3/h Av. 45,000 Nm^3/h 265,000,000 Nm^3/year 9,800,000 MMBTU/year
Service	Reducing gas for DR plant (Direct Reduction plant) Fuel gas for furnaces	Fuel gas for gas turbine and/or steam boiler
Supply pressure and quality	4.0±0.1 kg/cm^2G C5 + (Heavy hydrocarbon) : < 0.1(mol %) Sulfur (as H2S): < 5 ~ 10 ppm	27 ~ 30 kg/cm^2G

(2) Availability in each proposed Site

a) Salalah

< Present status>

No pipeline currently connects Salalah to the gas supply source.

The South Oman Gas Line (northern part :16" ; southern part: 10") is dedicated to PDO

operations and connects Saih Nihayda to Marmul.

It is fully used, leaving no capacity for the Steel Complex.

<Future plan>

A new pipeline is scheduled as Salalah pipeline.

The distance from Saih Nihayda to Salalah is approximately 700 km and the pipe size will be 20" ~ 28".

Front end design for the planned pipeline has started from June of 1998.

The construction of new pipeline is scheduled to be completed by the end of 2001.

[Required facilities outside the Steel Complex]

- Equipment :

Equipment will be prepared by Oman Government.

- Connection pipeline :

Pipeline will be prepared by Oman Government.

b) Sohar

<Present status>

The existing Government Gas System provides gas to Sohar area through a combined 20" and 36" pipeline from Yibal to Murayrat and a 16" pipeline from Murayrat to Sohar. In 1999, two new gas pipelines will be commissioned; a 48" pipeline from Saih Rawl to Sur and a 28" pipeline will link from Saih Rawl to the Government Gas System at Fahud. The supply capacity of the existing transmission system to Sohar is fully used and there is no capacity for the Steel Complex.

<Future plan>

A new pipeline is proposed from Fahud to Sohar to meet long-term domestic and industrial demands for the region. The distance from Fahud to Sohar is approximately 300 km. Front end design for the planned pipeline is based on a 32" diameter and design work has already been completed. The construction of new pipeline is scheduled to be completed by the summer in 2001.

(Required facilities outside the Steel Complex)

- Equipment :

  Equipment will be prepared by Oman Government.

- Connection pipeline :

  Pipeline will be prepared by Oman Government.

3.3 Industrial Water and Waste Water

Industrial water can be supplied in Salalah site because waste water treatment plant is under construction. However, it is necessary to construct desalination plant in Sohar site because there is no capacity to supply industrial water.

3.3.1 Industrial water

(1) Requirement of water for the Steel Complex

Requirement of water for the Steel Complex is estimated in Table 3-3-1.

Table 3-3-1 Requirement of Water for the Steel Complex

Water	Uses	Required quantity	Required quality
Potable water	For living in the Steel Complex	200 m^3/d	As per WHO or Omanian Standard
Fresh water	1. For cooling of equipment and products (cooling water) 2. Scrubber water for dust collectors	5,000 m^3/d	As per Recommendation by Japanese Iron and Steel Federation"
Sea water	1. For cooling of cooling water through heat exchanger 2. For power station (if required)	25,000 m^3/h (For the Steel Complex) 25,000 m^3/h (For power station)	Sea water temperature: Less than 35 deg.C

(2) Availability in each proposed site

a) Salalah

<Present status>

-Quantitative view

Potable water is available within 0.2 km.

Fresh water is not available and waste water treatment plant is now under construction.
Sea water is available at Raysut port.

-Qualitative view

Quality of potable water is within the limit of Omanian Standard.
The quality of TSW (Treated Sewerage Water) can be expected for the Steel Complex by using chemical treatment such as corrosion inhibitor, scale inhibitor and slime inhibitor.
The maximum sea water temperature is 30 deg.C and can be used for the Steel Complex.

<Future plan>

-Quantitative view

North Raysut water reclamation plant which has a capacity of 20,000 m^3/d at phase-I will be completed by the end of 2001. TSW will be in time for the Steel Complex and has enough capacity.

[Required facilities outside the Steel Complex]

- Equipment :

Total head of circulation pumps in the sea water intake system requires more than 20 m water head compared with those of circulation pumps in Sohar. This is because the Steel Complex is located about one kilometer away from the sea water intake system (unloading berth) at Raysut port in the case of Salalah and the highest plant site of the Steel Complex is 15.0 m higher than that of Sohar site.

(Calculation)

Friction loss of 1 km sea water pipeline : 5.6 m
(calculated as per Hazen & Williams equation)
Pumping height of the highest plant site : 15.0 m

Total required head : 20.6 m

- Connection pipeline :

The connection pipelines are required between supply point and the Steel Complex and

the details of connection pipelines are indicated in Table 3-3-2.

Table 3-3-2 Connection Pipeline in Salalah

		Potable water	Fresh water	Sea water
Required quantity	Max.(m^3/h)	200 m^3/d	5,000 m^3/d	50,000 m^3/h
	Av. (m^3/h)		150	50,000
Connection pipeline	From	Near port	North Raysut waste water treatment plant	Raysut port
	To	The Steel Complex	The Steel Complex	The Steel Complex
	Size (inch)	4	10	65
	Length (km)	0.2	3.0	1.0 x 2

b) Sohar

<Present status>

-Quantitative view

Potable water is available within 5.0 km ~ 7.0 km

Fresh water is not available.

Sea water is available at Sohar port.

-Qualitative view

Quality of potable water is within the limit of Omanian Standard.

Quality of fresh water will be attained by desalination plant so that product water quality will be meet the requirement of the Steel Complex.

The maximum sea water temperature could be 32 deg.C and can be used for the Steel Complex.

<Future plan>

-Quantitative view

The desalination plant can be installed in the Steel Complex and the required quantity will be covered by product water. On the other hand, there is a possibility that one of the big projects such as aluminum smelter, petrol chemical and oil refinery would have surplus water to other industries. In this case, the surplus water could be used for the Steel Complex and the desalination plant need not be installed in the Steel Complex.

[Required facilities outside the Steel Complex]

- Equipment :

Desalination plant (5,000 m^3/d) is required.

- Connection pipeline :

The connection pipelines are required between supply side and the Steel Complex and the details of connection pipelines are indicated in Table 3-3-3.

Table 3-3-3 Connection Pipeline in Sohar

		Potable water	Fresh water	Sea water
Required quantity	Max.(m^3/h)	200 m^3/d	5,000 m^3/d	50,000 m^3/h
	Av. (m^3/h)		150	50,000
Connection pipeline	From	Existing distribution network	In the Steel Complex	Sohar port
	To	The Steel Complex	The Steel Complex	The Steel Complex
	Size (inch)	4	10	65
	Length (km)	5.0~7.0	(Not required)	(Not required)

c) Summary of connection pipeline in both proposed sites.

The required pipelines between supply side and the Steel Complex are summarized in Table 3-3-4.

Table 3-3-4 Connection Pipeline in Both Sites

		Potable water	Fresh water	Sea water
Required quantity	Max.(m^3/h)	200 m^3/d	5,000 m^3/d	50,000 m^3/h
	Av. (m^3/h)		150	50,000
Connection pipeline in Salalah	From	Near port	North Raysut waste water treatment plant	Raysut port
	To	The Steel Complex	The Steel Complex	The Steel Complex
	Size (inch)	4	10	65
	Length (km)	Negligible	3.0	1.0x2
Connection pipeline in Sohar	From	Existing distribution net work	In the Steel Complex	Sohar port
	To	The Steel Complex	The Steel Complex	The Steel Complex
	Size (inch)	4	10	65
	Length (km)	5.0~7.0	(Not required)	(Not required)

3.3.2 Waste Water

(1) Waste water from the Steel Complex

Waste water from the Steel Complex is indicated in Table 3-3-5.

Table 3-3-5 Waste Water Quantity and Discharge Quality for the Steel Complex

	The Steel Complex	Power station (In case of GT/ST combined cycle)
Discharge quantity (m^3/h)	25,000 m^3/h	25,000 m^3/h
Discharge quality	7.0 deg.C above ambient receiving sea water temperature	7.0 deg.C above ambient receiving sea water temperature
(Live sewerage water)	Live sewerage will be treated in the Steel Complex and the treated water will be reused for plantation of the Steel Complex.	-

(2) Availability at the proposed site

a) Salalah

<Present status>

Sea water will be fed from Raysut port and hot waste water will be discharged via Wadi Adawni to the opposite side of container jetty.

[Required facilities outside the Steel Complex]

- Equipment :

  Not required.

- Connection pipeline :

  Not required.

b) Sohar

<Present status>

There is only the seashore.

<Future>

Sea water will be fed from Sohar port and hot water will be discharged to the sea outside of breakwater through 2 or 4 pipelines so that hot waste water will not be mixed with sea water intakes.

(Required facilities outside the Steel Complex)

- Equipment :

  Not required.

- Connection pipeline :

  Discharge pipeline from the Steel Complex to the outside of breakwater is required.

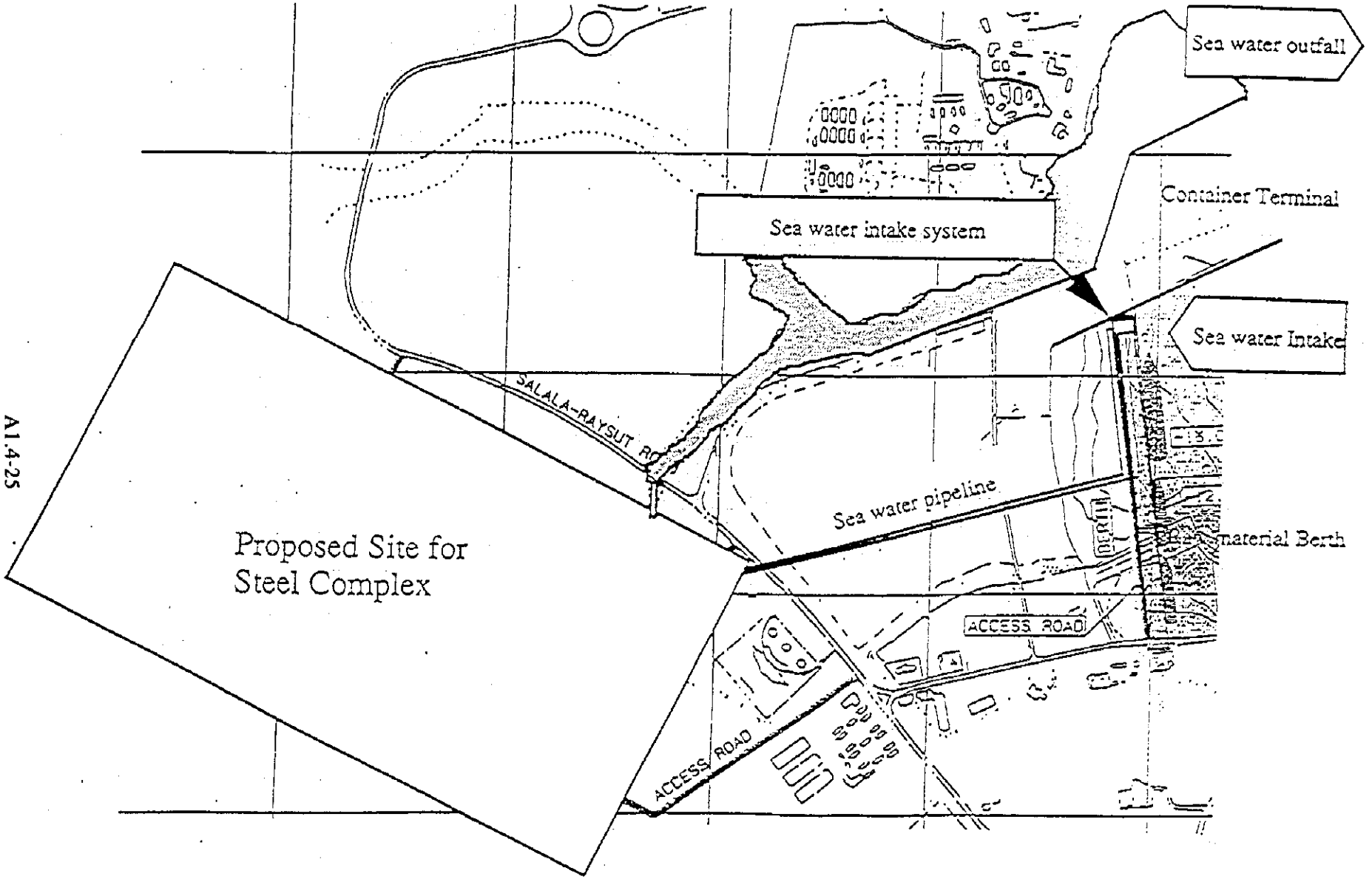

Figure Layout of Sea Water Intake and Outfall System in Salalah

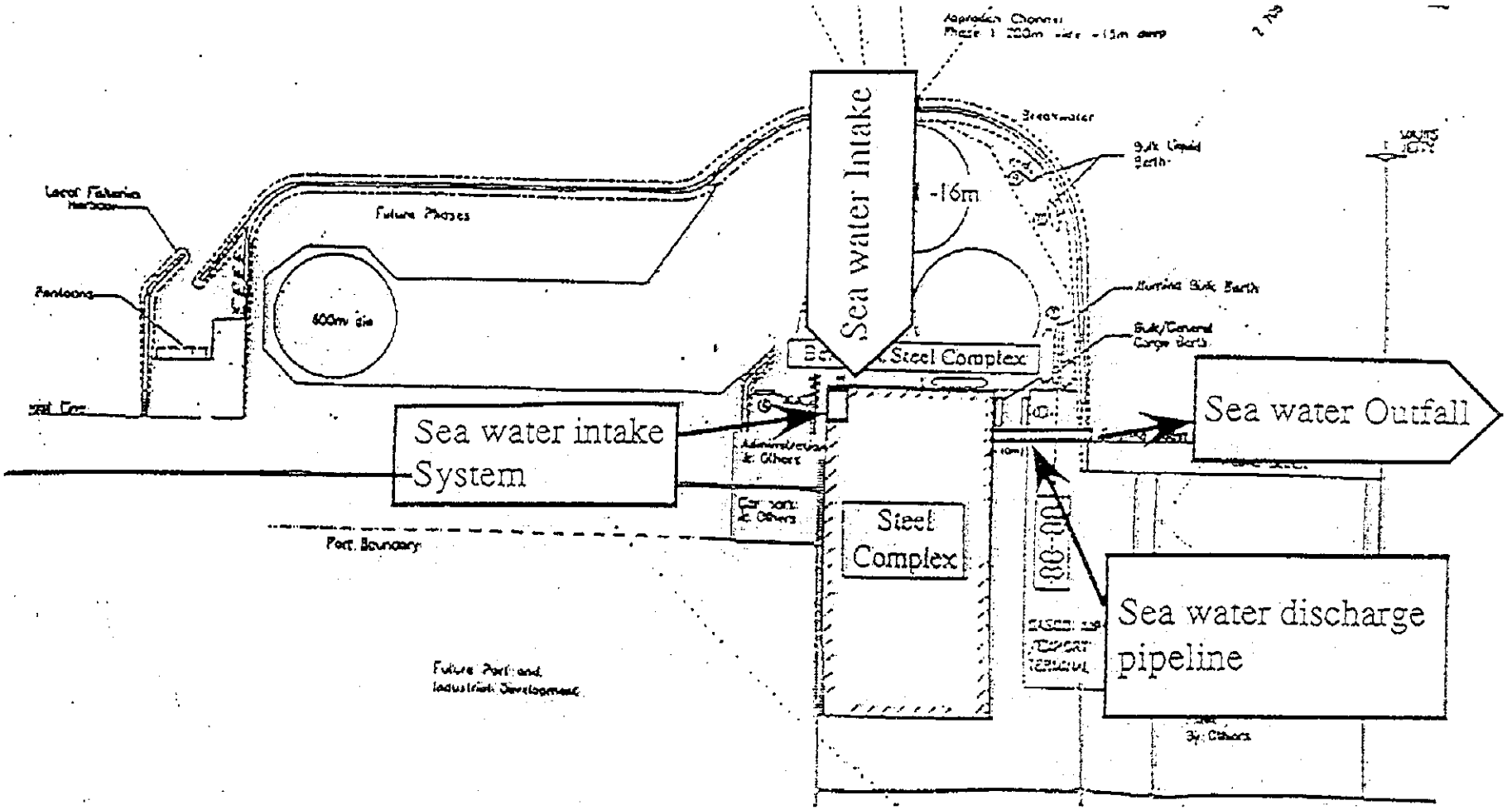

Figure Layout of Sea Water Intake and Outfall System in Sohar

4. SOCIAL CONDITIONS

There is no difference between Salalah site and Sohar site in social conditions. Especially, on environment and pollution, there is no difference because of no big industries.

4.1 Supporting Industries

According to the answer to our Questionnaire in February 1998, there are 248 companies in new-industrial area in Salalah, whose businesses are such as machining, steel member working, repair/maintenance work and transportation which could be subcontractors to the Steel Complex when necessary after the operation starts. The number of their employees are 3,880 in total, and among them 3,400 are employees in transportation companies.

In Sohar Industrial Area, there are about 200 companies in the same fields as above. Unfortunately, the Study Team could not get the number of employees of these companies in Sohar. But as far as we observed the Sohar Industrial Area, the numbers would not be less than that in Salalah because so many factories are already on operation there.
As already reported in the Interim Report (refer to 6.8 Maintenance, 6.10 Transportation), maintenance work and intra-works transportation are both planned to be done by the Company itself in principle. That means it would not be very fatal whether the number of companies or that of employees are big, or not. They will be helpful in case of some peaks of maintenance work or heaps of transportation work.

4.2 Human Resources and Housings

4.2.1 Human Resources

There is no integrated steel works in Oman at present, and there is not metallurgical or chemical engineering course in Sultan Qaboos University. As for vocational training, several numbers of public technical industrial colleges for secondary school graduates, and technical industrial institutes for dropouts are already established. Considerable number of private institutes have also started vocational training. Training expenses are paid by Government with some salary for student in case of public technical industrial colleges. The problem is, though the Study Team only observed Salalah Industrial Technical College (public) and High Institute of Administrative and Technical Sciences (private), that the number of trainers, especially well-specialized trainers are not enough compared with the experiment facilities. It will be indispensable for the Steel Complex to recruit most of engineers and skilled labor forces required from foreign countries, and qualified graduates in Oman will be adopted in accordance with Omanization policy, who must work together with experienced engineers and skilled workers to get necessary knowledge and skill.

According to the General Census of Population in 1993, the grand total of population in Oman is 2,018,074. That of Dhofar Governorate is 189,094 and among them economically active male population is 76,932. As for Al Batinah Governorate, the population is 564,677, among them economically active male population is 148,307. The Study Team learned that the population in Salalah city is around 140,000 and that of Sohar city is around 100,000. The Census shows that the population of boys aged between 10 and 15 in 1993 is about 139,000 (from the educational attainment table), and on a simple assumption, 7% and 5% (140,000 and 100,000/2,018,074) of them, near 10,000 or 7,000 boys will be in Salalah city and Sohar city. From those figures, we do not see any problem on recruiting work forces for the Steel Complex since it will only need 1,200 workers at most, and in earlier stage it is also necessary, as described above, to recruit most part of work forces from outside.

4.2.2 Housings

There is a residential area in the Raysut region, and it is possible to build corporate houses and dormitories there. It will also be possible in Sohar to build corporate houses and dormitories near to the Steel Complex. According to the branch offices of Ministry of Housing, it is also possible to obtain enough number of good houses for rent in either city. Therefore it will not be necessary to worry about problems on the Steel Complex employees' housing matter.

4.3 Environment and Pollution

4.3.1 The environmental laws

There is only one law on pollution control in Oman. Local law or regulation does not exist. Therefore, it will be under the same condition whether the Steel Complex is located in Salalah or in Sohar.

4.3.2 Environmental condition of both sites

At present, there are no remarkable environmental problems at Salalah and Sohar due to their lower industrial activity and the geographical conditions.

Both proposed site are located more than 1 kilometer far from the district of residence.

4.3.3 Evaluation

Two proposed sites are to be evaluated as same on environment and pollution.

There will not be any problems in installation of the Steel Complex at any sites if the plant is equipped with well designed environmental pollution control system.

5. SUMMARY OF THE TECHNICAL EVALUATION

Table 5-1 Summary of the Technical Evaluation

Item to be considered	Importance	Rating		Score	
		Salalah	Sohar	Salalah	Sohar
1. LAND					
1.1.Dimension and area of the site	5	A-8	A-10	4.0	5.0
1.2.Geographical conditions	5	A-7	A-10	3.5	5.0
1.3.Soil conditions	5	A-10	A-9	5.0	4.5
2. PORT AND ROAD					
2.1.Port and port facilities	20	A-10	A-9	20.0	18.0
2.2.Berth and berth facilities	5	B-7	B-7	3.5	3.5
2.3.Road	5	A-10	A-10	5.0	5.0
3.UTILITIES					
3.1.Electric power	15	B-5	B-7	7.5	10.5
3.2.Natural gas	15	A-7	A-7	10.5	10.5
3.3.Industrial water and waste water	10	A-9	B-7	9.0	7.0
4.SOCIAL CONDITION					
4.1.Supporting industries	5	B-6	B-6	3.0	3.0
4.2.Human resources and housings	5	B-6	B-6	3.0	3.0
4.3.Environment and pollution	5	A-10	A-10	5.0	5.0
TOTAL	100.0			79.0	80.0

II. ECONOMICAL COMPARISON

II. ECONOMICAL COMPARISON

1. LAND AND FOUNDATION

As for cost of land preparation, it is higher in Salalah by US$ 19.47 million than in Sohar. However, as for cost of foundation it is higher in Sohar by US$ 11.86 million than in Salalah.

The detailed economic comparison of two sites are tabulated below.

Table II-1-1 Comparison of Two Sites

ITEM	SALALAH	SOHAR
Land Preparation	7.220 million RO. (18.77million US$) (Cutting & Filling of Rocky Soil and slope protection) 0.730 million RO. (1.90 million US$) (WADI roundabout way)	0.480 million RO. (1.25 million US$) (Leveling of dredged soil).
	Total 7.950 million RO. (20.67 million US$)	Total 0.480 million RO. (1.25 million US$)
Foundation	0.720 million RO. (1.87 million US$) (Rock excavation)	3.480 million RO. (9.05 million US$) (Piling work) 1.800 million RO. (4.68 million US$) (Soil Improvement)
	Total 0.720 million RO. (1.87 million US$)	Total 5.280 million RO. (13.73 million US$)
Sea water	1.040 million RO. (2.70 million US$) (Intake Line)	1.060million RO. (2.76 million US$) (Discharge Line)
	Total 1.040 million RO. (2.70 million US$)	Total 1.060 million RO. (2.76 million US$)

2. PORT

There is not much difference on port between Salalah site and Sohar site.

The detailed economic comparison of port facilities is tabulated below.

Table II-2-1 Comparison of Two Port facilities

ITEM	SALALAH	SOHAR
Dredging	0.360 million RO. (0.94 million US$)	
Quay wall and crane foundation	9.700 million RO. (25.22 million US$)	10.890 million RO. (28.31 million US$)
	Total 10.060 million RO. (26.16 million US$)	Total 10.890 million RO. (28.31 million US$)

Berth shall be constructed by the Government of the Sultanate of Oman.

3. FACILITIES IN PLANT

3.1 Piping and Conveyor

Cost of piping and conveyor is higher by US$ 4.3 million in Salalah than in Sohar because Salalah site is 1 km away from the berth facilities.

(1) Piping

The required connection piping for the Steel Complex is indicated in Table 3-3-4 and the piping cost is estimated in each proposed site as follows :

a) Salalah

Table 3-1-a

	Potable water	Industrial water (TSW)	Sea water	Total
From	Near port	North Raysut waste water treatment plant	Raysut Port	
To	Steel Complex	Steel Complex	Steel Complex	
Size (inch)	4	10	65	
Length (km)	Negligible	3.0	1.0 x 2	
Materials	Ductile cast Iron pipe	Ductile cast iron pipe	Steel pipe with tar epoxy coating	
Piping cost as installed (indicative value)	Negligible	US$ 0.4 million	US$ 2.7 million	US$ 3.1 million

b) Sohar

Table 3-1-b

	Potable water	Industrial water (Desalination plant)	Total
From	Near port	Steel Complex	
To	Steel Complex	Steel Complex	
Size (inch)	4	10	
Length (km)	7.0	Not required	
Materials	Ductile cast iron pipe	-	
Piping cost as installed (indicative value)	US$ 0.2 million	US$ 0.0	US$ 0.2 million

(2) Conveyor

If the belt conveyors are to be installed within the battery limit of the Steel Complex concerned, there is no difference between Salalah site and Sohar site. However, as the Steel Complex located about one kilometer away from the unloading berth at Raysut Port in the case of Salalah, unloaded iron ore (oxide pellets and/or lump ore) will have to be transported by a belt conveyor to the Steel Complex.

The belt conveyor is estimated to be as follows;

Quantity: One set
Type: 30 deg. x 3 rollers, gallery frame
Capacity: 2,000 t/h

Belt width:	1,200 mm
Horizontal length:	Approx. 1 km
Vertical lift:	Approx. 13 m
Motor horsepower:	150 kW
Cost as installed:	US$ 4.2 million (indicative value)

The above cost has to be added to the capital investment cost in the case of Salalah site.

3.2 Foundation

Foundation cost is estimated in Table II-1-1.

3.3 Desalination Plant

Desalination plant is not necessary in Salalah site because waste water treatment plant is under construction. On the other hand, Sohar site will require desalination plant. Therefore the investment cost is higher by US$ 17.0 million in Sohar site than in Salalah site.

Specification and cost estimation of desalination plant which is to be installed in Sohar are described in detail as follows;

(1) Specification of desalination plant

(a) Design criteria

- Raw sea water temperature :

  Design condition : 30 deg.C

  Maximum allowable temperature : 35 deg.C

  Conductivity of sea water : 54,100 μS/cm

- Product water quality :

  The standard quality of drinking water in the Sultanate of Oman (OS8/1978)

  TDS : < 110 mg/litter

  Total hardness : < 20 ppm as CaCO3

Chloride iron : < 50 mg/l as CaCO3

- Production capacity : 5,000 m^3/d

(b) Type of desalination plant : R-O (Reverse Osmosis) type

The following equipment will be included;

- R-O module unit
- Sand filter bed
- Safety filter
- Main pumps
- High pressure pump
- Chemical dosing unit

(2) Estimation of desalination plant

Cost as installed: US$ 17.0 million (indicative value)

The above cost has to be added to the initial investment cost in the case of Sohar site.

3.4 Waste Water

Discharge pipeline is required in Sohar site. Although it is described in the column of Sea water in Table II-1-1, the details are as follows;

	Waste water (Discharge lines)
From	Sohar Port
To	Steel Complex
Size (inch)	65
Length (km)	0.8 x 2
Materials	Steel pipe with tar epoxy coating
Piping cost as installed (indicative value)	US$2.8

3.5 Electric

The investment cost for flicker compensation equipment is higher by US$ 5.1 million in Salalah site than in Sohar site.

Table 3-5-1 Flicker Compensation Equipment

Unit : Million

No.	Description	Site			
		Salalah		Sohar	
		Equipment cost	Opert'n cost	Equipment cost	Opert'n cost
1	Flicker compensation equipment SVC capacity ; 127 MVA for Salalah 56 MVA for Sohar	US$ 9.1	even	4.0	even

4. ENERGY AND UTILITIES

There is not much difference on energy and utilities between Salalah site and Sohar site. The difference is only the operation cost of industrial water in Sohar site, which is higher by US$ 0.8 million than that in Salalah site.

4.1 Unit Cost of Electric Power

Table 4-1-1 Unit Cost of Electric Power

Unit :Million

Description	Site			
	Salalah		Sohar	
	Equipment cost	Operation cost	Equipment cost	Operation cost
Power generation plant 100MW GT with 220t/h heat recover boiler x 2 sets				
(a) Constructed by the Steel Complex Equipment cost :US$ 110.5 Construction cost : RO 8.85 (US$ 22.8) Total : US$ 133.3	US$ 133.3*	18.9bz/kWh	US$ 133.3*	18.9bz/kWh
(b) Constructed by private sector	NA		(US$ -133.3)	(16bz/kWh)
(c)Generation cost difference Difference ;2.9bz/kWh Power consumption : 1,223.2GWh/y				
1) Constructed by the Steel Complex		US$9.2		US$9.2
2) Constructed by private sector		NA		(US$9.2)

Note ; ( ) shows in case that a big project is executed in Sohar.

The figure with * mark is the case of Ghubra Power Station, given by MOEW.

4.2 Unit Cost of Natural Gas

PDO has explained to the Study Team about unit technical cost of natural gas (Supply facility + Transportation + Quality) and requested us to apply the same unit cost to both site cases.

Unit cost will be not less than 0.8 US$/MMBTU.

4.3 Unit Cost of Industrial Water

a) Salalah

Unit cost of industrial water in Salalah will be 0. 22 RO/m^3 tentatively.

* Data of unit cost was collected from SSDCO (Salalah Sanitary Drainage Service Co.).

Operation cost in Salalah:

Consumption of industrial water=1,090,000m^3/y

Total operation cost =0.22 x 1,090,000 =239,800 RO/y

b) Sohar

[In case of installation of desalination plant in the Steel Complex]

Unit cost of industrial water in Sohar will be 0.515 RO/m^3 .

* Data of unit cost was collected from JICA report in 1994.

Operation cost in Sohar:

Consumption of industrial water = 1,090,000m^3/y

Total operation cost =0.515 x 1,090,000 = 561.350 RO/y

Difference cost between Sohar and Salalah = 320,550 RO/y (= US$ 0.8 million)

[In case of supply water from industrial area]

Unit cost of industrial water in Sohar will be 0.66 RO/m^3 .

* Data of unit cost was collected at SDO (Sohar Development Office)

Operation cost in Sohar:

Consumption of industrial water=1,090,000m^3/y

Total operation cost =0.66 x 1,090,000 =719,400 RO/y

Difference cost between Sohar and Salalah=479,600 RO/y (=US$ 1.25 million)

5. TRANSPORTATION COSTS FOR FINISHED PRODUCTS

Sohar site has a great advantage in transportation costs of finished products because it is by far near to the market. The difference of its transportation costs is about US$ 15 to 19 million per year.

Price of steel bars at each market : delivered price for each customer is the same, while the ex-works price of steel bars differs depending on the transportation cost from the Steel Complex to a customer.

In comparison of the location between two plant sites, Sohar site is nearer to the market than Salalah site.

(1) Sales plan of steel bars

According to our market study, the destination of steel bar shipment of the Steel Complex is as follows:

Steel Bar Shipment Plan

Country	Year 2005 ('000T/Y)
Oman	400
UAE	470
Kuwait	34
Bahrain	10
Saudi Arabia	30
Yemen	130
Jordan	5
Syria	10
Kenya	1
Tanzania	1
Pakistan	3
ASEAN	70
Total	1,164

Note) The above plan is revised from Table 4-5-3 of the Interim Report according to the Minutes of Meeting of July 8, 1998.

Regarding the regional demand in Oman, it is estimated as shown in the following table in proportion to the share of the investment in the Fifth Five-Year Plan (1996 - 2000).

Region of Oman	Steel Bar Shipment ('000T/Y)
Muscat	74
Al Batinah (Sohar)	67
Musandam	11
A'Dahirah	54
Ad Dakhlyah (Nizwa)	85
Ashsharqiyah (Sur)	55
Al-Wusta	16
Dhofar (Salalah)	39
Total	400

(2) Estimated transportation cost of steel bars to each market from the Steel Complex

According to the field surveys and various information, transportation costs of steel bars from Salalah and Sohar to each destination are estimated as follows:

Estimated transportation Cost of Steel Bars

Region of Oman	Estimated Transportation Cost (US$/T)			
	from Sohar		from Salalah	
Muscat	6	by road	25 - 30	by sea
Al Batinah (Sohar)	3	by road	25 - 30	by sea
Musandam	6	by road	30 - 35	by sea and road
A'Dahirah	6	by road	30 - 35	by sea and road
Ad Dakhlyah (Nizwa)	10	by road	25 - 30	by sea and road
Ashsharqiyah (Sur)	15	by road	25 - 30	by sea and road
Al-Wusta	20 - 25	by road	6	by road
Dhofar (Salalah)	25 - 30	by road or sea	3	by road

Export/Country	Estimated Transportation Cost (US$/T)			
	from Sohar		from Salalah	
UAE	8	by road	30 - 35	by sea and road
Kuwait	25 - 30	by sea	30 - 35	by sea
Bahrain	15 - 20	by sea	20 - 25	by sea
Saudi Arabia	15 - 20	by sea	20 - 25	by sea
Yemen	30 - 35	by sea	25 - 30	by sea
Jordan	25 - 30	by sea	25 - 30	by sea
Syria	25 - 30	by sea	25 - 30	by sea
Kenya	30 - 35	by sea	25 - 30	by sea
Tanzania	30 - 35	by sea	25 - 30	by sea
Pakistan	20 - 25	by sea	20 - 25	by sea
ASEAN	35 - 40	by sea	30 - 35	by sea

(3) Difference of the steel bar transportation costs to the market between Salalah and Sohar

Judging from the sales plan by region/ country and estimated transportation costs to each market, the Steel Complex located in Sohar will have advantage of about US$ 15 - 19 million per year in the transportation costs of finished products over the case of Salalah.

The advantage of US$ 15 - 19 million per year is equivalent to US$ 92 - 117 million of initial capital investment in terms of net present value for 10 operational years (discount rate: 10%/year).

The main reason for the above is that Sohar is located very close to the major target markets of the planned Steel Complex project: Muscat & northern regions of Oman and UAE.

6. Comparison in Total Amount of Initial Investment and Operation Costs

Cost Factors	Salalah		Sohar		Remarks
	Initial Investment Cost (Unit: Million US$)*2	Operation cost (Unit: Million US$/y)	Initial Investment Cost (Unit: Million US$)*2	Operation cost (Unit: Million US$/y)	
1. LAND					
1.1 Acquisition of land or rental fee	*1	100baiza/m2/year	*1	100baiza/m2/year	
1.2 Land preparation	20.7		1.2		
1.3 Slope protection					
2. PORT AND BERTH FACILITIES					
2.1 Port and berth tariffs	*1	same	*1	same	
2.2 Berth	*1	same	*1	same	
2.3 Berth facilities	*1	same	*1	same	
3. FACILITIES IN PLANT					
3.1 Piping	3.1		3.0		
Conveyor	4.2		0.0		
3.2 Foundation	1.9		13.7		
3.3 Desalination plant	0.0		17.0		In case of water supplied from industrial area at SUR
3.4 Waste water	-		-		
3.5 Electric	9.1	*1	4.0	*1	Flicker compensation equipment
4. ENERGY AND UTILITIES					
4.1 Unit cost of electric power	-	*1	-	*1	
4.2 Unit cost of natural gas	-	*1	-	*1	
4.3 Unit cost of industrial water	-	0.22 RO/m3	-	0.8 (0.515 RO/m3)	In case of installation of desalination plant
		0.0		(0.66RO/m3) (1.3)	In case of supply water from industrial area
5. TRANSPORTATION COSTS OF FINISHED PRODUCTS					
5.1 Road and sea	-	15.0 -19.0	-	-	
TOTAL OF INVESTMENT AND OPERATION COSTS	39.0	15.0 -19.0	38.9	0.8	

*1 Conditions of Salalah and Sohar are even.
*2 These figures of Initial Investment Cost are the differences caused by the site conditions.

III. RECOMMENDATION

III. RECOMMENDATION

The results and recommendation of the Study Team can be summarized as follow;

(1) Conclusion of the site selection

It is concluded that Sohar site would be more appropriate for conducting further feasibility study after due consideration of the features and results of the technical and economical evaluations on both sites of Salalah and Sohar based on Methodology for Plant Site Selection agreed by the Steering Committee of the Government of the Sultanate of Oman and the Study Team of JICA.

Followings are the briefing of the conclusion.

1) Technical evaluation

The scores of technical evaluation for both sites based on Methodology for Plant Site Selection are 79.0 points for Salalah and 80.0 points for Sohar. Both sites of Salalah and Sohar are technically acceptable as the Steel Complex site.

However, there is some concern for the operation of electric arc furnace with bigger flicker compensation because of small short circuit level of electricity in Salalah comparing with Sohar.

2) Economical evaluation

2)-1 Financial evaluation

- There is not much difference of the initial investment cost between both sites of Salalah and Sohar though it is higher by US$ 0.1 million in Salalah site than in Sohar site.
- Difference of operation cost between Salalah site and Sohar site is estimated at around US$12.2~15.6 per ton of finished products (US$14,200,000~18,200,000 per year), which is higher in Salalah site.

2)-2 Economical evaluation for national economy

- In view of national economy of Oman, investment cost of constructing gas pipeline to Salalah is much higher than that to Sohar because its length to Salalah is longer by 400 km than that to Sohar. Consequently unit technical cost of natural gas is to be different at each site. If the Government of Oman applies the same price of natural gas to each site, the supply of the price difference would be a big burden to the Government of Oman.

3) Recommendation

In careful consideration of big flicker compensation, a big difference of annual operation cost (US$14,200,000 ~ 18,200,000 per year) and of national economy of Oman, Sohar site would be more appropriate for conducting further feasibility study.

The Steering Committee of the Government of the Sultanate of Oman shall make its decision based on this report and inform the selected site (one site) to JICA and the Study Team by September 14, 1998.