FEASIBILITY STUDY
OF
THE SAWAHLUNTO COAL EXPLORATION

〔SUMMARY〕

FEBRUARY 1981

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

A feasibility study under the program of "Scope of works for the feasibility study of the Sawahlunto Coal Exploration (CTA MINING 115)", concluded on 5th October, 1979, between the Ministry of Mines and Energy, Indonesia,and Japan International Cooperation Agency was carried out aiming to the project evaluation based upon an increased coal production from the Ombilin Coal Mine, subsequent to the completion of the geological exploration.

The study consists of following four main chapters.

I Development of Coal Mine

II Coal Storage and Shiploading

III Railway Transportation

IV Economic Evaluation

Basic idea for the study was discussed fully with the members of the Steering Committee and its working group in Indonesia in advance of the commencement of works, and concluded in the "Guidance for the feasibility study of the Sawahlunto Coal Exploration" dated 7th August, 1980.

Here, we take pleasure in expressing our sincere gratitude to the Authorities concerned in Indonesia and Japan.

February 1981

Eiichi KAWAI
Chief of Study Team
Japan International Cooperation Agency

N

PADANG PANJANG
ELEV+773 M

△ 1377

Batutabal
.370 M

Kajutanam
ELEV+144 M

Ombilin river

OMBILIN COAL MINE

LAKE
SIRGKARAK

1440 △

CURRENT OPERATING
AREA

NEW DEVELOPMENT
AREA

△ 967

LUBUKALUNG
ELEV+25 M

Singkarak
· 369 M

Sawah Lunto

Muaro

Sidjunjung

TRANSMATRA HIGH WAY

△ 1600

△ 1190

Duku

SOLOK
· 388 M

△ 1500

Indian Ocean

Tobing

△ 1800

Semen Padang

PADANG

Rope way

BTPUTUS

TELUK BAYUR PORT

△ 1550

DIBARUH

0 5 10
km

KUTARADJA

MEDAN

SUMATRA

PADANG

INDIAN
OCEAN

100°

6°

0°

96°

5°

Legend

Rail Way (WEST SUMATRA PJKA)

Main Road

SAWAH LUNTO COAL EXPL

PADANG PANDJANG
ELEV+773 M

△ 1377

Batutabal
.370 M

Kajutanam
ELEV+144 M

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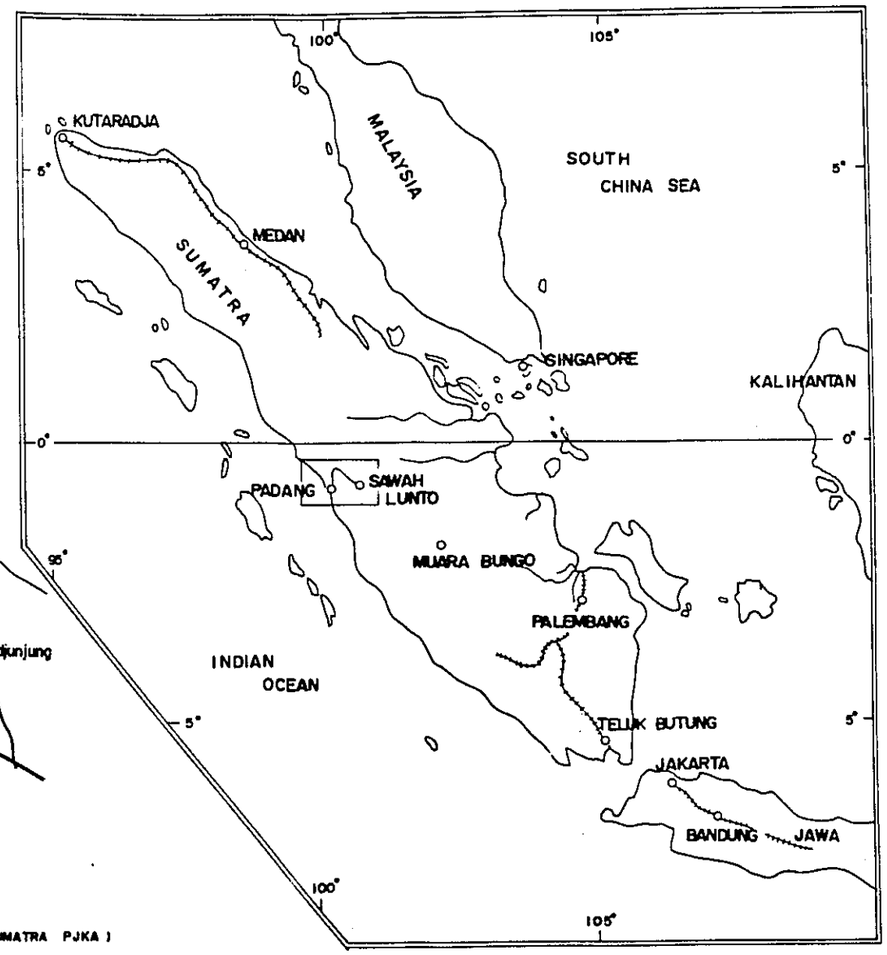


SAWAH LUNTO COAL EXPLORATION

CONTENTS

1. BRIEF

(1) Project schedule

- Decision 1981
- Engineering design 1982
- Procurement, construction and installation 1983∿85
- Commencement of production from the new developing area 1986

Production from the current operating area is continued toward the future with increased output.

(2) Coal output

Aiming to 1.0 million tons a year (clean coal basis) comprising,

400,000 tons from the current operating area

600,000 tons from the new developing area

(3) Initial investment

US$ 107 million (basis of the end of 1980) comprising,

US$ 49 million for mine development

US$ 22 million for storage and shiploading

US$ 36 million for railway transportation

(4) Coal sale (correspond to 1.0 million tons output)

60,000 tons : Own use

480,000 tons : Domestic sale (330,000 for Padang Cement & 150,000 for Andaras Cement)

460,000 tons : Export (Malaysia etc.)

(5) Economics (As most likely case)

- Selling price

Domestic	US$ 22.0/ton	FOR basis
Export	US$ 30.0/ton	FOB basis

- Escalation

  10%/yr for both of the price and all expenses

- DCF rate of return

  About 17% (Evaluation period: 1981∿2005, Present value of 1980)

Table 1 PRODUCTION AND SALES SCHEDULE

[1,000t]

		1981	1982	1983	1984	1985	1986	1987	1988	1989	1990∿2005
Production	Current operating area	200	300	400	400	400	400	400	400	400	Equal to the amount of 1989.
	New developing area						150	300	450	600	
	Total	200	300	400	400	400	550	700	850	1,000	
Sale	Own consumption	15	15	20	20	20	40	40	60	60	
	Domestic sale	140	235	235	330	330	480	480	480	480	
	(Padang Cement)	(140)	(235)	(235)	(330)	(330)	(330)	(330)	(330)	(330)	Equal to the amount of 1989.
	(Andaras Cement)						(150)	(150)	(150)	(150)	
	Export	45	50	45	50	50	30	180	310	460	
	Total	200	300	300	400	400	550	700	850	1,000	
Remarks	Amount for railway transport	185	285	280	380	380	510	660	810	940	Equal to the amount of 1989.
	Amount for shiploading	45	50	45	50	50	180	330	460	610	

Table 2 INVESTMENT SCHEDULE

[10^6US$]

	Item	Investment			Investment by year										( ): Additional	
		Initial	Additional	Total	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991~2005
Mine	Current operating area	13.6	36.2	49.8	0.7	1.8	8.2	0.2	1.8	0.9	(1.8)	(0.8)	(0.2)	(3.0)	(5.8)	(24.6)
	New developing area	29.2	41.4	70.6				4.0	6.2	10.4	2.9	5.7 (0.9)	(0.6)	(0.6)	(1.8)	(37.5)
	Contingency	2.9		2.9				0.4	0.6	1.0	0.3	0.6				
	Engineering Design	3.6		3.6			0.4	0.1	0.9	2.1	0.0	0.1				
	Sub total	49.3	77.6	126.9	0.7	1.8	8.6	4.7	9.5	14.4	3.2 (1.8)	6.4 (1.7)	(0.8)	(3.6)	(7.6)	(62.1)
Port	Wharf	6.4		6.4					4.5	1.9						
	Shiploading	10.4		10.4					7.3	2.8	0.3					
	Coal storage	2.4		2.4					1.8	0.6						
	Contingency	0.9		0.9					0.6	0.3						
	Engineering Design	1.6		1.6			0.5		0.9	0.2						
	Sub total	21.7		21.7			0.5		15.1	5.8	0.3					
Total		71.0	77.6	148.6	0.7	1.8	9.1	4.7	24.6	20.2	3.5 (1.8)	6.4 (1.7)	(0.8)	(3.6)	(7.6)	(62.1)
Railway	Rolling stock	21.9		21.9			4.6	0.2	1.0	3.3	10.0	1.6	1.2			
	Rail track	8.0		8.0				5.0	3.0							
	Others	3.9	2.6	6.5			0.4	2.1	1.4				(0.3)	(0.3)		(2.0)
	Contingency	2.0		2.0			0.6	0.9	0.5							
	Engineering Design															
	Total	35.8	2.6	38.4			5.6	8.2	5.9	3.3	10.0	1.6	1.2 (0.3)	(0.3)		(2.0)
Grand total		106.8	80.2	187.0	0.7	1.8	14.7	12.9	30.5	23.5	13.5 (1.8)	8.0 (1.7)	1.2 (1.1)	(3.9)	(7.6)	(64.1)

Table 3 Ombilin Coal Mine profit and loss, and cash flow

				1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
①	Capital investment (loan)	US$ 10^3																											
②	" (cash)	"		717	1,839	9,133	4,758	24,523	20,124	5,272	8,090	874	3,616	7,639	4,117	3,779	3,097	4,875	8,793	4,040	2,604	8,161	3,887	4,071	2,793	2,296	3,117	3,314	2,885
③	Dep. asset	"		717	1,839	9,133	4,758	24,523	20,124	5,272	8,090	874	3,616	7,639	4,117	3,779	3,097	4,875	8,793	4,040	2,604	8,161	3,887	4,071	2,793	2,296	3,117	3,314	2,885
④	Clean coal production	t 10^3		150	200	300	300	400	400	550	700	850	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
⑤	Saleable amount (inland use)	"		125	140	235	235	330	330	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480	480
⑥	" (export)	"		10	45	50	45	50	50	30	180	310	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460	460
⑦	" (total)	"		135	185	285	280	380	380	510	660	790	940	940	940	940	940	940	940	940	940	940	940	940	940	940	940	940	940
⑧	Sales	US$ 10^3		3,050	4,430	6,670	6,520	8,760	8,760	11,460	15,960	19,860	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360	24,360
⑨	Operating cost (current operating area)	"		2,925	3,033	3,245	4,063	4,150	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121	4,121
⑩	" (planning area)	"								4,171	4,417	4,386	4,457	4,457	4,457	4,457	4,457	4,457	4,457	4,447	4,447	4,447	4,447	4,447	4,447	4,447	4,447	4,447	4,447
⑪	Common expenses	"		1,499	1,513	1,527	1,492	1,453	1,468	1,483	1,498	1,514	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530	1,530
⑫	Selling expense (railroad fare)	"		41	184	205	184	205	205	123	736	1,268	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881	1,881
⑬	(port charge)	"		30	135	150	135	150	150	Δ891	Δ380	Δ214	Δ100	Δ100	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9	Δ9
⑭	Overhead of head office	"		843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843	843
⑮	Operating profit	"	8 - 9 - 10 - 11 - 12 - 13 - 14	Δ2,288	Δ1,278	700	Δ197	1,959	1,973	1,607	4,725	7,942	11,628	11,628	11,537	11,537	11,537	11,537	11,537	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547
⑯	Interest on loan	"																											
⑰	Depreciation	"		968	968	1,006	2,013	2,013	2,013	5,686	6,038	6,817	6,851	6,890	5,834	5,858	5,817	5,737	5,771	5,674	5,738	5,833	5,861	5,868	5,928	5,949	5,967	5,335	5,364
⑱	Fixed cost	"																											
⑲	Profit B.F. tax	"	15 - 16 - 17 - 18	Δ3,256	Δ2,246	Δ306	Δ2,210	Δ54	Δ40	Δ4,079	Δ1,313	1,125	4,777	4,738	5,703	5,679	5,720	5,800	5,766	5,873	5,809	5,714	5,686	5,679	5,619	5,598	5,580	6,212	6,183
⑳	Income tax	"																											
㉑	Net profit	"	19 - 20	Δ3,256	Δ2,246	Δ306	Δ2,210	Δ54	Δ40	Δ4,079	Δ1,313	1,125	4,777	4,738	5,703	5,679	5,720	5,800	5,766	5,873	5,809	5,714	5,686	5,679	5,619	5,598	5,580	6,212	6,183
㉒	Cash flow	"	21 + 17	0	0	0	0	1,959	1,973	1,607	4,725	7,942	11,628	11,628	11,537	11,537	11,537	11,537	11,537	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547
㉓	Repayment	"																											
㉔	Net cash flow	"	22 - 23	0	0	0	0	1,959	1,973	1,607	4,725	7,942	11,628	11,628	11,537	11,537	11,537	11,537	11,537	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547	11,547
㉕	Cumulative N.C.F.	"		0	0	0	0	1,959	3,932	5,539	10,264	18,206	29,834	41,462	52,999	64,536	76,073	87,610	99,147	110,694	122,241	133,788	145,335	156,882	168,429	179,976	101,523	203,070	214,617
㉖	Balance of debt	"																											

Fig. I SENSITIVITY ANALYSIS ..... ①

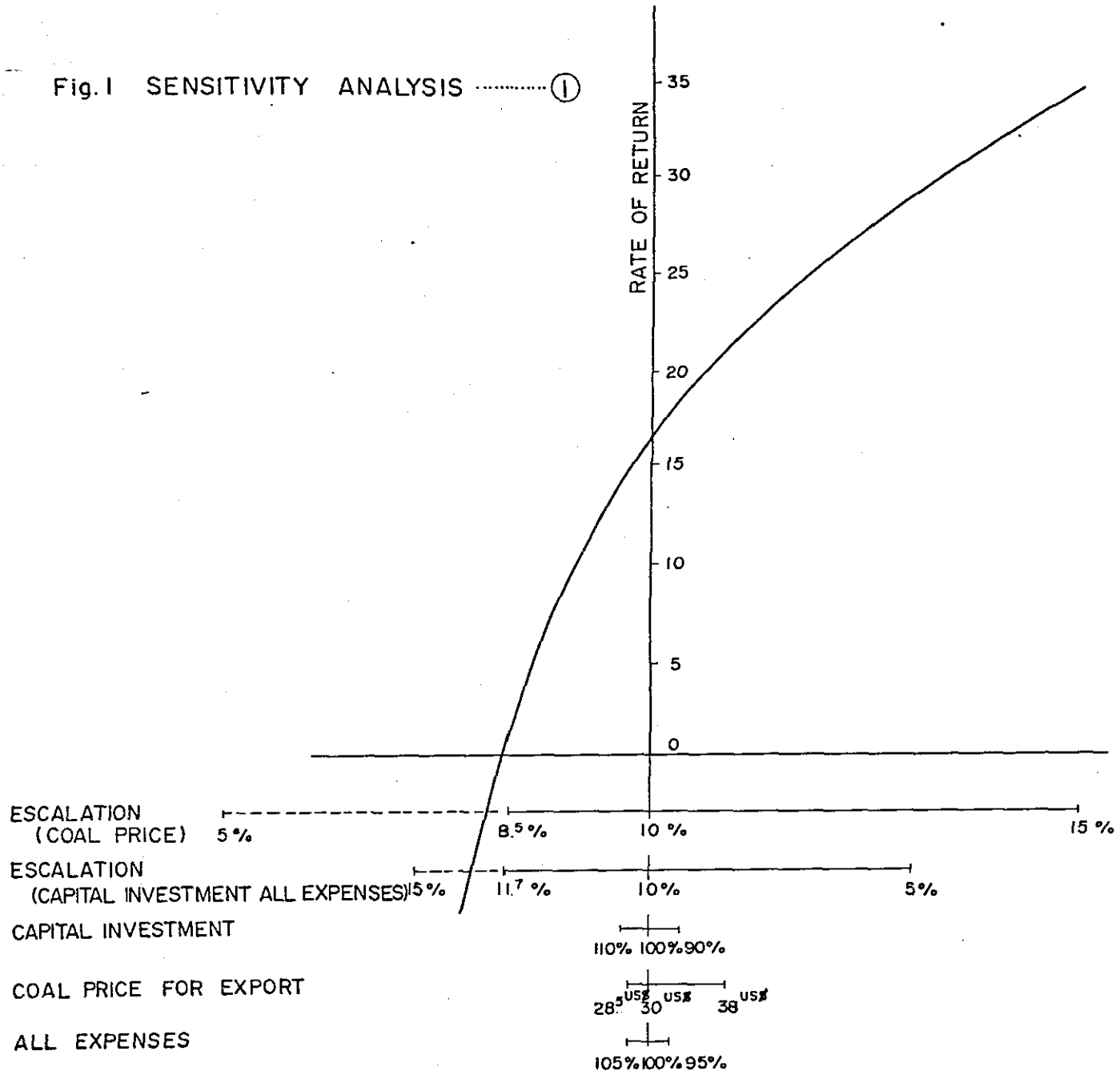


Fig 2 SENSITIVITY ANALYSIS ..... ②

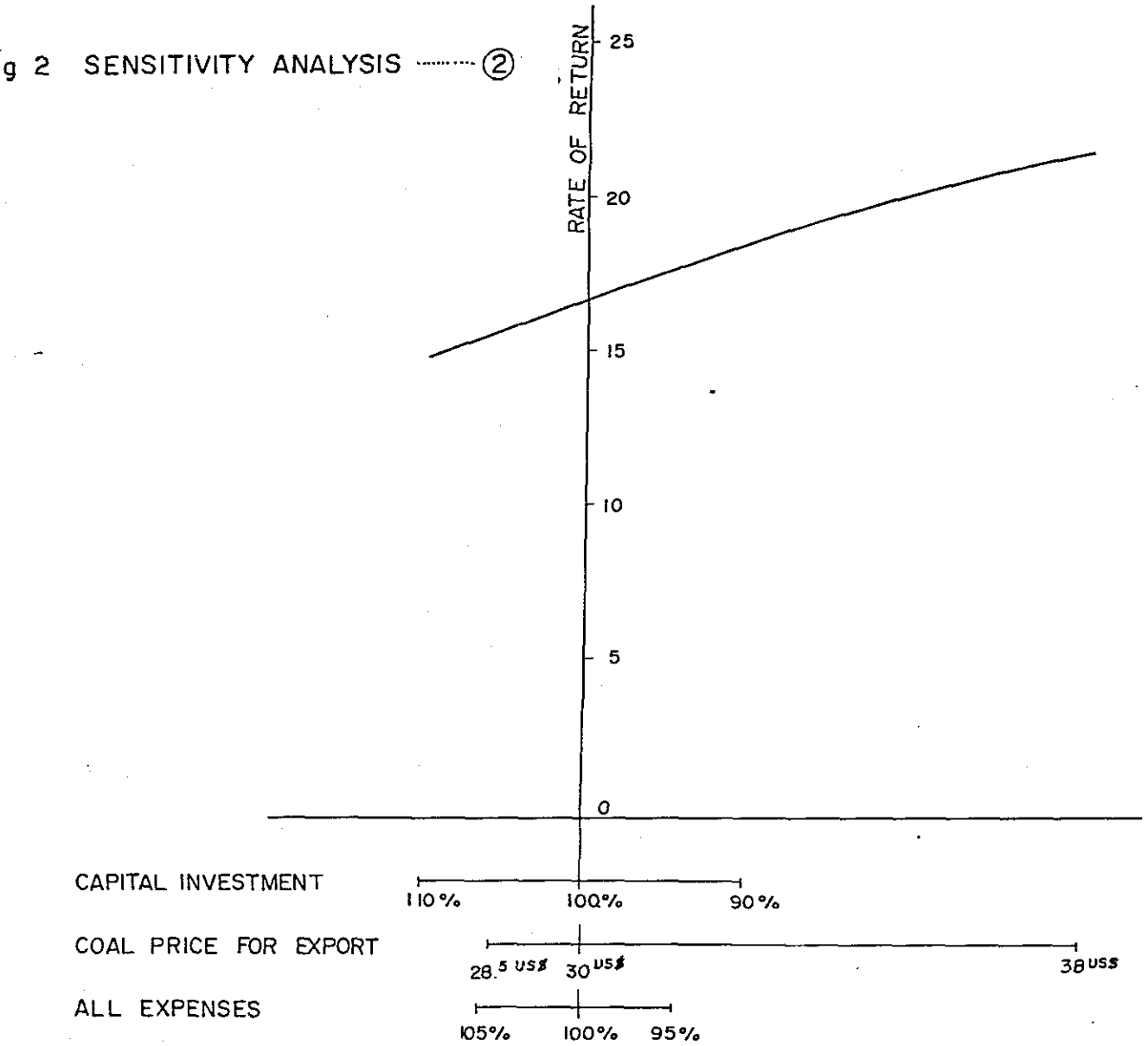
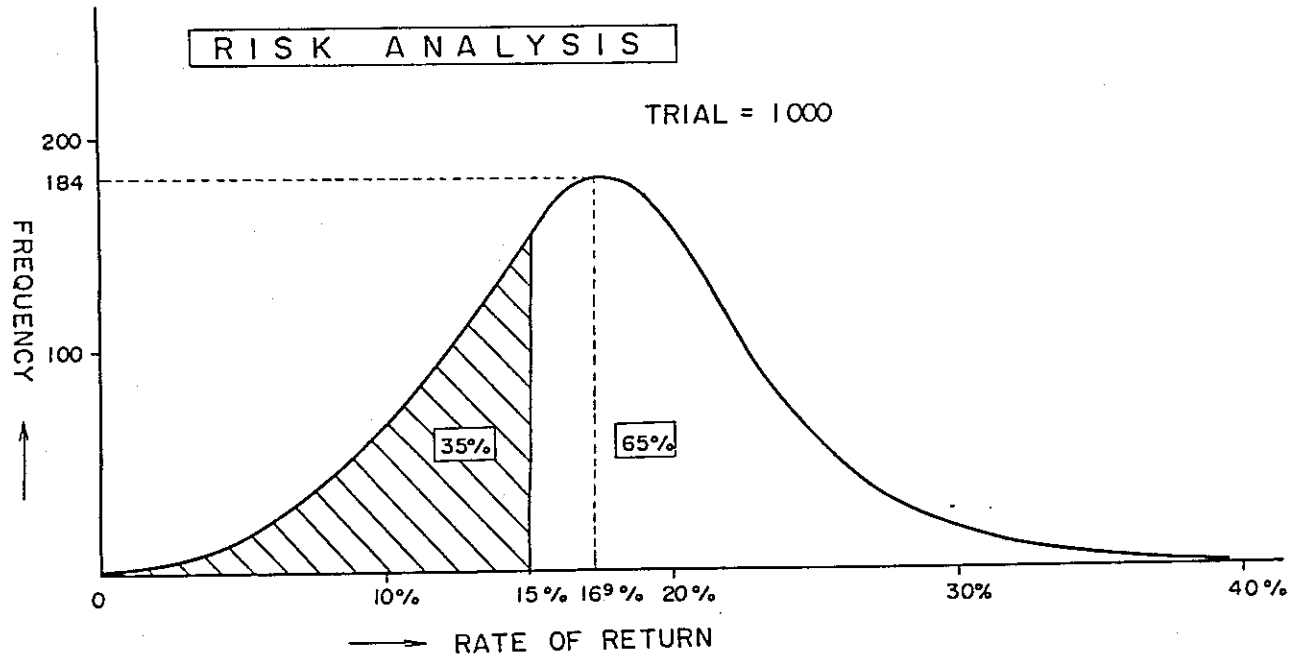


Fig. 3 RISK ANALYSIS



2. SUMMARY OF THE STUDY

2.1 Development of Coal Mine

(1) Scope of the study

Waringin and Sugar area are aimed to be developed for the new mining area together with the current operating area.
However, the study was carried out mainly for the former area except the study of the investment and cost account.

(2) Mine structure

Twin inclines, named "Central incline", are provided first for mine opening in the middle portion of Waringin area, of which pit mouth is located at Kepara Rantai.
Fundamental drifts are arranged in the main levels from the incline toward north and south, which will be connected with the further inclines provided in the northern and southern portion of the area in order to form an adequate transport and ventilation system in the future.
Current development is proposed in the following area.

- until 1.2 km to the north from the incline
- until 0.7 km to the south from the incline
- down to minus 200 m sea level

(3) Coal getting

Two longwall mining faces with respective systems of self-advancing support and single prop are provided for the operation.
Drum shearer is adopted for coal cutting and loading.
Two stages upper preceding slicing method is applied to mine

the thick portion of C seam.
Each face productivity of 2,000 and 600 tons per day is expected in the self-advancing support face and the single prop face respectively.

(4) Drift and road excavation

Steel arch framed drifts and seam roads with sufficient cross sectional area for transportation and ventilation are arranged in principle.
An average excavation amount of about 10,000 meters is required a year. It corresponds to 16 meters, comprising 3 m in rock and 13 m in coal seam, per 1,000 tons of coal output.

(5) Transportation

Belt conveyor is installed in one of the central inclines, and hoisting system is introduced in another one.
Conveyor system is applied for coal transportation from the mining face to the surface. While waste rock and materials are handled by rail track system, in which battery locomotives and wagons are used in the level, and hoists in the incline.
Personnel car is introduced only in the incline.

(6) Mine safety

Central ventilation system is adopted for about first 10 years, in which one of the central inclines are used for air intake and the other for upcast. After that, an intake air flows down through both of the central inclines, and upcasted

by the inclines newly provided in the north and south wings of the area.

Countermeasures for mine water, combustible gas, coal dust, spontaneous combustion, etc. are also taken into account.

(7) Surface facilities

Air compressor, electric equipments, coal washing plant, waste disposal places, work shop, warehouse, mine office, etc. are arranged in the area around pit mouth.

(8) Personnel

Underground workers of 440 are required for the operation in the new developing area, in which 265 workers will be available from the current operating area.

(9) Investment

Refer to Table 2.

(10) Operation cost

An operation cost of US$ 42 per ton of clean coal output at the mine site was resulted in 1979. This amount will be reduced in accordance with the increased production if no escalation is considered.

US$ 16 to 17 per ton in the present value is estimated for the production scale of 1 million tons a year.

2.2 Coal Storage and Shiploading

(1) Basic idea

This study was carried out for an introduction of adequate equipment needed for coal discharging, storage, reclaiming, delivery to wharf and shiploading.

Following terms are taken into account based on field survey and consultation with the authorities of Indonesia.

a. Up to 1985, the shiploading quantity is to be kept to the capacity of the existing facilities, say, 50,000 ton a year.

b. Shiploading quantity is to expand substantially from 1986 (180,000 ton/year of 1986 to 610,000 ton/year of 1989). To cope with this plan, the facilities shall be set to come into operation from 1986.

c. The capacity of coal carrier shall be maximum 15,000 DWT and minimum 5,000 DWT, with average of 8,000 DWT. Specification of each equipment is to be determined based on the maximum loading quantity according to queuing theory and disadvantages of staging investment.

d. Cost reduction is to be considered in utilizing the existing facilities and land to the full extent.

e. The wharf is to be built close to the existing petroleum yard in consideration of expansion conception of the Teluk Bayur port and the area that can be covered by the existing breakwater, and the wharf is to be built in a type which allows handling of general cargo for efficient use.

(2) Major equipment and facilities

- Coal discharging equipment

  The existing facilities are utilized with the capacity of about 2,000 tons (9 chambers of the existing silo).

- Coal reclaiming equipment

  A rotary plow feeder is equipped to carry the coal unloaded from coal wagons and stored in the silo. The operation is fully automated from the central control room. The handling capacity is variable in the range of 65 t/h through 125 t/h.

- Stacker

  A stacker (capacity 250 t/h) for stacking the coal reclaimed from the silo is introduced. The operation is remotely controllable from the central control room and fully automated operation is available according to the programs.

- Reclaimer

  A reclaimer (1,000 t/h) to scoop the coal stacked in the yard onto the belt conveyor is installed. The operation is carried out in the same way of the stacker.

- Shiploader

  A shiploader (1,000 t/h) is installed to load the coal brought by the belt conveyor to the coal carrier moored at the wharf.

- Belt conveyor

  The length of the conveyor belt will be about 1,800 m as the total of receiving (stacking line) and reclaiming

(loading line).

- Weighing equipment

  A set of weighing equipment is introduced at the receiving side of the storage for measuring the coal for receiving and reclaiming (shiploading).

- Sampling equipment

  The sampling equipment is mounted to pick up an increment for each passage of coal quantity predetermined by signals from the weighing equipment.

- Electric facilities

  The facilities are able to receive 3,000 V class electric power supplied from a power plant.

- Wharf

  In consideration of an earthquake-proof, the wharf is built on steel pile foundation including batter piles, and the upper part is a marginal type wharf built with reinforced concrete slab, and requiring dredging of approximately 56,000 m^3.

- Control building

  The control building contains offices for controlling the coal storage yard, belt conveyor lines and shiploading facilities.

A schedule is considered that details designing is carried out in 1982 including soil survey of the port and the coal storage, and civil works and installation of facilities are executed in 2 years starting from 1984. Outline of the expenses, including engineering and supervision expenses and

10% of contingency expenses is shown in Table 2 in 1980 price basis.

2.3 Railway Transportation

(1) Basic idea

This study was carried out for improvement and installation of facilities for railway transportation of coal produced in the Ombilin Coal Mine from Sawahlunto to Bukit Putus, where a portion for the Indarung cement plant is separated, and then to the silo located near the Teluk Bayur port. Following terms are taken into account based on field survey and consultation with the authorities of Indonesia.

a. The coal is to be transported over the existing railway system.

b. The plan is to be considered into two stages of up to the year of 1985 and to 1989, when reaches full scale.

c. Cost reduction is to be considered by utilizing the existing facilities to the full extent.

d. The number of locomotives and coal wagons are to be increased as the coal quantity increases.

e. Necessary investments for improvement of the existing facilities and additions are to be made by 1985 in view of imperfection of facilities.

f. The degree of soundness on all bridges is to be assumed from that of 4 representative bridges, which is determined upon stress calculation as of the target transportation quantity with the strength on test pieces and

degree of corrosion to be worried.

g. The plan reviews locomotive depots and workshop for maintenance, general inspection and repairs respectively and required personnel for operation, maintenance and others.

(2) Introduction and/or improvement of facilities

· Locomotive

The following introduction plan is concluded based on the operation diagram for each block.

	1982	1985	1986
Diesel-rack-adhesion locomotive	6	1	7
Diesel locomotive		3	6

. Coal wagon

150 coal wagons are introduced in several stages from 1984 to 1988.

Air brakes are to be installed to the existing 97 coal wagons.

. Station facility improvement

2 sidetracks are provided anew in Bukit Putus station.

. Track improvement

All rails, except the rack rail, are changed from the current R2 (25.75 kg/m) to R3 (33.45 kg/m). R3 rails taken from the trunk lines in the Java Island are to be reused.

The sleepers between Padang Panjang and Sawahlunto are changed from the current 810 mm to 680 mm. This requires about 65,000 sleepers.

Ballast of approximately 77,000 m^3 is supplemented in view of the shortage.

- Bridges and civil engineering structures

  Based on the stress calculation, members used are within allowable stress intensity range and no reinforcement and replacement are needed.

  However, in order to stop corrosion and rusting, first grade scaling and painting are immediately needed for about 600 m^2. 70% of the entire bridge painting area require second grade scaling and painting.

  Tunnels and cut slopes require minor repair.

- Signal facilities

  Tokenless system is introduced.

- Locomotive depot and work shop

  Equipment for adjustment, inspection and minor repair of electric diesel locomotives is installed anew in the Padang Panjang Locomotive Depot.

  Equipment for inspection and repair of electric diesel locomotives is installed anew in the Padang Work shop.

A schedule is considered that details designing is carried out in 1982, including field survey, and all facility construction and improvement works other than locomotive and coal wagon increase are executed during two years of 1984 and

1985. Outline of the investment, including engineering and supervision expenses and 10% of contingency expenses, is shown in Table 2 in 1980 prices.

All bridges must be repainted once every 5 years. The work period is to be 2 years and this maintenance cost is US$ 650,000.

2.4 Economic Evaluation

2.4.1 Terms and conditions for the evaluation

The economic evaluation is made on the basis of studies in Chapter I to III with following terms and conditions. Table 3 shows the bases of the profit and loss and the cash flow.

1) Coal sales and prices

Sales plan is shown in Table 1. Sales prices of US$ 22.0 (F.O.R. basis) and 30.0 (F.O.B. basis) per ton are basically applied for the domestic and export coal respectively.

2) Mining cost

Mining cost is that of whole Ombilin Coal Mine including the current operating area.

3) Head office expenses

Current organization and expenses of the head office are regarded as those in the future.

4) Selling cost

Present railway freight is applied for coal transportation. Port charges consist of expenses required for coal storage,

handling, shiploading etc.

5) Tax, interest, etc.

Corporation tax, interest for loan and the like are out of consideration, since the condition of fund procurement is not taken into account.

6) Evaluation method and period

Evaluation is made by the rate of return obtained by means of the D.C.F. method for a period from 1980 to 2005. "Sensitivity analysis" and "Risk analysis" are carried out by following range estimation.

Factor	Range
Export coal price	-5% ∿ 38 US$
Investment	-10% ∿ +10%
All expenses other than investment	-5% ∿ +5%
Escalation rate	5% ∿ 15%

2.4.2 Result of evaluation

1) Most likely case

Rate of return of 16.62% is obtained by the most likely amount for all factors.

2) Sensitivity analysis

Fig. 1 and Fig. 2 show the results of analysis. Escalation rate seems to be the most sensitive factor for the rate of return, while the expenses including the investment give rather low affection to it.

3) Risk analysis

The result is shown in Fig. 3.

Although the decision of the project materialization depends upon the judgement by the Authorities in consideration of various conditions, the probability of the project feasibility would be expected to be rather high.

For an instance, the probability of 65% will be estimated when the required rate of return is settled as 15%.

3. CONCLUSION AND RECOMMENDATION

Here, the feasibility study for the rehabilitation of the Ombilin Coal Mine which has been carried out since the beginning of 1978 comes to a conclusion.

That is, as far as an economic view is concerned, fairly high possibility will be expected for the project on the basis of the coal production of 1 million tons a year with the corresponding improvement of the existing infrastructure.

Furthermore, circumstances in Indonesia would strongly support the project promotion even if the certain amount of the social costs should be burdened, since the requirement of coal as a petroleum substitute is indisputable in consideration of the needs coping with the latest energy situation, reformation of the industrial structures, regional development and the like.

However, it would be pointed out that an attainment of the project depends upon not only the economic view but following terms and conditions which will remarkably affect each other.

(1) Sophisticated management organization for the project promotion.
(2) Securing the skillful workers in each field.
(3) Quantitative and qualitative balances in developing the fields of coal production, its market and the transportation system.
(4) Adequate political support to the project and the relations.

(5) Timely fund supply.

Lastly, it would be desirably expected that the project will successfully contribute to the economic development in Indonesia in the near future with the powerful support borne by an eagerness and effort of the Authorities concerned.