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REPORT ON OMBILIN & BUKIT ASAM COALMINES

Dec. 1971

Overseas Technical Cooperation Agency
The Government of Japan

F O R E W O R D

We are very pleased to be able to make this report. This report is based on our visit and discussions between Sept. 27 and Oct. 26, 1971, and our recommendations.

We think that this report was made with the help of many people who were so kind to us during our visit and discussion. For example, at Ombilin because of time limitation we had to discuss from early morning till midnight in Japanese style, but all the people stayed the full length of the meeting. And at Bukit. Asam mine we were able to meet active managers who were making every effort to improve the economic and social conditions of that mine.

Our conclusion, in a word, is to build up the conditions with which each mine can survive, that is, to build up the mine whose production scale is two times as the present one.

The entire plan should be started based on this idea. The reasons for this are:

1st. to build the basis for sure mine management.

2nd. This production scale may be rather small, but it will supposely be managed economically.

3rd. If the mines were closed, there would not be any hope of Indonesians reopening the coalmines by themselves forever because of lack of experienced mining engineers.

4th. Not only these coalmines play a part of employment but also they are deeply connected with the regional society through the supply of electricity, water etc.

In this report we have added the future plan of Ombilin Coalmine, taking into account of expected construction of Solok Power Plant and some more information we have received. Both Bukit Asam and Ombilin Coalmines should survive under the above considerations, however, the proper amount of capital investment should be provided for this project. Before commencing the project, we sincerely hope that an adequate feasibility study will be carried out so they can revive as distinguished coalmines.

We shall be very happy if this report is useful to the coal industry in Indonesia.

15th November 1971

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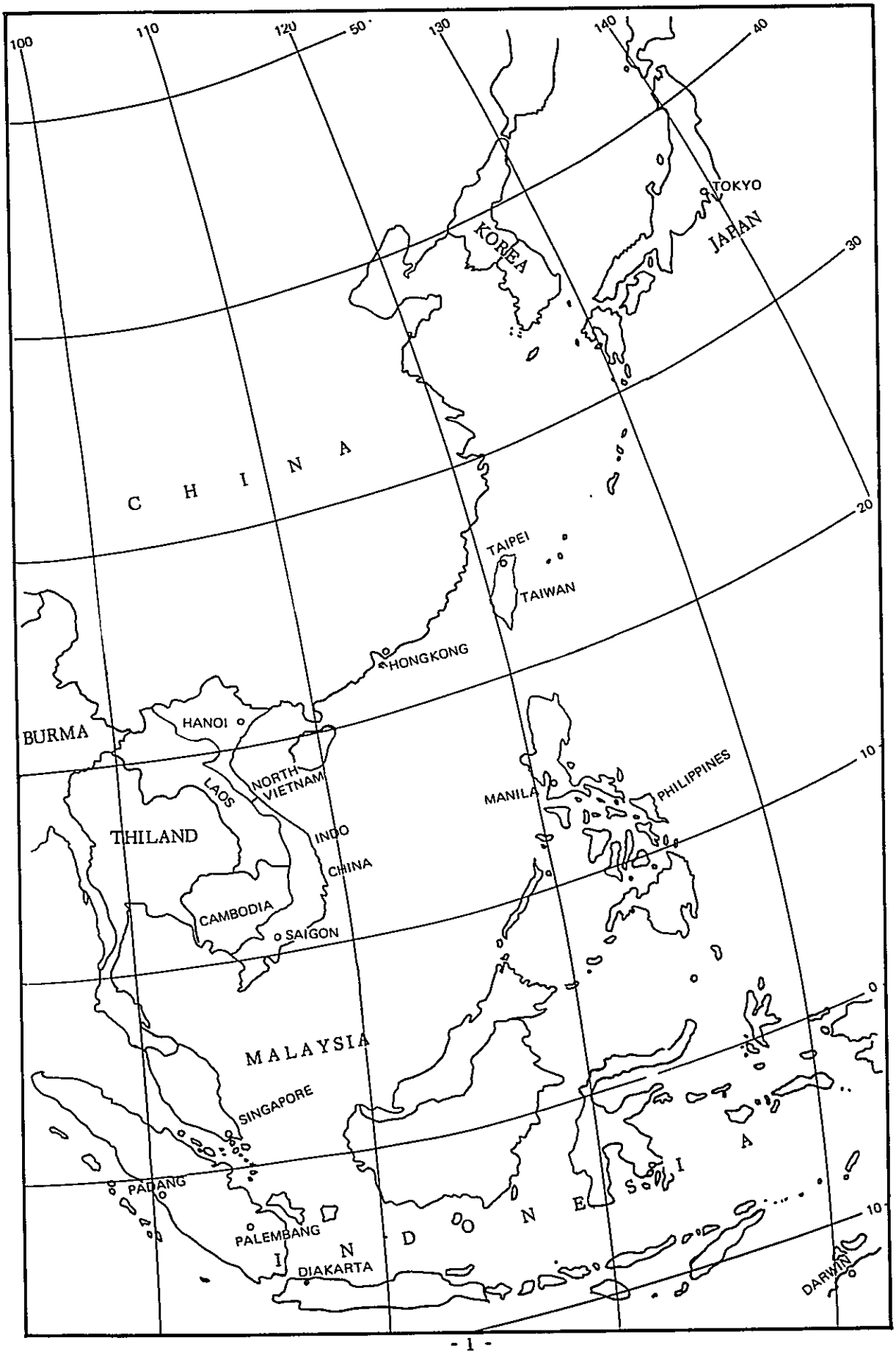
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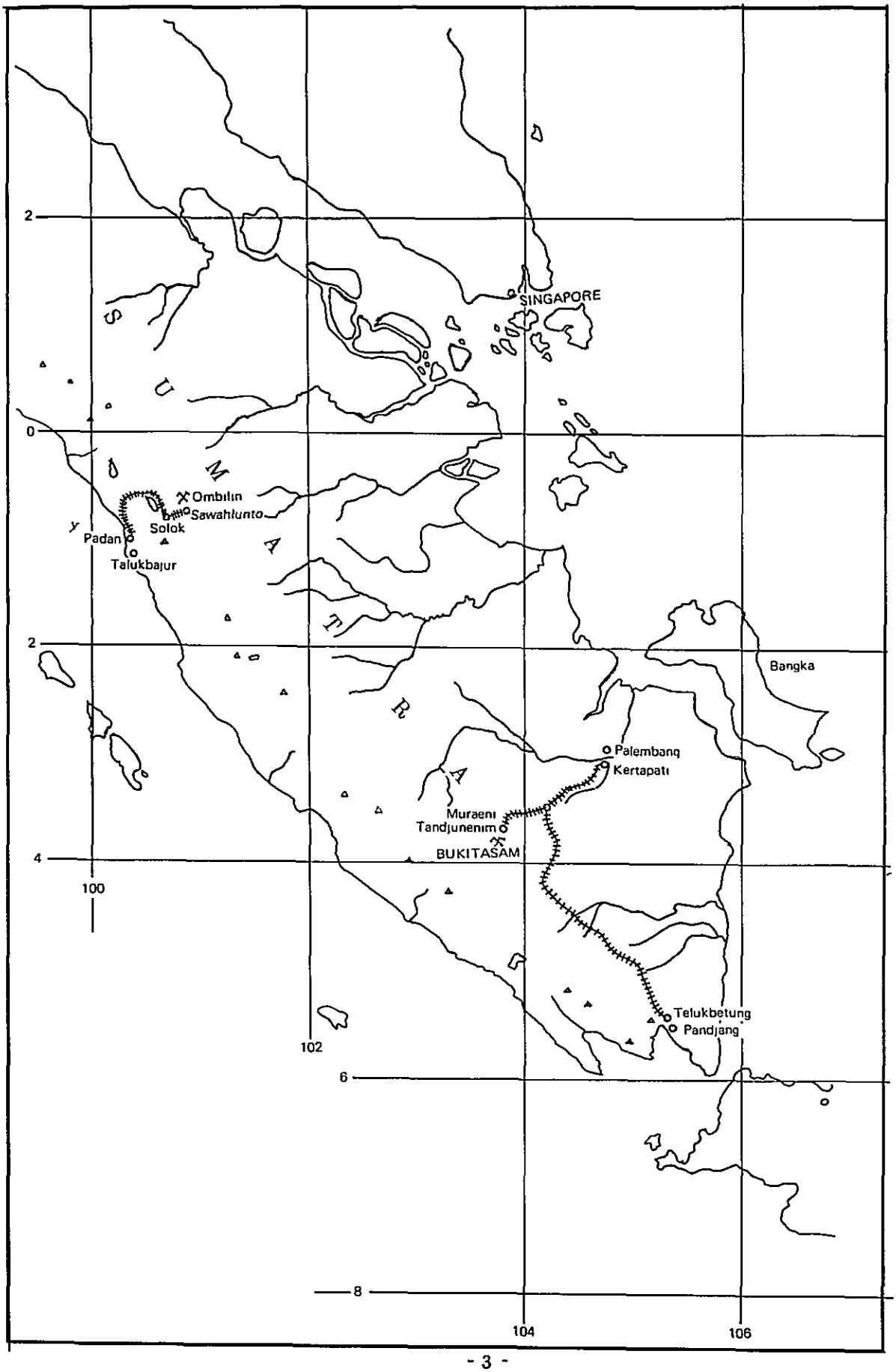
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I RECOGNITION OF PRESENT SITUATION.

After the field survey and study of equipment and data at Ombilin and Bukit Asam Coalmines, Sumatra Island, we have come to the following conclusions;

Both mines, though they have favorable natural conditions, are in difficult situations because the annual production of each mine has decreased in the past several years. The difference between the mining cost (which is higher) and the selling price of coal has increased, resulting in deficit management, and the mines are experiencing difficulty in paying wages to the workers.

If the mines had not been connected with the government, they would have already been closed down.

The reason for this deficit management is that the production of coal has decreased in spite of the many workers employed. The recent decrease of production was caused by the lack of capital investment for production equipment over the past several years. The present equipment can no longer produce the initial capacity.

It must be remembered that almost no capital investment has been provided for these mines for the past several years, in spite of the fact that the lifetime of mining equipment has proved shorter than those of other manufactures, and hence has a shorter economical life.

The management of these mines, nevertheless, seems to have high morale even in the above difficult situations. They are also making efforts to reduce production cost and to maintain the production, introducing the contractor system and so on. The work developing mining fields up to now has been done comparatively normally and according to plan.

In spite of the efforts of management, it is natural that both mines can hardly survive if the lack of new equipment continues in the future.

Judging from the favorable natural conditions and eagerness of management at both mines, we can assure that production will be increased and the balance of income and outgo will be improved by providing relatively small amounts of capital investment for equipment.

II IDEA AND INTENTION FOR RATIONALIZATION

Rationalization of coal mines means mass production by as few workers as possible, increasing productivity, reducing production costs, and supplying stabilized amount of coal to consumers. This can also be realized from the fact that over 50 per cent of the cost of coal production is the cost of labor, which is a fixed cost and does not vary with increase or decrease of production. So we have decided on the following approach:

A. Estimation of potential of mine from the standpoint of coal reserves and natural conditions.

B. Analysis of reasons for decrease of production and how to increase production.

C. Possibility of rationalization of manpower.

D. Development of demands for coal with the increase of production.

E. How should the Djakarta office and coalmines be reorganized.

However, as for C, D, and E, we could not undertake sufficient study because of time limitations, because of the difficulty of our side learning the natural circumstances, and because we could not apply our experience in Japan to these subjects.

Concerning these three subjects, we can merely confirm from the basic concept and from the information we have received in Indonesia. Therefore, it is hoped that the Indonesian Government will continue to study these subjects.

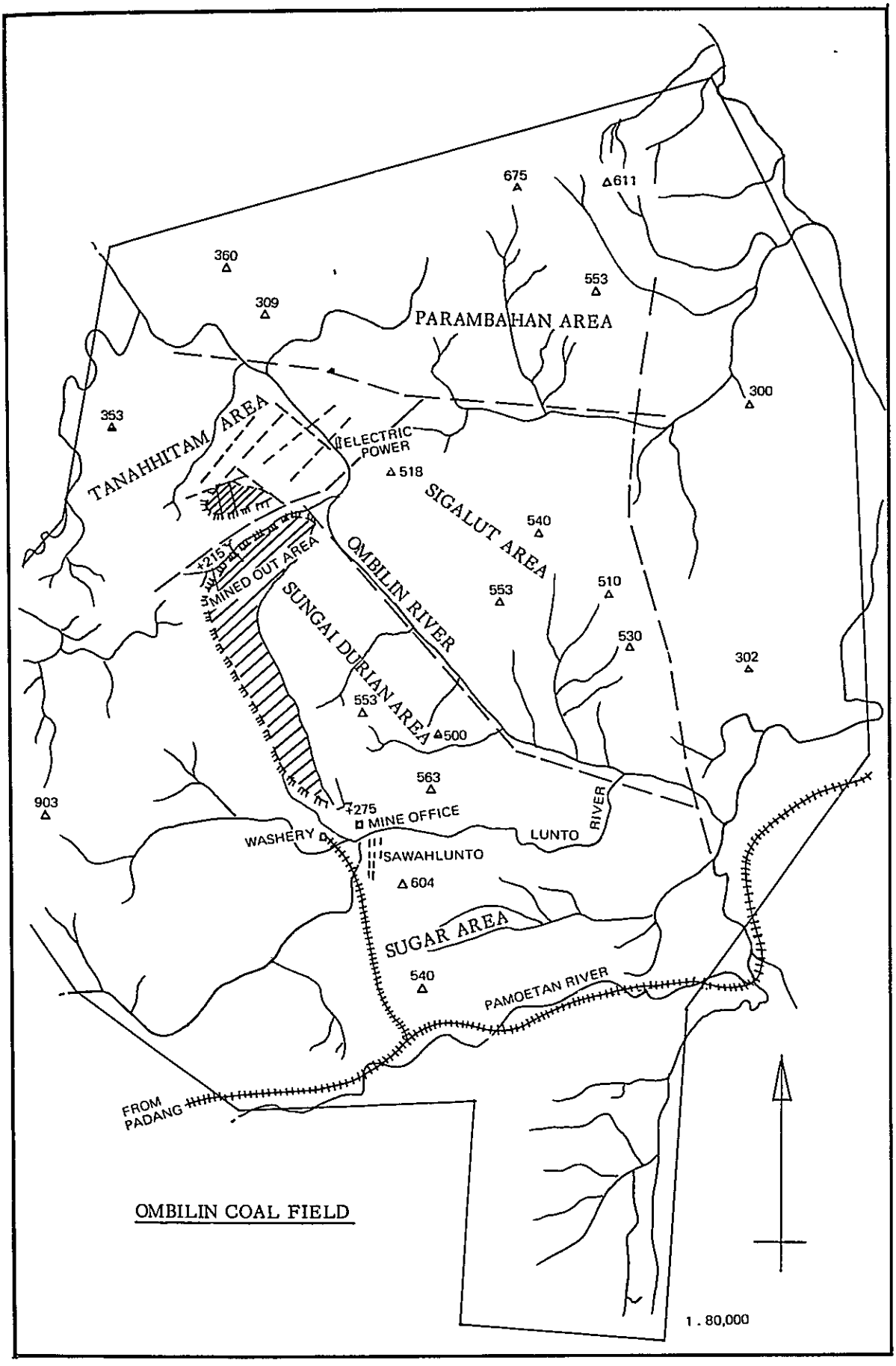
We have assumed the following two steps to rationalize the coalmines and increase production:

A. Short-term measures to increase production in proportion to demand and to balance income and outgo as much as possible.

B. Long-term measures for stable production, including items for study, research, and development.

Here, we have concentrated our thought on reducing cost by increasing production. The reason was that we could not assume how many labors can be dismissed. Nevertheless, we know from our experience in Japan, that the increase of production is very effective for rationalization.

However, it goes without saying that the increase of production should meet the increase of demand. On A. step we have tried to assume the demand for coal.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III OMBILIN COALMINE

A. Natural Condition

Ombilin Coalmine is located to the east of divided mountain range of Sumatra Island. The topography of Ombilin mine and its vicinity is of mature topography and is full of undulations. The scale of the coalfield is not very large. However, judging from outcrops and underground seam conditions known by mining operation, both A and C seams have not large variations. From the standpoint of geological structure, Sungai Durian area, which covers Sawah Rasau pit is most stable. So this area is supposed to be the main future working places, although Marubeni Company's Report says that in the deeper part of Sungai Durian area no coal seam could be found, or, even if the seam were found, thickness of the seam was thin.

Because of the above reason, Marubeni Company had aboudoned the production plan of two million tons per year.

From our field study, however, we have found the following results. In the underground of Durian area we can see C seam of the same quality and thickness as of the outcrop. Also, from prospecting by drilling, A seam has been found in Durian area, the thickness of which does not change so much though its quality is a little worse compared with A seam of Sawah Rasau V.

It is suggested that both from Durian and Sawah Rasau V areas, entry driving should be carried out to Sungai Durain area and prospecting should be done by entry driving for A seam, and by underground drilling for C seam. Coal property of Durian area is said to be little parting, low ash, law sulphur and 3-5 for F.S.I. This coal cannot be used for coking coal. But, if the coal can be applied for blending with high quality coal from overseas, demand for Ombilin coal will be increased all the more. It would be dangerous to export this coal as a coking coal from the viewpoints of coal quality, scale of mine, capacity of the railway from the mine site to Padang, and the facilities of the port.

B Production Pattern

1. Present State of Production

At Ombilin Coalmine, mining operation is being practiced at Sawah Rasau V. pit, northern end of Sungai Durian area and at Tanah Hitam area. At sawah Rasau V, pit mouth is formed at +215 m sea level, and a crosscut is driven in the floor of C seam. The cosscut reaches C seam at a distance of 280 m, then A seam at 250 m. The section area of the main roadway is 8 m^2 and 6-7 m^2 for gate roads. The support system of the roadways is of three-piece set.

(a) Mining

Mining system at Sawah Rasau V pit is three slice retreating longwall system with sand flushing for C seam (6-8 m thick) and usual retreating longwall system with sand flushing for A seam (2.0 m thick). The production of this pit is about 150 tpd. (tons per day)

At Tanah Hitam, room-and-pillar system is now being planned at two places each driving two parallel roads of 50 m apart in C seam which has been exposed to the surface by open pit mining. The operation of Tanah Hitam is carried out by contractor. And the production is about 100 tpd.

The mining is practiced by blasting and the coal is loaded to panzer conveyor (22 kw) by men.

Actual results of the face are as follows (Oct. 1971)

Name of Pit	Face	Dip	Mining Height	Face Length	Mining Method	No. of Workers	Production
Sawah Rasau V	3rd Slice C Rantih	9°	2.0 m	60 m	(Under preparation)		
"	2nd Slice C Rantih	9	2.0	60	Longwall Wooden props sand flushing	Coal getting 37 men Flitting & Maintenance 15 men Sand flushing 25 men	75-100 tpd.
"	1st Slice C Rantih	9	2.0	40	same	same	
"	A Langkok I	9	2.0	60	same	same	75 tpd.
"	A Langkok II	9	2.0	40	same	same	
Tanah Hitam	C Simang	8	1.8	Room-width 10 m	Room-and-pillar	(Contractor)	100 tpd.

Note:

C Rantih: Three slice retreating longwall system with lower slice advancing 50 m ahead of the immediate uppers upper slice.

Mining for seven days (one shift mining per day, advancing 0.8 m) then filling for 5-6 days.

Actual results of timbers and explosives in use are as follows :

	Explosives		Woods
	coal face	development	
1967	0.097 kg/t	2.19 kg/t	0.11 m^3/t
'68	0.385	1.52	0.11
'69	0.087	0.59	0.06
'70	0.190	2.10	0.07

(b) Sand filling

Sand filling system is practiced for the prevention of spontaneous combustion and for roof control.

This system is practiced as follows :

From the pump station by the side of the Ombilin River, water is pumped up 300 m high, where two ponds of 4,000 m^3 and 1,800 m^3 in capacities are located. After breaking the sandstone of mountain top by blasting, the broken sand is again crushed with monitors of 6-7 kg/cm^2 pressure each and is flown to the settling pond.

After eliminating the lumps through grizly, the sturry is transported through 10 inch vertical pipe to the goaf. Necessary amount of sand for filling is 0.7 m^3 for each ton of coal mined, and 20 m^3 of water is needed for transporting one m^3 of sand from sand quarry to the coal face. And the amount of electric power required for pumping one m^3 of water is 3.3 kw. This means that an enormous amount of electric power is needed for sand filling.

(c) Transportation

Transportation system of Sawah Rasau V is as follows :

Underground ...

Coal face panzer conveyor 22 kw x 60 m long

Gate panzer conveyor 22 kw x 60 m long x 1 set

Gate belt conveyor 30 kw x 100 m long x 2 sets

Trolley loco. 30 hp x 2 engines(6 tons) x 0.5 ton x 25 cars
x 3-4 Loco. x 300-500 m long

Pit mouth Bunker (2,000 ton)

Surface ...

Bunker

Belt conveyor (60 t/hr) 13 sets x 320 kw x 1,500 m long

Trolley loco 26 kw x 1.0 ton x 15 cars x 3 loco. x 2,000 m long (300 cars exist)

Incline 27 kw x 1.0 ton x 3 cars x 250 m long (downward dip 27°)

Trolley loco. 26 kw x 1.0 ton x 15 cars x 3 loco. x 1,900 m long

Belt conveyor 100 kw x 800 m long

Washing plant

At this pit, because of shortage of electric power, on the 1st shift coal from the face is transported up to the trolley locos of mountain top, and is loaded on 300 1-ton cars.

On the 2nd shift, this coal is transported to the washing plant for washing. In addition to the above difficulty, some of the equipment have not enough capacity.

The coal from Tanah Hitam area is transported with 3-ton trucks to the washing plant or power plant owned by Ombilin mine.

(d) Washing

Washing plant of this mine uses 30 m/m screen. Over 30 m/m coal goes to hand picking band, and under 30 m/m is again classified with 12 m/m trommel. Size 30-12 m/m coal goes to the storage and undersize flows through Condint to the storage. The power of the plant is 75 kw,

(e) Safety

Regarding the safety, no high density methane gas cannot be found, nor any flow of water.

Mining depth is shallow and causes no problem of roof pressure. However, on the immediate roof of A seam, extremely small particle sandstone is layered. This sandstone sometimes causes rock-falling.

(f) Working time

Working time at this mine is as follows :

Morning Shift 6:00 - 12:00 Coalgetting or Sand filling

Afternoon " 12:00 - 18:00 Maintenance and Flitting

Night " 18.00 - 24:00 Safety inspection

Midnight " 24:00 - 6:00 Maintenance (Surface only)

Actual working time is 4.0-4.5 hours and very short compared with Japanese mines.

(g) Other facilities

Power plant ...

9116/DTG	2,000 kw
4916/DTG	2,000
12874/DTG	2,400
15919/DTG	2,400

However total capacity at present is only 1.5 MW and when the rehabilitation is completed in Apr. 1972 the capacity will be increased to 2.5 MW. Also a new power plant is under construction - 3 MW by March 1973 and another 3 MW later on.

All these generators are planned to use Ombilin coal. Expected consumption of coal by these generators is 1.2 kg/kw for the present ones and 0.7 kg/kw for the new ones.

Trolley loco. and mine cars ...

Polish 26 kw trolley loco.	20 units	(6 units in use)
" 1-ton mine car	600 "	(100 " broken)
Underground 30 hpx2 engines trolley loco.	4 "	
" 0.5-ton mine car	200 "	

Compressor

Place	Type	Capacity	Pressure	Motor Power	R.P.M.	No.
Sawah Rasau V	Turbo	150 m^3/min	6 kg/cm^2	1,050 kw	9,000	1
Durian	Plunger	100	6	625 hp	122	1
Local		60	6	75 kw	—	5

These compressors are unable to work sufficiently because of electricity shortage as mentioned before.

Workshop

The workshop of this mine is located at Sawahlunto and employs 134 men. Practicing one shift operation from 6:00 to 14:00, this workshop is repairing from surface and underground equipment to motorcars or trucks.

2. Personnel Arrangement

Personnel arrangement at Ombilin Coalmine is as follows (Sept. 1971):

General Manager	1	Total
Vice General Manager	1	
Assistant to General Manager	18	
Secretariat	16	36
Mining Department		
Director	1	
Safety & Engineering Div.	54	
Underground Coal getting Div.	305	
Strip Mine & Sand Quarry	136	
Development & Ventilating Div.	206	
Coal Transportation Div.	170	
Washing Plant	45	917
Electrical & Technical Department		
Director	4	
Underground Mech. & Elec. Div.	222	
Central Workshop	140	
Electrical Distribution Div.	134	
Civil Works Div.	51	
Electrical Power Generating Div.	76	
Purchasing Div.	5	632
Financing & Administrative Department		
Director	1	
Personnel Div.	30	
Bookkeeping Div.	22	
Warehousing Div.	42	95
Representative	20	20
Grand Total		1,700

It is hard to find out the number of mine officials from this table. However it is possible to assume the ratio of underground workers to surface workers.

Number of undergroundworkers = 857

Underground coal getting Div.	305	
Development of Ventilation Div.	206	552 (other underground workers)
Coal Transportation Div..	70	
Underground Mech. & Elec. Div.	222	
Safety & Engineering Div.	54	

Number of surface workers = 1,700 - 857 = 843

Therefore the ratio of underground workers to surface workers is 857:843 = 50.4:49.6. And this figures mean that this mine has still a possibility of increasing underground manpower by moving surface workers to underground.

In the same way, the ratio of other underground workers to face workers are 552:305 = 64:36. And if the production is not so heigh as at present, no problem will arise. However, to increase production more than twice as much, face workers should be increased together with the increase of productivity.

C. Relation between Coal Production and Balance of Payment

The production, number of workers, productivity, and profit and loss of Ombilin Coalmine for the past few years are shown in the following table:

Trend of Mining Activity

Year	Production (1,000 tons)	Number of Workers (men)	Productivity (tons/man/yr)	Profit and Loss (Rp. 1 million)
1967	66.5	2,530	26.3	-16.6
1968	68.9	2,340	29.4	-84.8
1969	69.3	1,683	41.2	-125.0
1970	77.5	1,669	46.2	-105.7

Also, the trend of coal demand in recent years are as follows :

Trend of Coal Demand (1,000 ton)

Year	1967	'68	'69	'70
West Sumatra Railway	2.3	18.6	22.1	19.5
Padang Cement Factory	15.1	30.5	33.1	41.7
Djakarta gas Factory	4.5	2.6	1.0	—
Others	4.7	6.4	2.3	2.9
Total	26.6	58.1	58.5	64.1
Own Use	19.2	14.5	12.4	13.4
Grand Total	45.8	72.6	70.9	77.5

And this table shows that the biggest consumers are Padang Cement Factory and West Sumatra Railway.

Next, the balance of payment of Ombilin in 1970 is shown in the following table :

Balance of Payment in 1970 (Rp. 1,000)

Income		Outgo	
Coal Sales			
National Railway	59,439	General	104,351
Cement Factory	121,394	Mining Department	120,884
Others	8,874	Technical Department	71,648
Total	(189,707)	Civil Service	9,046
Own Use		Transportation	1,625
Power Plant	41,413	Total	(307,553)
Workshop	220	Depreciation	33,172
Total	(41,633)	Retirement Allowance	303
Other Income		Total	(33,475)
Electric Power Sales	2,931	Decrease of Stock	1,015
Interest	733		
Others	1,351		
Total	(5,015)		
Loss	105,688		
Grand Total	342,043		342,043

On the above table the following points should be considered :

1. The price of coal consumed by mine itself is included in the income. The same amount is included in the outgo.

2. The amount of coal stock at the end of 1969 decreased at the end of 1970. And in that year the amount of coal sales increased. But this amount of money which is equivalent to the decreased amount of stock is added to the outgo of 1970. Therefore, total cost of 1970 should be Rp. 342,043,000 - Rp.1,015,000 =Rp. 341,028,000. So, the production cost per saleable ton of coal in 1970 is calculated as Rp. 4,413. And adjusting other income and own use of coal the unit cost of saleable coal amounts to Rp. 5,245/ton.

3. At Ombilin, by getting subsidy of Rp. 105,688,000 from Central Government, the income and outgo was balanced in that year. However, the financial condition of the mine was not good because the money for coal which was sold to National Railway could not be collected smoothly. Bukit Asam Coalmine also has the same problem like Ombilin. To relax this difficult condition, Ombilin Coalmine makes it a rule to receive money in advance for the future delivery from Padang Cement Factory to use for a revolving fund. The average selling price of caol in 1970 was Rp. 3,058 for West Sumatra Railway, Rp. 2,816 for Padang Cement Factory, averaging Rp. 2,961 per ton of coal.

This price of course does not correspond to more than 56% of the cost of production.

Regarding the cost of production at Ombilin mine, it consists of 30% of wages, 40% of social welfare, 10% of maintenance cost, 20% of material cost, and the ratio of fixed cost to total cost is 80%.

D. Present Problems

The problems which Ombilin Coalmine is now confronting are concentrated into the next three items and they are mutually related.

1. Depression of Coal Production.

The coal production in 1970 was 77,285 tons, number of workers 1,669, and productivity 46.2 tons per man-year. (Average productivity in Japan was 750 tons per man per year.)
The reasons for the depression of coal production are, from the standpoint of mining system :

(a) Mining is only one shift per day.

(b) Working time in a shift is 4.5 hours, which is very short.

(c) Productivity is very low because of the practice of mining by blasting and hand loading.

2. Shortage of Transportation capacity.

Panzer conveyors of coal faces have exceeded the lifetime (used for 7 to 8 years), and have caused frequent engine trouble. breaking down of conveyor chains, etc. and lack sufficient capacity.

Between the trapnportation systems from underground to the washing plant, there are two bottlenecks, maximum capacity of which is only 300 tons per shift, i.e., trolley locomotive transportation between pit mouth and underground loading point, and surface incline.

3. Shortage of power sources (electric power).

The amount of electric power required for simultaneous operation of all the present equipment at the mine is supposed to be about 2.5 MW. However, the present supply of electricity for the mine is at most 1.0 MW. Therefore, the underground operation and surface transportation, etc., cannot help being practiced on alternating shifts. And this fact also causes the depression of coal production.

As a countermeasure against the above conditions, mine management has been attempting to increase production and to reduce the cost of production by introducing the contractor system.

E. Items of Urgent Improvement

The demands for coal at Ombilin mine in 1974 would be assumed to be 140 to 150 thousand tons because of increased production of Padang Cement Factory, (150 thousand tons of cement production in 1971 to 220 thousand tons in 1974), rehabilitation (1 MW at present to 2.5 MW by 1972) and new establishment (two units of 3 MW each) of power plants, and increased coal consumption by South Sumatra Railway Co. with the increase of coal transportation to Padang Cement Factory. In addition, Ombilin coal, in the category of soft coking-coal, might be used in a gas factory for making coke when mixed with strong coking coals from overseas.

With the first step, coal production should be increased with the increase of local demand, and the balance of income and outgo should be improved.

1. Try to increase production of contractors.

As we intend to give the same redommendations about B. Asam mine, we now introduce our own idea of contractor system. Depending upon seam conditions, there are cases in which mining work can be done cheaper by hand rather than big machines. Coal production by the contractor system, on the one hand, brings about the effectiveness of reducing the overall production cost of the mine; on the other hand, it absorbs the regional unemployed persons and makes effective use of regional manpower. At Ombilin mine, it is suggested that the contractor system must be introduced on a larger scale to increase overall coal production. And the safety of mine have to be watched carefully by the senior engineers.

2. To increase face production at the present production front based on the present mining system, carry out the following improvements :

(a) Improve the conventional blasting method, increase the blasting results, and improve the rate of face advance per shift.
Length of drill hole: from 1.0 m at present to 1.3-1.5 m
Rate of face advance per shift: from 0.6-0.8 m at present to 1.0 m and more.
Explosives: from 200 g at present to 250 g/hole.

(b) As for A. Langkok coal faces, the present filling system should be changed to partial filling system (filling per cent: 50-20%) using stones of mind-out area. To increase the rate of face advance, try to introduce coal picks.

(c) Standardize the face length to about 75 m, and make the movement of equipment and wokers easy.

(d) Supply the shortage of cap lamps.

3. Increase transportation capacity.

(a) Replacement of equipment
Panzer conveyor 40 kw x 75 m long - - -
5 units (one is a spare in case of face moving)
Belt conveyor 40 kw x 200 m long - - -
5 units (one is a spare in case of face moving)

(b) Improvement of transportation system.
increase the main underground transportation roadway between pit mouth and loading point (from 8 m^2 now to 12 m^2), and replace

with 1-ton cars or upgrade the loco's capacity (25 0.5-ton cars at present to 50-40 cars for one trip).
Increase the capacity of incline from 27 kw now to 50 kw.
Build a 30-50 ton capacity pocket at each loading point underground.

4. Premising the introduction of the above equipment, the number of workers should be the same or less than at present. And try to move the workers from indirect divisions to mining division.
5. Rehabilitation and construction of power plants should not be allowed to fall behind schedule.
6. For the purpose of developing the underground structure of C seam in the present mining district (Sawah Rasau), development work of C seam should be promoted.

F. Recomendation on Study, Research, and Development.

Judging from seam conditions and known coal reserves, we suppose that Ombilin Coalmine has a capacity of annual production of 300,000 tons. To Secure and increase the present potential it is advised to study the following items.

1. Study and Development

There are four areas in prospecting the claims at Ombilin Coalmine, such as Sungai Durian area, Sugar area, Sigarut area, and Parambaham area (which lies to the east of the Ombilin River); among which the most important area is supposed to be Sungai Durian area from the standpoints of distance from mine center, depth of coal seams, stability of geological structure and the effect of the Ombilin River and fault which runs along the river. Sungai Durian area covers old mining area (Pandjang, Waringin, Durian), present mining area (Sawah Rasau V) and Tanah Hitam area where temporary open pit mining is being practiced. We would like to call the first two areas "Sungai Durian area" and the third "Tanah Hitam area."
Coal reserves of Sungai Durian area are 13,700,000 tons as against 23,000,000 tons in Tanah Hitam. However the latter is divided into small parts by the faults and cannot be expected to become a primary mining area in the future. Therefore, we advise that the area be worked by combining both surface and underground mining methods.
Sungai Durian area will have to be the main mining area in the future. According to the study of Marubeni Co, A seam exists without great variat-

ion. C seam, on the other hand, vanishes because of a buried hill. To our regret, we could not make sure of this fact from our field study. The roof of C seam near the Ombilin River at Sawah Rasau V consists of corse sandstone and from this geological formation we can imagine the thinning of C seam by washout, somewhere around this area.

In this area, Sungai Durian areas' outcrop and underground C seam were recognized at unchangeable condition but Marubeni's drillings (No.6, No.7, No.9) could not encounter C seam. In such cases drills must commonly be done in the middle of upper and lower drill holes.

The surface of this area is undulating, and surface drilling seems to be difficult and expensive.

So it would be better to drive in the A seam both for prospecting and development purposes and to explore the C seam applying underground drilling. On an underground map, a rock tunnel can be seen at +290^{m} sea level and this tunnel reaches the coal seam at Durian area; also it connects with upcast slope (which can be used now).

From the mining results standpoint in Durian area, the distance between A seam and C seam is only 25^{m}. Condition of each seam is good and structure stable. This area is capable of being the main mining area in future. So there is the idea of connecting the pit mouth level of Sawah Rasau V, which is +220 m, with the +290 m level by driving a slope from this level to +220 m level.

In other words, from Sawah Rasau V (A seam) drive a crosscut about 500 m long (crossing the C seam), and then drive about 800 m in A seam ; and from this point drive a crosscut of about 350 m until it reaches C seam (crossing A seam), and again drive about 400 m long where the present incline is located.

We are not confident what method is the best to explore and develop. But it is necessary to explore from where C seam disappears.

2. Research Work.

To practice mass production, and to increase productivity, introduction of mining equipment can never be neglected.

Mechanization of coal face should be started from A seam.

In proceeding with mechanization, the steps of 1) partial filling, 2) nonfilling, and 3) caving should be treaded in this order. The move from Wooden props to iron props should be done with necessary time inter-

vals. As for coal getting machines, either drum shearer loader or hobel (or planner) with coal face blasting can be chosen. However, in adopting a new machine mining system, fully examine the following items.

Rehabilitation of Washing plant; Recover fine coal

Demands for fine coal; Power plant

Hardness of coal.

Availability of spare parts

Technical level of Workshop.

G. Future Plan

On the future plan of Ombilin Coalmine, two steps can be taken as mentioned in the previous chapter. This plan is based on the concept that Sungai Durian area will be a main future mining area, and that mining will mainly be concentrated in A seam of that area, applying the partial filling method. According to Marubeni Company's Report, C seam is dispersed in some parts of Sungai Durian area. So we have judged that in Sungai Durian area, no workable C seam exists. Also, no other area offers the possibility of two million tons production per year.

A seam of this area, on the contrary, has been confirmed to lie in uniform structure by means of underground driving and surface deep drilling. So we propose development of this area focusing on A seam, prospecting by underground drilling, and a change to a new mining method if a new coal field is found.

The purpose of a new mining method - practicing partial filling of the mined-out area is to increase production and to improve productivity. According to Marubeni's Report, Tanah Hitam area is supposed to have an enormous quantity of coal reserves. However, from the geological map, this area is divided into several small districts with faults, and it does not seem to be a main future mining area of Ombilin mine.

1. Demand for Ombilin Coal

In developing and meeting the demand for coal, it is very important to supply good quality coal at low price, especially to supply stable amounts at fixed quality, to the consumers.

Judging from expected future demands for Ombilin coal, following figures are projected:

Padang Cement Factory	70,000 tons
South Sumatra Railway	30,000

Own Use	24,000 tons
Local Use	6,000
Gas Factory	10,000 - 20,000
Total	140,000 - 15,000

It is said that P.N.L. is planning to construct a new power plant (30 MW x 2 units) at Solok, West Sumatra for the purpose of supplying electricity in that area, and which is scheduled to be completed by 1975 or 1976. If this plan is actualized, a new demand of about 240,000 tons of coal will be developed. At that point, a demand of approximately 400,000 tons would be expected.

2. Production Plan

Ombilin Coalmine is now experiencing a vicious circle of decreased production and deficit balance of income and outgo due to decreased prodction and no supplement of equipment and spares. All the conveyors and parts which have been used over the lifetime or have been worn out must be replaced with new ones immediately. Our proposed production scale will be 140,000 tons on the 1st step and 300,000 tons on the 2nd step.

It is supposed that by taking the above mentioned measures, the balance of income and outgo will be improved; in other words, reinvestment and purchase of equipment and materials will become possible and a good circle will result.

The above idea has naturally taken into account the improvement of electricity shortage which is now distructing the coal production at Ombilin, with the construction of two units of 3 MW power plant by the end of 1973.

Mining operation is now being practiced in Tanah Hitam area by a contractor. This contractor system is important to Ombilin Coalmine.

Therefore, it is hoped that this operation will be continued and that more coal will be produced in the future.

(a) Production Plan for 140,000 tons per year

The length of each coal face should be 75 m for purposes of increasing coal production and giving interchangeability between the conveyors of the faces, and each coal face should be mined one shift per day (advancing 1 m.)

Considering the future increase of productivity and face advance rate, the present compact filling method in A seam should be replaced by partial filling method using wood chocks, etc. In the

future, the top slice of C seam should also be replaced, if possible, by the same pirtial filling method.

In C seam, meanwhile, it is proposed that speed up the sand flushing method practicing two faces-mining and one face-filling per day from three slicing coal faces. Then the production will be :

75 m. (face length) x 2 m. (mining height) x 1 m. (rate of face advance per cycle) x 1.2 (specific gravity) x 0.8 (yield) x 3 (number of coal faces) ≒ 420 tpd.

Adding 60 tons produced by development work, total production will be 480 tpd.

Therefore, annual production will be

480 tpd. x 300 days / yr ≒ 140,000 tons

The capacity of the present panzer conveyors is too small (22 kw) to carry out the above production, and their motors and chains have been worn out. All the panzer conveyors now in use should be replaced with new ones, and the old ones should be used at gate roads.

The belt conveyors have worn out too, so some of them should also be replaced with new ones.

At present, coal from the face is transported by conveyors up to the loading point of the main transportation road where it is directly loaded onto 0.5-ton cars because there is no pocket at that point. It is proposed to build two pockets of 40 tons each in the roof rock of each loading point to avoid direct loading from gate conveyor to cars. Also, the section area of main roads between the pit mouth and loading points should be widened from the present 8 m^2 to 12 m^2 in order that 1-ton cars can be used.

Necessary equipments

Panzer conveyor	40 KWx75m.long	5 units (One is spare in case of face moving)
Belt conveyor	40 KWx200m.long	5 "
Surface hoist (downward)	50 KW	1 " (dip.27°, now using 27KW)
Cap lamp		500 "

(b) Production plan for 300,000 tons per year

This production plan is based on stable supply of fixed quality and quantity of coal from Ombilin to the expected Solok Power

Plant. To achieve this production plan, A seam and, locally, C seam of Sungai Durian area, especially those of Durian and Woringin area, should be mined. To develop and mine these areas, entry driving and underground prospecting should be carried out from the old rock tunnel in Sawahlunto, from the main air way of Waringin, and from the present Sawah Rasau mining area; and after connecting these entries, build an underground transportation system from Sawah Rasau area to Sawahlunto.

Railway transportation from Sawahlunto to Solok Power Plant (30 Km apart) should be no problem because Solok is located before the Abt system rail (max. dip of 8% and average 6.6%) which causes the bottleneck between Sawahlunto and Padang.

As for the production plan, two longwall faces with partial filling method should be placed in A seam, each mining two cycles (two shifts) per day.

Production will be :

140 tons / face x 2 faces x 2 cycles ≒ 560 tpd.

C seam should be operated by applying three slice longwall mining with compact sand flushing to medium and bottom slices and partial filling to top slice.

Estimated production from C seam will be 300 tpd. Therefore, taking into account the 140 tpd. produced with development work, total underground production can be expected to be 1,000 tpd.

To carry out the above production plan, the following investment will be necessary :

Panzer conveyor	40 KWx 75 m	3 units
Belt conveyor	40 KWx 150 m	3 "
1-ton car		200 cars
Underground boring machine		2 units

Loading machines, iron props, ventilating equipment will become necessary.

(c) Contractor system

As mentioned in section 2- "Items of Urgent Improvement", the contractor system is very important to Ombilin mine, and Tanah Hitam area seems to be the most favorable area for contractor fields. In this area, open pit mining used to be applied where available, and when it comes to economic mineable limit, open

pit mining is replaced with room - and - pillar mining system.
As there are sufficient coal reserves in Tanah Hitam area, production from this area can be increased by increasing manpower when the demands for coal increases in the future.
Judging from the geological map, there is an area near the Ombilin River were open pit mining method can be applied. And it would be wise for Ombilin mine itself to strip the overburden of that area after studying the thickness of seams and amount of soil to strip, and let the contractor mine the area.
From the standpoint of transportation, we would advise that the coal produced from Tanah Hitam area be transported to, and be used at the power plant owned by Ombilin mine.

3. Personnel Plan

In practicing the production plan for 140,000 tons per year, there should be no problem because the mining scale is not so different from that of the present one. However, when the production reaches 300,000 tons per year, the number of coal faces will have to be increased, in a working two shifts will have to be devoted to mining and one shift will have to be devoted to maintenance work, and the following men will be needed at the faces :

A Seam ..... 188 men x 2 faces = 376 men

C Seam ..... bottom slice and medium slice: 50 men for filling, 72 men for coal getting) total 122 men

top slice 96 men

C seam total 218 men

Grand total of face workers should be 594 men.

Considering the present number employed at Ombilin, the following manpower would be available :

Underground Coal Getting Div.	305 men
Development & Ventilation Div.	206
Coal Transportation	170
Underground Mech. of Elec. Div.	222
Total	903 men

It is also natural that a definite number of workers are needed to drive the entries for future development and prospecting. The ratio of

other necessary underground workers to face workers should be 70:30 to 60:40. Considering the ratio as 60:40, about 900 workers will be needed besides face workers. For this, surface works should be concentrated as much as possible and excess workers should be moved underground. Also, the reduction of manpower for coal winning is urged.

In the above plan, coal face O.M.S. (output per man-shift) is estimated at 1.46 tons. And if O.M.S. is increased to 2.0 tons, 430 face workers will suffice, and if O.M.S. is 2.5 tons, 344 workers will do. In this case, the total number of underground workers will be: (Assuming face workers are 30% of total underground)

$344 \text{ men} \times \frac{100}{30} = 1{,}147 \text{ men}$ (O.M.S. 2.5 tons), or

$430 \text{ men} \times \frac{100}{30} = 1{,}433 \text{ men}$ (O.M.S. 2.0 tons).

(Assuming coal face workers are 40% of total underground)

$344 \text{ men} \times \frac{100}{40} = 1{,}075$ m3n (O.M.S. 2.5 tons), or

$430 \text{ men} \times \frac{100}{40} = 860 \text{ men}$ (O.M.S. 2.0 tons)

Therefore, underground structure should be formed to match the following :

In case face workers occupy 30% of total underground, O.M.S. of 2.5 tons should be ensured.

In case face workers occupy 40% of total underground, O.M.S. of 2.0 tons should be ensured.

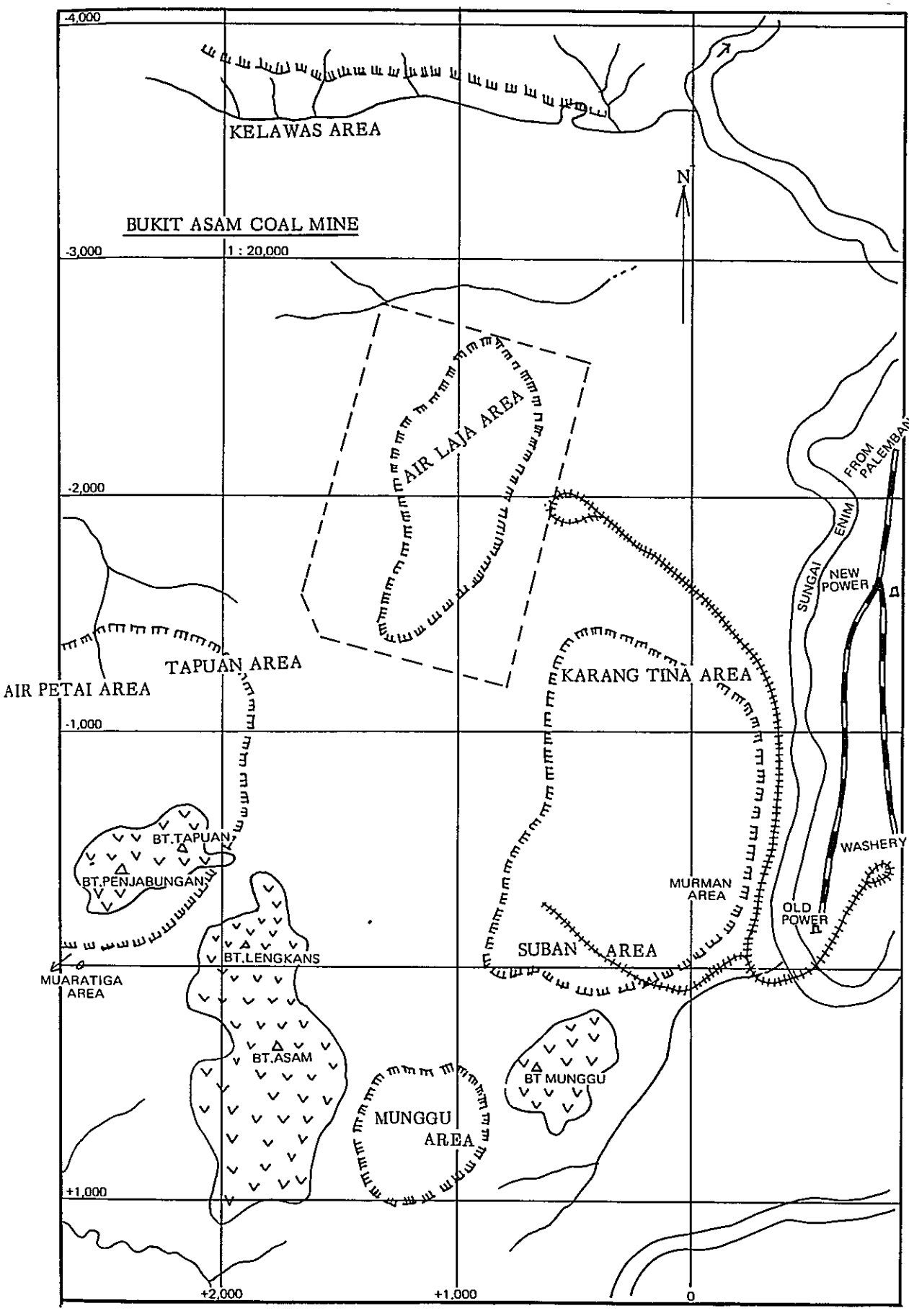
Tanah Hitam area should face no problem as it has only to develop the present mining system. However, as the mining system of thie area mainly uses manual works, it would be necessary to increase manpower to increase coal production.

4. Problems

(a) From the standpoint of workable coal reserves, Sungai Durian area has a problem as shown from Marubeni Company's Feasibility Study, if it is based on the stable supply of coal to the expected Solok Power Plant. As, in this future plan, A seam is estimated to be a main seam (production percentage is high), it would be necessary to prospect A seam of Durian area, and to study coal quality of A seam there. To do this, we propose to develop a new entry from the present one and to do prospecting considering this entry to be a main future transportation roadway.

(b) It is known that Ombilin mine has once tried partial filling method, though unsuccessfully. This idea is very important to increase face production. And there is a key point in how to master two-shift coal winning in four shifts working per day by applying partial filling or caving method.

(c) Mine workers are accustomed to doing individual work in individual ways. So, management should teach them how to improve their ability and how to increase productivity without sticking to the conventional concepts or personal experiences.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KELAWAS AREA
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BUKIT ASAM COAL MINE
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FROM PALEMBANG
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SUNGAI ENIM
NEW POWER
TAPUAN AREA
AIR PETAI AREA
KARANG TINA AREA
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BT.TAPUAN
BT.PENJABUNGAN
WASHERY
MURMAN AREA
OLD POWER
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IV BUKIT ASAM COALMINE

A. Production Pattern

1. Present State of Production

(a) Mining

At Bukit Asam Coalmine the operation is now being practiced in Air Laya and Suban areas. In Air Laya Area open pit mining method is being applied and the coal reseaves of the present mining area are :

District	Seam	Coal Reserves	(Oct., 1971) Soil	Ratio
North	AI	98,200 ton	275,000 m^3	1:2.8
South West	AII	17,050	11,340	1:0.66
South	AI	65,000	260,000	1:4
Total		180,250	546,340	1:3

Stripping work is being carried out with two sets of draglines at North, and with two sets of wheel excavators at South. However, these machines are considered to be unfavorable. It is impossible to throw away the soil by one dragline, so, two of them are used together - one being acting as intermediary. Besides, the damped soil is moved again with a bulldozer.
At South, on the other hand, two excavators are now in use. Only one of them, however, is now being used together with a band wagon, because the capacity of the belt conveyor is not enough for the two excavaters to operate simultaneously. And both excavators and conveyors don't have sufficient supply of spare parts, so quite often machines get troubles. For coal getting, power shovel and belt conveyor system are now being applied, and they are operating in good order. However, because of shortage of branch belt conveyor system, only one coal face is being in operation, and another coal face is being kept for waiting until the present face is finished.

The equipment now in use is as follows :

	Number	Capacity	Actual Results
Wheel Excavator	3(2 in use)	500m^3/hr	48.56m^3/hr and 42.47
Dragline	2	3.5cu.yd	25.77 " and 19.40
Power Shovel	5	2.5cu.yd	
Band Wagon	1	130Kw	
Dump Wagon	2	10cu.yd 20cu.yd	
Bulldozer	2	Caterpillar D8	
Conveyor Belt	1,000m 2,000m	1,000-1,200m/m Wide...for soil 800m/m " ...for coal	

Stripping operation is carried out three shifts per day, but the actual results of the machines are :

Excavator 5.86 hr/day and 5.43 hr/day

Dragline 12.76 " and 13.60 "

And the operating hours of excavators are very low. Coal getting operation is practiced on 1st and 2nd shifts. And the average production at Air Laya is 400 tpd. (Oct., 1971)

Suban Area, where the contractor is working, is located between Air Lya and Washing plant. And mining is practiced only by manpower. The number of workers is about 100 and production is about 150 tpd. (Oct. 1971).

Although it is not so easy to increase production in a short time, because the production is stable, Bukit Asam management will be able to expect a bright future for Suban Area.

(b) Transportation

Air Laya :

Coal face - Belt conveyor 25hp x 3 sets x 150m long
Belt 48Kw x 2engines x 2 sets x 140m long
Trolley loco.60hp(6 tons) x 0.5 ton x 50cars x 4 loco.
x 4,500m long - Washing plant

Suban area :

Coal face - 0.5-ton car x 800m (manpower)
Trolley loco.60hp x 50cars x about 2,000m
Washing plant.

(c) Washing plant

Coal is classified into over and under 30m/m sizes with shak-

ing screen. And each size coal is cleaned and loaded to 6-ton cars.

(d) Working time

Working time of this mine is 3 shifts per day, 40 hours per week.

1st shift 6:30 - 14:00 (On Friday 6:30 - 12:00)
2nd " 14:00 - 21:00 (30 minutes rest)
3rd " 21:00 - 4:30 (30 minutes rest)

(e) Other facilities

Power plant

		Old plant	New plant
Generator	Maker	Willem Smit	Siemens Schuckert
	Capacity of Manufacturing year	2,000 KW 1916 (Trouble) 2,000 KW 1921 (Rest) 2,400 KW 1927 (Rest) 2,400 KW 1930 (Operaing)	5,000 KW 1965 (Operating) 5,000 KW 1965 (Trouble)
Turbine	Maker	Bibcoc & Welox	Borzig
	Pressure	max. 13 Kg/cm^2	Max. 42 Kg/cm^2
Present Capacity		0.5 MW	3.5 MW

Bukit Asam Coalmine has two power plants and not only the mine uses electric power for its own use, but also it sells the surplus electric power to the electric company. Coal consumption for these power plants amounts to about 36,000 tons per year.

Coking plant.

In 1959, Lurgi Co., West Germany built a pilot plant for coking. This plant was planned to have two steps - at 1st step build a coke and gas plant, at 2nd step build a plant to crush coke and make coke of necessary size. However, before the 2nd step plant was built, it was found that the coke quality was not good. And so this plan was abandoned. Now this mine has two small coking plants to make coke using good quality coal of Suban area. The capacity of each furnace is to produce one ton of coke from two tons of coal spending four days, this coke is

used at the workshops of this mine.

Workshops

This mine posseses the following workshops :

General Workshop

Big Machineries Workshop

General Electricity Workshop

And all the equipment of the pit, plants, etc. is repaired at the above workshops.

Quarry

Bukit Asam owns a quarry near the mine site. Production is 5,000 men per month, and the number of workers is 29 men per day. The products are used for road construction.

2. Personnel Arrangement.

Personnel arragement at Bukit Asam Coalmine is as follows :

(Sept. 1971)

		Total
Director & Staff	5	
Secretary & Staff	8	13
Mining Department		
Chief & Assistant	2	
Earth Moving Div.	207	
Coal Winning Div.	157	
Coal Washing Div.	171	
Exploration Div.	17	
Maintenance (in Pit) Div.	87	
Electricity (in Pit) Div.	39	680
Technical Department		
Assistant	2	
General Workshop	120	
Big Machineries Workshop	92	
General Electricity Workshop	99	
Power Plant	100	
Building / Stone Quarry	70	483
Administration Department		
Chief & Assistant	2	
Finance Div.	16	

		Total
Personnel Div.	41	
Storage Div.	34	
General Administration Div.	14	
Hospital	38	145
Branch at Kertapati (Palembang)	52	
Grand Total		1,373

Number of workers in the pit is 509.

Earth Moving Div.	207
Coal Winning Div.	157
Exploration Div.	17
Maintenance Div.	87
Electricity Div.	39
Staff	2

Number of other surface workers is 864.

Therefore, the ratio of open pit workers to other surface workers is 509:864 = 37:63. The reason of large number of surface workers is because B. Asam mine has three big workshops and two power plants.

In the same way, the ratio of other pit workers to face workers is 352:157 = 69:31. At present, because the production is not high no problem occurs for manpower. However, to increase the production two to three times as much, face workers should be increased all the more.

Relation between Coal Production and Balance of Payment

Production, number of workers, productivity, and profit and loss of Bukit Asam Coalmine in recent years are as follows :

Trend of Mining Activity

Year	Production (1,000 tons)	Number of Workers (men)	Productivity (tons/man/yr)	Profit and Loss (Rp. 1 Million)
1967	121.8	2,664	45.7	52.6
'68	91.6	2,523	36.3	-66.0
'69	112.7	1,465	76.9	-22.5
'70	91.0	1,385	65.7	-90.5

Note : Number of workers is of the end of December.

From 1968 to '70 the profit and loss always showed red figures. And even the black figure of 1967 was brought out by increasing the sales amount by decreasing the stock of the previous year.

Next, the trend of coal demand in recent years are as follows :

Trend of Coal Demand (1,000 tons)

	1967	'68	'69	'70
South Sumatra Railway	75.0	40.2	48.1	33.5
Banka Tin Company	53.6	6.0	18.1	23.4
Padang Cement Factory	——	3.0	17.2	3.0
Others	2.8	0.9	0.8	0.3
Total	131.4	50.1	84.2	60.2
Own Use	41.3	41.4	42.9	38.3
Grand Total	172.7	91.5	127.1	98.5

Big demand for the coal of Bukit Asam Coalmine is from South Sumatra Railway and Banka Tin Company. And a fairly large amount of coal is consumed as Own Use. For such production and demand of coal mentioned above, the balance of payment of 1970 is shown as follows:

Balance of Payment in 1970. (Rp. 1,000)

Income		Outgo	
Coal Sales			
National Railway	107,936	General	26,050
Banka Tin Company	86,382	Mining Department	112,729
Padang Cement Factory	3,000	Technical Department	45,263
Others	114	Total	(184,042)
Total	(197,432)	Transportation & Handling	30,476
Other Income		Other Cost	97,556
Electric Power Sales	18,721	Depreciation	1,650
Quarry	756		
Others	6,297		
Total	(25,774)		
Loss	90,518		
Grand Total	313,724		313,724

The biggest difference between the balance sheet of Bukit Asam and of Ombilin is that at Bukit Asam mine, the cost of coal consumed by Own Use is eliminated. And by including this amount of money, the productin cost of B. Asam becomes Rp. 4,711. This cost also includes transportation cost from Tandjungenim to Kertapati and loading cost at Padang Port. So the pit top cost at Bukit Asam becomes about Rp. 4,400. (Ombilin:Rp. 4,413). This shows that the production cost of Bukit Asam coal was almost same as Ombilin coal. As a matter of fact, the deficit of Bukit Asam is less than that of Ombilin because the former have received more income from electric sales, quarry sales, etc.

By adjusting other income and cost of coal consumed by Own Use Production cost per ton of saleable coal at Bukit Asam mine is assumed to be about Rp. 6,000. And this cost is higher than that of Ombilin. (Rp.5,245).

This cost difference seems to be caused by the difference of scale of home electric power plant, difference of generating cost and selling price of electric power. Generating cost of home power plant of Bukit Asam mine is Rp.6.5/Kwh when selling price of coal is Rp.3,000/t. However, selling price of surplus electric power to P.L.N. is Rp.3,75/Kwh. So in this case, the mine has to get deficit of Rp.2.75/Kwh.

Since the contractor system was introduced in July 1970, the production scale and balance of payment have been changed a great deal. The trend of production cost is shown in the following table.

Trend of Production Cost in 1971

Month	Total Production (tons)	Contractor's Production (tons)	Production Cost(Total) (Rp.)	Production Cost (Excluding the cost of Own Use Coal (Rp.))
January	8,753	(2,317)	2,549	4,006
February	6,393	(5,850)	3,724	6,633
March	8,663	(6,321)	2,934	4,366
April	4,972	(4,697)	4,918	10,645
May	8,631	(3,663)	2,976	4,647
June	8,821	(2,742)	2,850	4,248
July	9,128	(2,416)	3,050	5,059
August	11,854	(2,961)	1,967	2,910
September	10,903	(3,229)	—	—

Note: 1. This table followed the form used in P.N.Tambang Batubara.
2. Cost of coal consumed at mine is eliminated.
3. Production cost showes pit top cost.
4. Adjustment is not practiced for other income.

Well, the production cost of 1970 is shown as follows :

Production cost (total) per ton of coal is Rp.3,437. (average production : 7,852 t/mo)

Production cost (Excluding the cost of own use) per ton of saleable coal is Rp.5,021. (average production 5,207 t/mo)

And it is known that after the contractor system was introduced, the cost of production has been reduced. The coal from Bukit Asam Coalmine is, as mentioned bofore, mainly sent to South Sumatra Railway and Banka Tin Company. However, like at Ombilin mine, Bukit Asam mine is experiencing more difficult financial conditions than the above balance sheet because it cannot recover the money from South Sumatra Railway.

C. Present problems

Bukit Asam Coalmine is in the same situation as Ombilin. The problems are summarized as follows :

1. Depression of coal production.

The production of Bukit Asam mine has sharply decreased, from 550,000 tons in 1960 to 257,000 tons in 1965, and 91,000 tons in 1970; the number of

workers, on the other hand, has declined from 3,038 in 1960 to 3,508 in 1965, and 1,385 in 1970. And the above statistics show the decrease of productivity. The reason of the decrease of productivity is that the decrease of demands, especially those from National Railway, and the decrease of producing capacity have happened simultaneously. And in 1970 this mine had a deficit of Rp. 91 million.

It is almost certain that the production of 1971 will exceed that of 1970, but the main reason for this is due to the production by the contractor system which has been introduced in July, 1970.

Production

	Air Laja	Contractor	Other	Total
1970	79,753t (87,5 %)	11,230t (12,5 %)	---	90,983t (100%)
1971*	46,632t (56,0 %)	35,405t (43,2 %)	625t(0,8%)	82,662t (100%)

* until October 11, 1971.

2. Unstable Operation.

The production of Air Laja, which is the main production front, tends to decrease in the rainy season. Especially in 1971, the production has decreased there to 543 tons in February, 2,042 tons in March, and 0 tons in April.

In the rainy season, stripping operations also decline. Although unstable operation due to rains might be regarded as unavoidable, this can be solved by increasing the machine capacity.

3. Exhaustion and Capacity Shortage of Machines.

Machines have been used beyond their lifetimes, resulting in the increase of maintenance costs, increase of maintenance time, and a great decrease of capacity.

Table of the Machines now in use.

Name	Date of Installation	Number	Capacity/%
Demag Dragline	1961	2	40
T.L. Shovel	1952	1	10
B.E. Shovel	1953	1	20
L.B.S.Shovel	1949	1	10
D & H Cat Tractor	1968	2	40
DW 10 Cat Wagon	1951	1	5
DW 20 Cat Wagon	1954	1	5
D 82 U Cat Tractor	1948	2	5
D 4 Cat Tractor	1948	1	5
Shovelrad Bagger	1956	3	40
Absetzer	1957	1	40
Band Wagon	1956	1	40

In addition, each machine is without spare parts. Therefore, the parts of any broken machine are removed and are used for repair of other machines. And if this condition continued another few years, all production would have to be stopped.

The capacity of machines cause problems mainly in the following cases;

(a) Stripping .... at present although one coal getting machine could produce approximately 33 tons/hr at the face, because of shortage of stripping capacity due to above reasons it cannot be continously mined as above.

(b) Pumping ... at moment max. capacity is only 330 m3/hr (Rain falls in rainy season... about 478 m3/hr).
Actually, in Air Laja area there will be 4 operating places including stripping only, and so, it is evident that the present pumping system is inadequate.

(c) Transportation... Engine trouble or breakdown of belt conveyor systems occur frequently, which hinders continuous operation.

D. Items of Improvement.

Bukit Asam Coalmine consists of two areas -- Air Laja(main mining area) and the contractor's area. As for the demands for coal at this mine, twice the present demands from Banka Tin Mine and new demands from Kuramasan Power plant can be expected in one or two years.

And so, 230,000 tons of production can be expected in the coming few years. To attain the above production the following improvement should be carried out.

1. Increase of production by contractor system.

From February to April of 1971 the production of Air Laja dropped sharply. However, by dint of the Contractor's increased production, Bukit Asam's overall production did not decrease so much as expected. And looking at last August, when the top production for 1971 was recorded, Air Laja produced 8,893 tons and the contractor 2,961 tons, for a total of 11,854 tons, and the production cost,at mine site was Rp. 2,910.

This production cost which excludes the cost of coal consumed by its own showed a balance with the selling price. The fields where contractor system can be introduced in the conventional way have come to be fewer. From now on, to maintain production by contractor system it will be necessary to introduce some machines—such as bulldozers-and create mining fields in advance.

2. Machines.

The machines now in use have almost worn out and renewal of equipment is urgently required.

In renewing the equipment it would be better to change from the present fixed type big machines to movable equipment. On the basis of this idea, necessary machines will be as follows:

Stripping	Production	10 - 120,000 tons	20 - 250,000 tons
	Power Shovel	2 units	3 units.
	DW 20 Dump Wagon	4 "	6 "
	DW 10 " "	4 "	6 "
	D 8 Tractor Dozer	10 "	10 "
	Scraper	5 "	6 - 7 "
Coal Winning	Power Shovel	1 unit	2 units
	Belt Conveyor	1,000 m.	1,500 m.
	Pump	60 units	60 units

E. Future Plan.

1. Natural Conditions.

The coal of Bukit Asam coal field is of Pleiocene, Neogene. This kind of coal which was originally lignite, is steam coal, highly carbonized and with high calorific value because of the influence of intrusive andesite. And because of this andesite, there are irregular domes. These coal seams are all thick and susceptible to spontaneous combustion (ignition temperature is 250 - 300°C). The roof of the coal seams are clay and methane gas cannot easily go out of the seam. It is known that many years ago gas explosion took place in underground mine there, and since then all the mining has been practiced by open pit method. During this field study we looked at Air Laja, Karang Tinah, Murman, Suban, Mungu, Tapuan and Air Petai areas. Among these areas, Air Laja was practicing large-scale mining, and at Suban area contractor mining was being carried out.

2. Coal reserves.

As for coal reserves of Air Laja area, it seems to be reasonable to calculate within the range shown by P.W.C.(Paul Weir Co.). And this time the coal reserves were calculated in the area enclosed by the 45° slopes from the P.W.C.'s range. The areas are I, II, III as shown in the attached map. The thickness of each coal seam was averaged from boring data and the partings were eliminated.

The average specific gravity of coal was regarded as 1.2. The total amount of coal in this area was calculated to be 14,518,000 tons and is estimated as 15,000,000 tons adding + X.

It is hoped that this calculation will be checked again using a 1 : 2,000 map because it was done using a 1 : 10,000 map.

The unmined area in Suban was already assured to have 600,000t of minable coal by 6 drilling holes.

At Kelawas area, on the geological map A & B seams dip 30° - 50°, and seems to have about 6,750,000t ($\underset{\text{strike}}{1{,}500\text{m}} \times \underset{\text{dip}}{150\text{m}} \times \underset{\text{thickness}}{25\text{ m}} \times 1.2$) of coal, though the mining system will be different from Air Laja's.

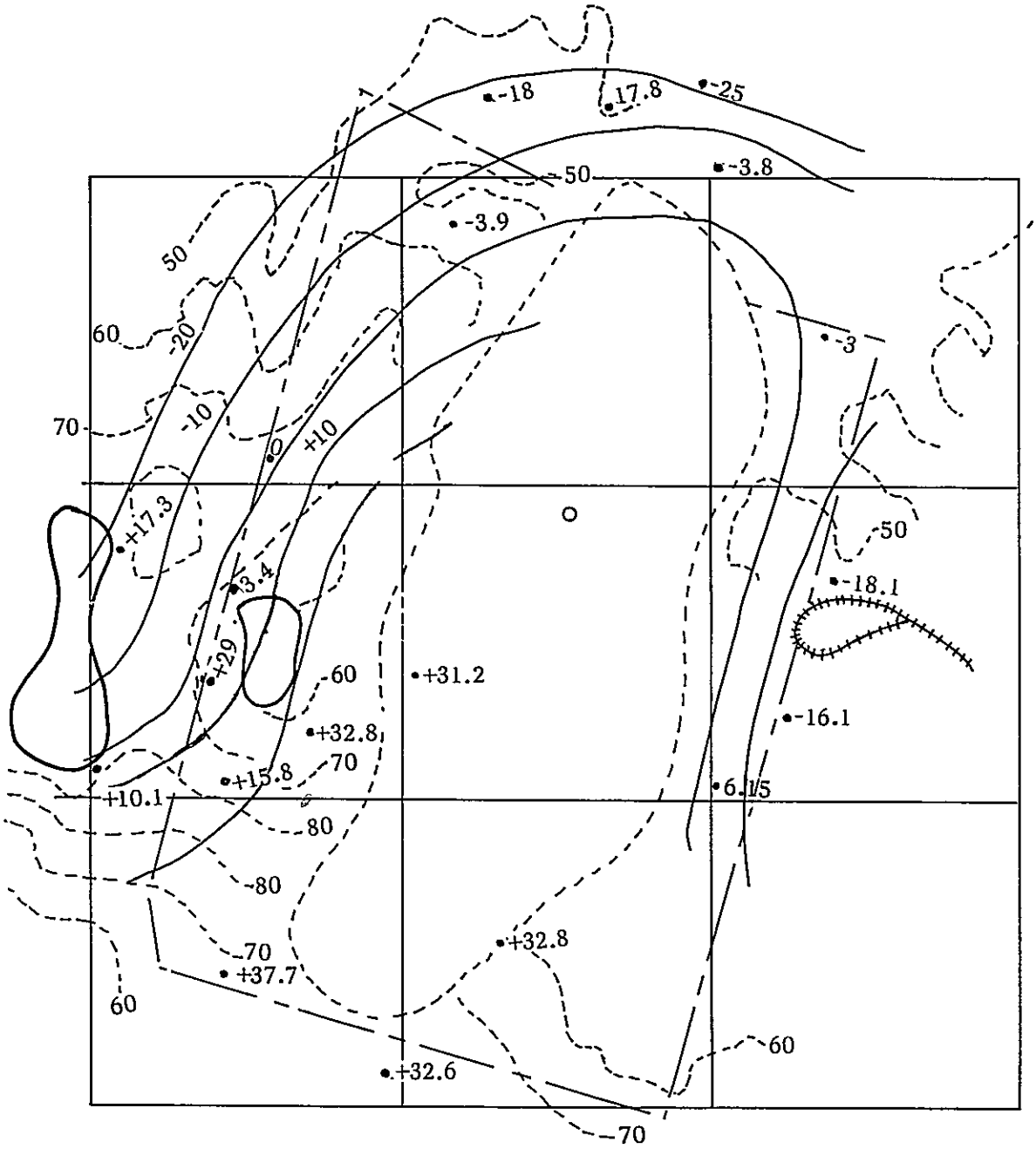
In Muara Tiga area, B seam only exists near the Lawai river and it is thick but in the area over 500m distant from the river the seam seems to be bad, so that a large quantity of coal cannot be expected. In this area there is a seam 20m thick called Hanging seam No.6 and the quantity can be calculated as 6,000,000 tons.

Thus it would may be said that in Air Laja area the most stable and largest quantity of coal exists, and such amount of coal cannot be found in any other areas.

3. Future Study.

In Air Laja area, it would be useful to study the amount of overburden, thickness of coal, and coal quality. For South - East Area early drilling will be necessary because of the possibility of strike change.

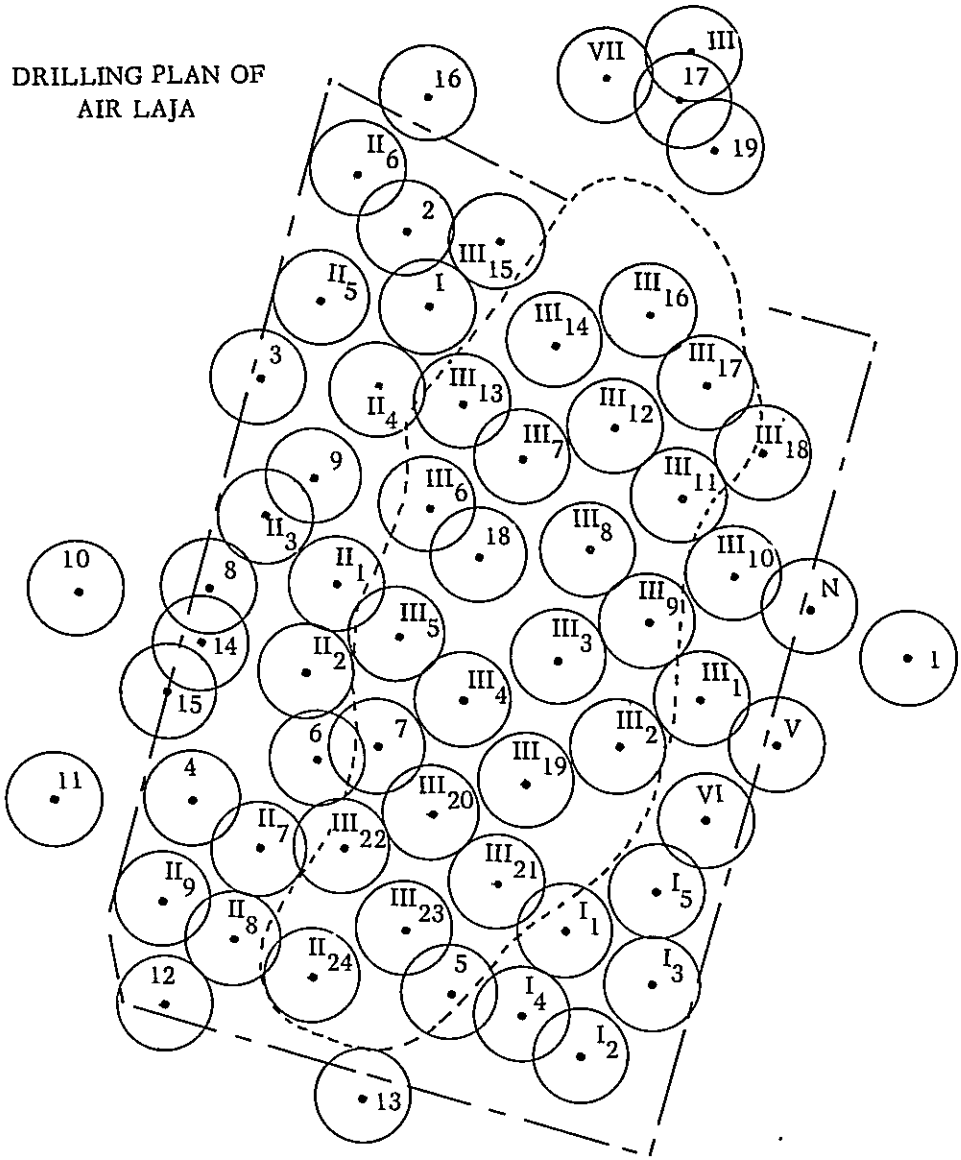
As for Kelawas area and Muara Tiga area, it is hoped to make production plan after fully studying the seam thickness together with the seam condition.



ALTITUDE OF FLOOR LEVEL OF A_1 SEAM

Scale : 1 : 10,000.

DRILLING PLAN OF
AIR LAJA



I. AREA

I_1	A_1A_{II}	B_1B_{II}	I_4	I_5
I_2	A_1A_{II}			
I_3	A_1A_{II}			

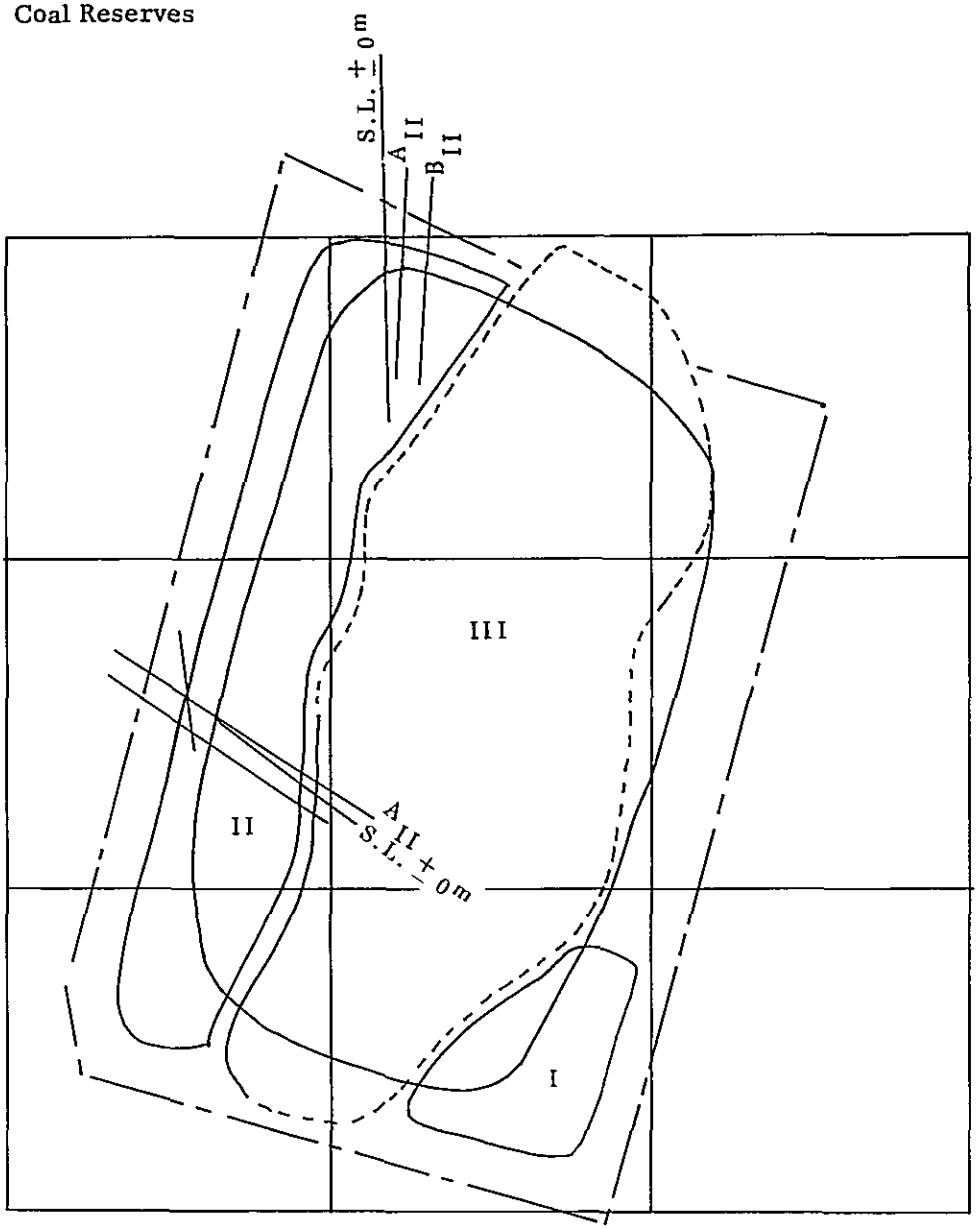
II. AREA

II_1	A_1A_{II}	B_1B_{II}
II_2	"	" "
II_3	A_1A_{II}	
II_4	A_1A_{II}	B_1B_{II}
II_5	A_1A_{II}	
II_6	"	
II_7	"	B_1B_{II}
II_8	"	"
II_9	A_1A_{II}	

III. AREA

$III_1 \sim III_{24}$. B_1B_{II}

Coal Reserves



		Area	Seam thickness	Parting	Specific gravity
I.	$A_I A_{II}$	70,000 m2	A_I (2) 6m50 A_{II} (2) 9m90	.50 = 6m00 - .50 = 9m40 15.40	x 1.2 = 18.48
II.	$A_I A_{II}$	250.000 m2	A_I 6m04 A_{II} 7m37	- .50 = 5.54 - .50 = 6.87 12.41' =,	12.40 x 1.2 = 11.88
III.	$B_I B_{II}$	720.000 m2	B_I (3) 8.10 B_{II} (3) 3.53	-0.50 = 7.60 - = 3.40 11.00	x 1.2 = 13.2

Coal reserves

I.	1.294.000 tons
II.	3.720.000
III.	9.504.000
Total	14.518.000 tons

V. ACTION WHICH THE GOVERNMENT SHOULD

A. Installation of equipment which has been taken up as items of urgent improvement. It is advised that capital investment be provided quickly, otherwise to maintain the present production will become very difficult, besides we are afraid it will cause the drop of morale at the mine sites, especially of management.

B. Maintain and/or promote the demands for coal. To secure the demand is very important for the coal industry. Considering the harbor system and freight charges, demand should be mainly extended to local or regional consumers near mine sites.

The present required action is about KRAMASAN power plant under construction in Palembang. This power plant, though it is planned to have dual system, is not assured of using coal at this point, yet in order that Bukit Asam mine survive and continue it is very important to secure demand for coal on the part of this power generating plant. Concerning Ombilin, which produces soft coking coal, it is necessary to study making coke by mixing it with strong coking coal from abroad. Of course, it is a premise that cheap coal can constantly be supplied. Increase in the selling price of coal should be avoided and the increase of costs should be absorbed by increasing productivity by mass production. Both mines have the means to avoid increasing the costs.

C. Promotion of study and prospecting.

It is very important to promote study and prospecting in parallel in order to decide on production systems and to increase its potential. We have recommended the area to research and methods at both Ombilin and Bukit Asam mines. In the discussion at the mine sites, too, we have explained these items based on the geological maps. Up to present, it seems that the ability of study at each mine site is not enough. We have visited the Geo-Geological Survey Institution and the Mining & Metallurgy Research Center in Bandung and found that the gathering and analysis of data were steadily being carried on. We hope that the study and research work will continue.

D. Improvement of organization and atmosphere for management.

We have felt strongly during the discussion at mine sites that communication between each mine and Djakarta office was not quite good. The managements of

the mines were irritated because the present situation of the mines is not recognized correctly, and their opinions or proposals are not communicated to the government. They have not been taught that in what situation each coal mine is and how the government expect them to be. Such conditions tend to cause management's morale to drop.

At the time of reorganizing the system of P.N. Tambang Batubara, we hope the head office be the following organization.

1. Decision of long-term study, investment, production plan and securing of necessary funds.

2. Developing and acquiring of new big consumers according to the long-term production plan.

3. To eliminate sectionalism and to improve mutual understanding, adopt limited, best qualified staff.

Finally, we sincerely hope that the persons in charge of coal mines will go to the mines and see the working places and equipment and listen to the opinions of persons at the mine sites.