THE INTERIM REPORT III

ON

THE FEASIBILITY STUDY

ON

EFFECTIVE UTILIZATION OF BANKO COAL

IN

THE REPUBLIC OF INDONESIA

(FY 1986)

JULY 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

THE INTERIM REPORT III

ON

THE FEASIBILITY STUDY

ON

EFFECTIVE UTILIZATION OF BANKO COAL

IN

THE REPUBLIC OF INDONESIA

(FY 1986)

SUMMARY

1. OUTLINE OF THE STUDY

The objective of the Study is to establish an appropriate master plan for the effective utilization of Banko coal and to examine its technical, economic and financial feasibility, including coal gasification test, and to prepare the proposed project.

TYPE OF PROGRAM	Government-sponsored technical cooperation
AGENCY FOR THE IMPLEMENTATION	
Japanese side	JICA (Japan International Cooperation Agency)
Indonesian Side	BPPT (Agency for the Assessment and Application of Technology)
OBJECTIVE	Feasibility study on effective utilization of Banko coal in Indonesia
COAL RESOURCES	Non-transportable brown coal reserved in Banko area of South Sumatra
APPLICATION TECHNOLOGY	Coal Gasification
PRODUCTS	Synthetic fuel oil, chemicals
SCOPE OF THE STUDY	1) Market survey on alternative liquid fuel and basic chemical in Indonesia 2) Survey on reserves, quality and mining cost of Banko coal 3) Survey on gasification characteristics of Banko coal, using a small scale test plant 4) Investigation of a master plan for effective utilization of Banko coal 5) Financial analysis and economic evaluation for proposed project
DURATION	1984 - 88 (5 years) 1) Strategic Investigation Stage: One year 2) Coal Gasification Test Stage: 2.5 years 3) Feasibility Study Stage : 1.5 years

2. BACKGROUND OF THE STUDY IN FY 1986

2-1 STUDY IN FY 1984

In FY 1984, the following studies were carried out in view of strategic points.

1) Survey on background of the project
2) Preliminary survey on markets of brown coal and its derivatives
3) Survey on Banko coal resources and its preliminary mining cost estimation
4) Survey on Brown coal utilization technology
5) Strategic investigation on Banko coal effective utilization
6) Study of coal gasification test

As the results of the above strategic investigation, the following conclusions were obtained:

1) The most possible utilization of Banko coal is production of fuel methanol, urea and electricity generation by coal gasification in view of the market, technology, economics and Indonesian Government policy.

2) The measured reserves of Banko coal are enough for commercialization, 435 million tons. However, the quality of Banko coal is "non-transportable- problem coal" because of spontaneous combustion and fragility during transportation and storing as well as high sodium in ash.

3) The preliminary mining cost of Banko coal is estimated to be 14$/t(wet base) by non-continuous mining method. The selling price is estimated to be approximately 25$/t (dry base) on the basis of "cost and profit" for coal mining.

4) Molten iron bath gasifier for synthesis gas production and fluidized bed gasifier for electricity generation were evaluated as the most superior technology for the time being.

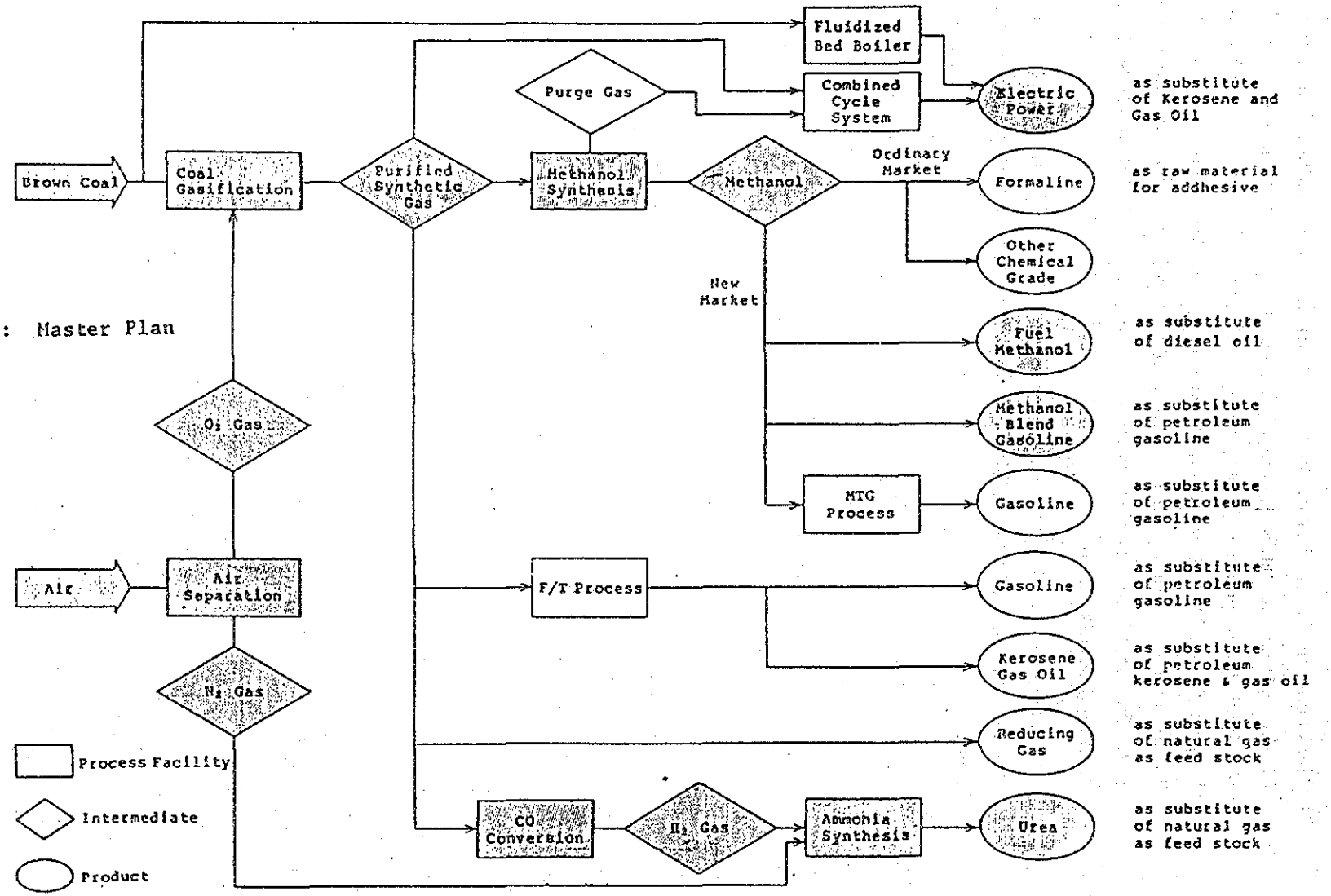
5) It was revealed that a spark assited diesel engine designed for neat methanol as fuel is ready for commercialization and has flexibility for fuel selection, diesel oil or neat methanol.

6) A master plan and preliminary proposed projects for Banko coal effective utilization were proposed. (See Fig. - III.) However, such a plan and projects must be studied furthermore in due course.

7) The economic feasibility of Banko coal utilization was studied on the basis of the estimated selling price of Banko coal and production cost data obtained from published literatures. Production of fuel methanol is "hopeful", but MTG (mobil) and urea depend on the price of crude oil in future and Government price policy for petroleum gasoline and natural gas. The possibility of electricity generation by CGCC depends on future technical development.

8) As a conclusion of the strategic investigation, the effective utilization of Banko coal seems to be feasible from the technical and economic stand points.

FIG. III Preliminary Flow Scheme and Master Plan for Brown Coal Utilization



2-2 STUDY IN FY 1985

In FY 1985, a study of the 2nd stage shown on Fig. IV was started.
The scope of the study in FY 1985 was as follows:

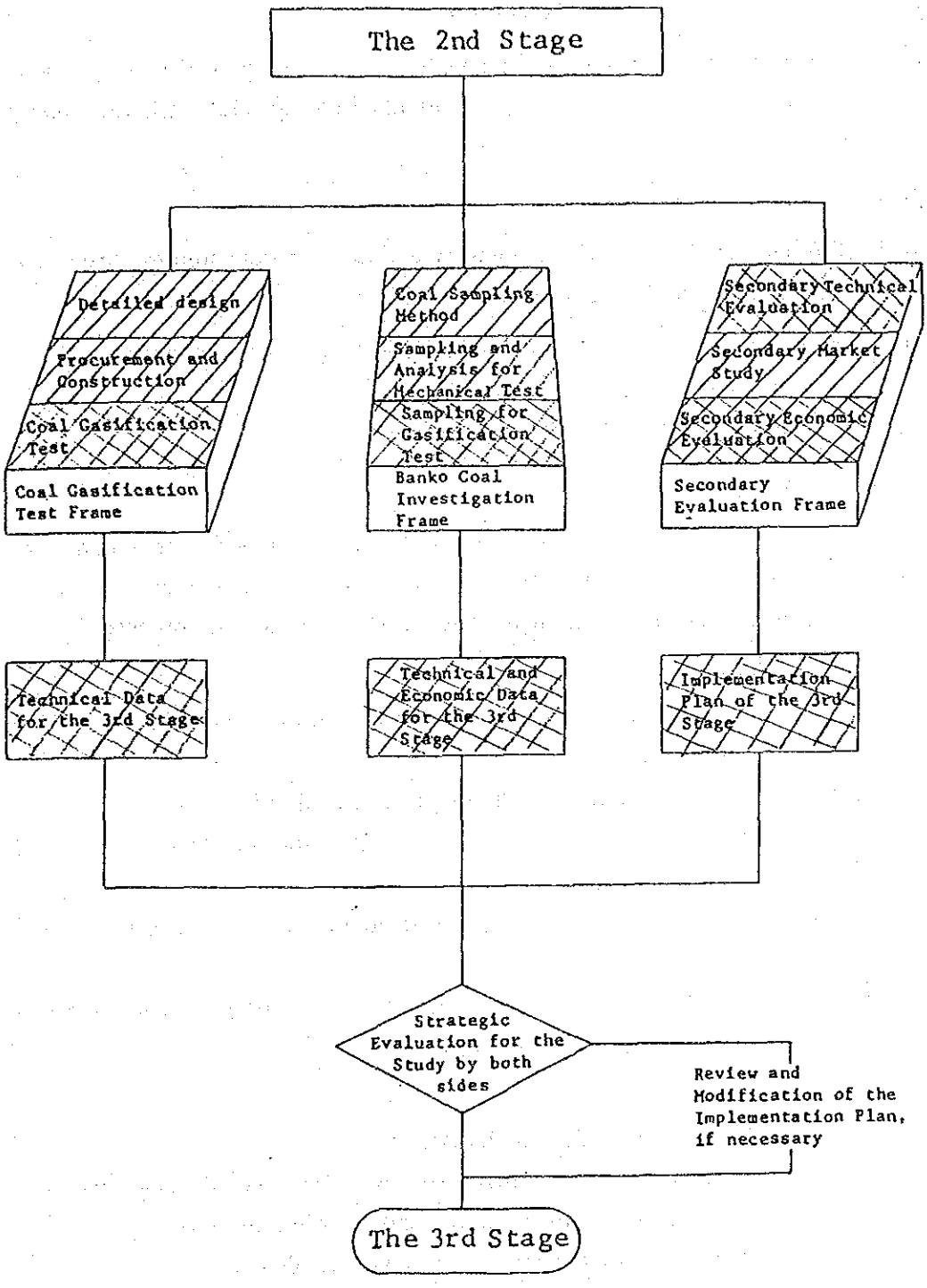
1) Detailed design on coal gasification test facilities
2) Survey on coal quality
3) Prelimianry evaluation of economic feasibility

All of the studies in F.Y. 1985 have successfully been completed and the results were as follows:

1) Detailed design of the coal gasification test facilities was carried out and completed in September, 1985.
   JICA has started procurement of the equipment in accordance with the Scope of Work.
   BPPT has continued the construction work of the pilot plant building in PUSPIPTEK and is almost completed, excepting maintenance facilities.
2) A coal sampling study was carried out including shallow boring and deep boring in North West Banko and West Banko (partially).
   i) The outcrop lines and coal seam structure in NW Banko and West Banko were grasped in detail.
   ii) Sodium content in coal is a maximum 0.6%; however, sodium in ash is in the range of 0 - 40%.
   iii) Coal samples (200 kg/sample x 10 samples) for the coal gasification test will be taken in NW Banko using two sets of 101 mm core drilling machines in FY 1986.
3) The project, producing 1,600,000 ton/year of methanol from Banko Coal, was preliminarily evaluated in terms of financial viability and profitability.
   i) The results show relatively low IRR of 13.5% (before tax) because the sales price of methanol (35¥/kg at gate, before tax) was assumed to be rather low, reflecting the current oil prices which have declined extremely. Since the viability as well as profitability of the project depend greatly on the sales price, there is a possibility that this project is appraised as viable in case of an oil price higher than 30$/bbl.

ii) Provided that produced methanol is imported to Japan as transportation fuel, the estimated methanol sales price in Japan (44¥/l before tax) is between those of gasoline (96¥/l) and diesel oil (81¥/l), considering the difference of overall energy efficiency for automobiles. Fuel methanol also benefits air pollution improvement.

Fig. IV Flow Chart of Implementation Plan of the 2nd Stage



: Scope of the Study

: Scope of the Study in 1986

3. SCOPE OF THE STUDY IN F.Y. 1986

The scope of work of the 2nd stage is shown in Fig. (IV).
The scope of study in FY 1986 is as follows:

1) Fabrication, construction and mechanical test operation of coal gasification test facilities including pilot plant building and utilities supply system.
2) Coal sampling work (1st phase)
3) Preliminary evaluation of economic feasibility of coal mining, urea production and electricity generation.
4) Study of market for fuel alcohol and its supply system in Indonesia.

4. OUTLINE OF THE SITE SURVEY

4-1 STUDY TEAM

The staff and his area of expertise of the Japanese study teams which were dispatched to Indonesia in F.Y. 1986 are summarized on Appendix-IV.
The objective and special notes of the each study team are as follows:

i) Study Team (A)

Objective: Explanation and discussion with Counterpart on items 2.10.3 and 2.6.2.

2.10.3 Kick-off meeting of "Fuel Alcohol Project"
(Study on the Marketing and Distribution System of Fuel Alcohol in Indonesia)

2.6.2 Acceptance and inspection of equipment and materials transported from Japan

Note: 2.10.3, 2.6.1 etc. mean the item number of scope of Study described in Scope of Work.

ii) Study Team (B)

Objective: Coal sampling for gasification test

2.9.1 Reconnaissance/scientific survey of Banko coal resources
2.9.2 Selection of sampling points and sampling of coal
2.9.3 Packing and transportaton of coal samples

iii) Study Team (C)

Objective: Survey on "Fuel Alcohol Project"

2.10.3 - Survey on utilizing technology for fuel alcohol
- Demand for petroleum products in Indonesia
- Potential demand for fuel alcohol in Indonesia
- Production and upstream distribution cost of fuel alcohol
- Issues and countermeasures for introducing fuel alcohol
- Programme for introducing fuel alcohol in Indonesia
- Policy and measures for introducing fuel alcohol

iv) Supervision Team

Objective: Supervision of field work of the coal gasification test facilities

2.6.2 Acceptance inspection of equipment and materials for the field work

2.6.3 Construction of the facilities

v) Operation Team

Objective: Test operation of coal gasification test facilities

2.7.1 Final inspection of the field work

2.7.2 Mechanical test of the facilities

2.7.3 Operation test and adjustment using specified coal

2.7.4 Final drawing, operation manual, and maintenance manual

vi) Study Team (D)

Objective: Explanation and discussion with Counterpart on following items based upon draft report of F.Y. 1986.
- Coal sampling for gasification test
- Mining cost estimation of N.W. Banko coal
- Study on "Fuel Alcohol Project"
- Test operation of the facilities

4-2 SCHEDULE OF THE SITE SURVEY

Six (6) JICA missions organized by the staffs of above mentioned team were dispatched to Indonesia for the site survey.

1st mission	June 16 - June 27	Jakarta, Serpong
2nd mission	June 30 - Oct. 4	Jakarta, Bandung, Banko
3rd mission	Aug. 13 - Sept. 11	Jakarta, Kupang, Balikpapan Palembang, Cilacap
4th mission	Oct. 6 - Nov. 11	Serpong
5th mission	Dec. 23 - March 15	Serpong
6th mission	March 1 - March 17	Jakarta, Serpong

The detailed schedule, organization and program visited by the each mission are attached as APPENDIX II.

4-3 SPECIAL NOTES OF THE SITE SURVEY

(1) 1st mission

The 1st mission was organized by the staffs of the study team A and B.

1) Implementation plan of the study in FY 1986 was discussed on the basis of the Inception Report and was agreed by both parties.

2) Budget for the study in FY 1986 was explained by both parties and confirmed that the study in FY 1986 will be proceeded on the same mode with Scope of Work.

3) Detailed implementation plan of coal sampling work in FY 1986 was discussed. Both sides agreed and confirmed the revised coal sampling schedule which topographic survey and drilling operation would be started from 6th of July and 17th of July respectively.

4) Construction procedure and schedule of the coal gasification test facilities were discussed and agreed on:

   i) The JICA's procedure of "bidding and order" of the construction work of the facilities to be installed at PUSPIPTEK in Serpong.

   ii) The expected schedule as follows:

   - o Explanation meeting to tenders: 20 June
   - o Closing date of quotation : 15 July
   - o Order of the Work : End of August
   - o Arrival of JICA equipment : Middle of Sept.
   - o Start of the work : Beginning of Oct.
   - o Completion of construction : End of Jan. '87

5) Implementation plan of the study on "market for fuel alcohol and its supply system in Indonesia" was discussed with the counterpart including relevant organizations.

Questionnaire of this study was explained at the first joint meeting held on June 20, 1986.

(2) 2nd mission

The 2nd mission was organized by the experts of the study team B and carried out the coal sampling work at N.W. anko as well as topographic survey at Suban Jeriji and Central Banko.

(3) 3rd mission

The 3rd mission was organized by the study team C, and carried out data collection and opinion building though discussions with the counterpart and relevant organizations including such site visits as Cilacap refinery, alikpapan refinery, diesel power plants in Kupang, and ethanol plant in

In Indonesia, introduction project of CNG (compressed natural gas) on fleet cars will start in April, 1987 in Jakarta city using natural gas from Cirebon gas pipe line.

ii) Ethanol is prospective as fuel because molasses from sugar plants and Cassava from transmigration area will be produced in accordance with related Government policies. Fleet test of low blending gasoline has been done by BPPT.

iii) Methanol utilization has been studied in PERTAMINA and LEMIGAS for blending into gasoline with/without an additive.

(4) 4th mission

The 4th mission is the supervision team and supervised the construction work of coal gasification test facilities, which was completed by the end of January 1987.

(5) 5th mission

The 5th mission is the operation team and carried out mechanical test and process test operation of the coal gasification test facilities. Technology transfer has proceeded using operation manual and maintenance manual as well as process test operation.

(6) 6th mission

The 6th mission was organized by the study team A, B, C and D.

i) The draft Interim Report (FY1986) was discussed and agreed upon.

ii) The implementation plan of the Study in FY 1987, including overall review and evaluation for the result of the coal gasification test stage,

was discussed and confirmed mutually that both sides shall continue necessary preparation work for the Study in FY 1987.

5. RESULTS OF THE ENGINEERING STUDY ON THE CONSTRUCTION WORK OF THE COAL GASIFICATION TEST FACILITIES

The engineering study on the construction work of the coal gasification test facilities that is constructed in PUSPIPTEK, SERPONG, was successfully finished in FY 1986.

The following were mainly studied:

1) Project Specification
2) Requisition
3) Request for Quotation
4) Operation Procedure & Maintenance Manual

5-1 PROJECT SPECIFICATIONS

The installation work of the coal gasification test facilities regarding the following items is specified:

1) Opening of the packed facilities which had been transported there
2) Arrangement
3) Supplementation of acceptance
4) Transportation to site
5) Temporary laying
6) Indoor foundation work
7) Painting (only touch up)
8) No-load test run
9) Attendance at individual load test
10) Attendance at integrated load test run
11) Cleaning and so forth.

The details are given in the separate volume of "Technical Specifications for the Construction Work of the Coal Gasification Test Facilities."

5-2 REQUISITION

This requisition includes the purchase conditions, the general conditions and the technical conditions.

The details are given in the separate volume of "Technical Specifications for the Construction Work of the Coal Gasification Test Facilities."

5-3 REQUEST FOR QUOTATION

The Japan International Cooperation Agency INDONESIA Office requested the bidder to quote in accordance with the applicable documents for the construction of the coal gasificatior. test facilities. It was understood that unless exceptions, deviations or alternatives were clearly defined and listed separately and the documents would be deemed to be accepted by the bidder.

The details are given in the separate volume of "Technical Specifications for the Construction Work of the Coal Gasification Test Facilities."

5-4 OPERATION PROCEDURE & MINTENANCE MANUAL

The operation procedure shows separately the start, daily operation, stop and emergency stop procedures of the coal gasification test facilities.

The maintenance manual shows the procedures of maintenance and troubleshooting procedures for the individual equipments of the coal gasification test facilities.

The detailes are given the separate volume of in "The Operation Procedure of Coal Gasification Test Facilities" and "The Maintenance of Coal Gasification Facilities."

5-5 CONSTRUCTION AND OPERATION TEST

1) The construction work of the Pilot Plant Building in PUSPIPTEK was completed in September, 1986.

2) Fabrication and transportation of equipment for the coal gasification test facilities as well as utilities facilities was carried out and completed in September, 1986.

3) Field work of the coal gasification test facilities and utilities facilities was completed in January, 1987, including acceptance inspection of equipment.

4) Mechanical test and operation test of the facilities, including performance test, were successfully completed in March, 1987. The operation test result shows that the coal gasification test can be carried in FY 1987 as scheduled.

6. RESULTS OF THE COAL SAMPLING WORK AND GEOLOGICAL SURVEY

6-1 THE OBJECTIVES OF THE COAL SAMPLING WORK AND GEOLOGICAL SURVEY IN FY 1986

1) To take coal samples for mechanical and process test run of gasification facilities and regular gasification test.

2) To carry out a geological survey for selecting appropriate drilling spots for coal sampling to be done in FY 1987.

6-2 THE SURVEY WORK CARRIED OUT IN FY 1986

1) About 2,667 kilograms of coal samples for the test run of the gasification facilities were taken from pits dug in the Northwest Banko area.

2) About 2,236 kg of coal samples for the regular gasification tests were taken from different coal seams by large diameter core drilling in the Northwest Banko area.

3) The above coal samples for the regular tests were analyzed to check their quality.

4) Geological survey of several favorable places for coal sampling in FY 1987 was made in the Central Banko and North Suban Jeriji areas.

5) Appropriate drilling spots for coal sampling were selected on the basis of geological study.

6-3 RECOMMENDED COAL SAMPLING METHOD IN FY 1987

Places: Central Banko and North Suban Jeriji areas.
Weight of Samples: Total 2,000 kg (1,000 kg for each erea)
Method: Large diameter core drilling (core diameter: 101 mm)
Drilling Machine: 2 sets
Total
Drilling Length: 435m (Central Banko : 240m,
North Suban Jeriji: 195m)
Working System: 2 shifts/day
Working Period: 2 months

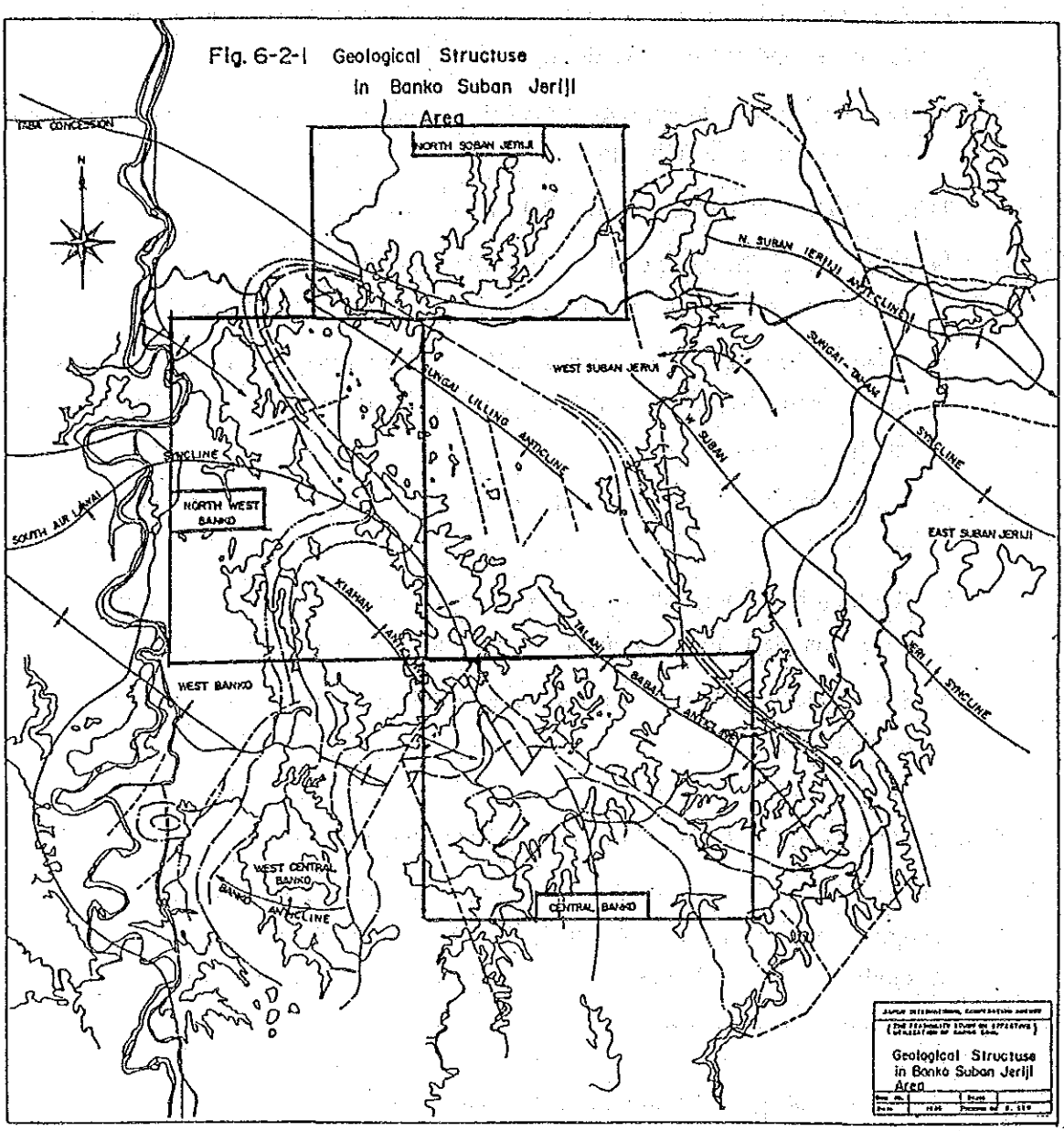
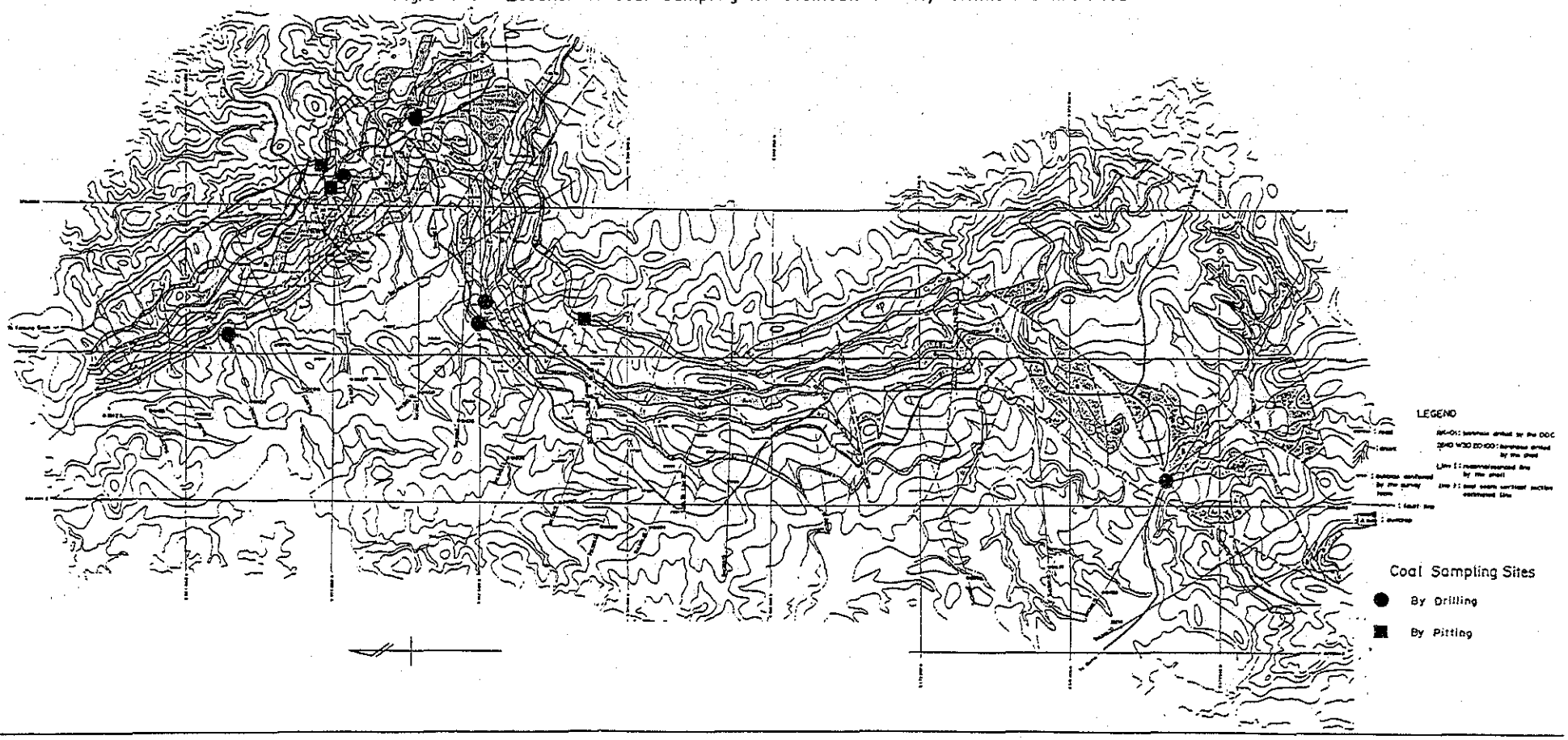


Fig. 6-2-1 Geological Structuse
In Banko Suban Jerijl
Area
NORTH SUBAN JERIJI
N. SUBAN JERIJI ANTICLINE
SUNGAI - DAWAH
WEST SUBAN JERIJI
SUNGAI LILING ANTICLINE
SYNCLINE
NORTH WEST BANKO
SOUTH AIR LAWAI
KIAMAN ANTICLINE
TALANG
BABAT ANTICLINE
WEST BANKO
WEST CENTRAL BANKO
BANKO ANTICLINE
CENTRAL BANKO
EAST SUBAN JERIJI
JERIJI SYNCLINE
Geological Structuse
in Banko Suban Jerijl
Area

Fig. 6-1-1 Location of Coal Sampling for Gasification Tests, Northwest Banko Area



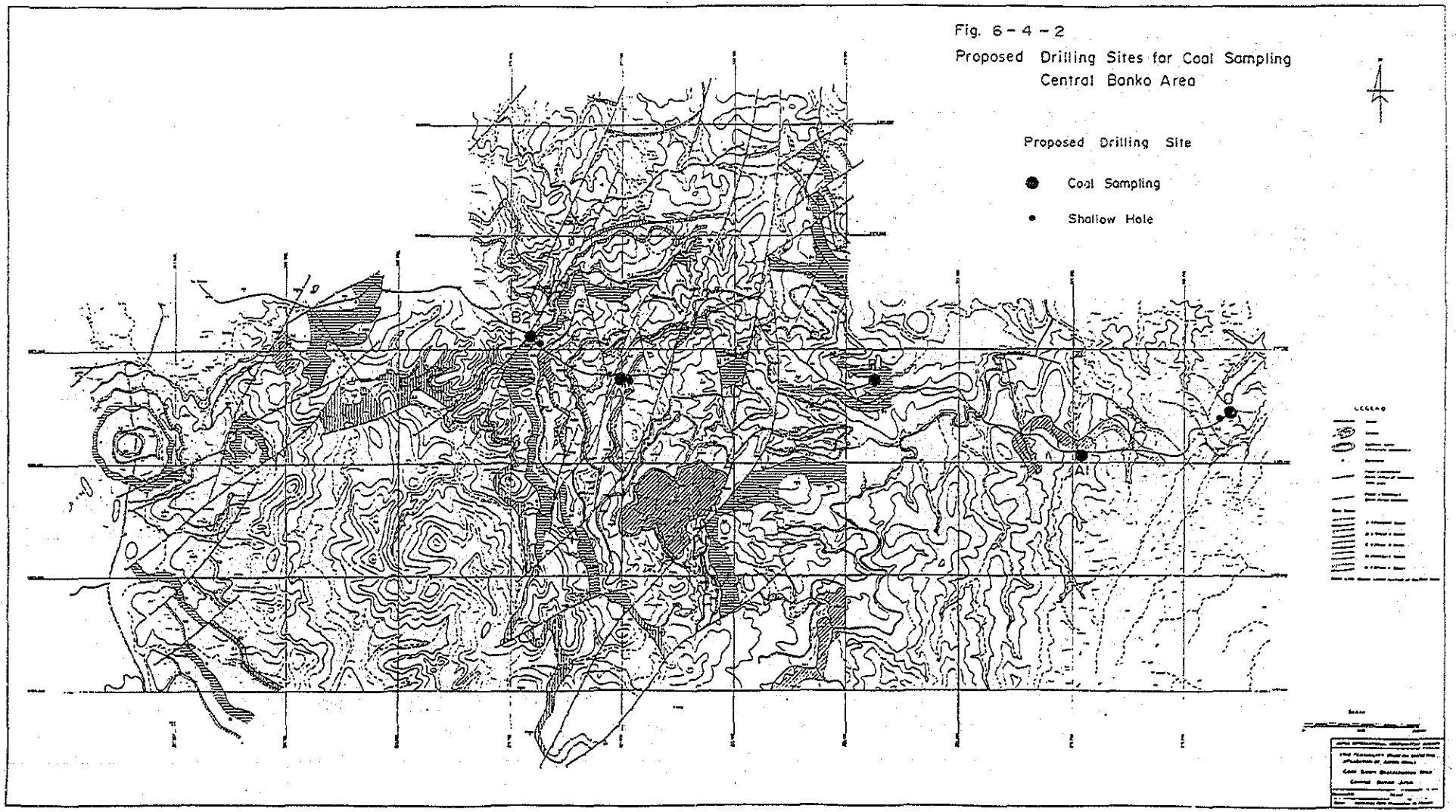
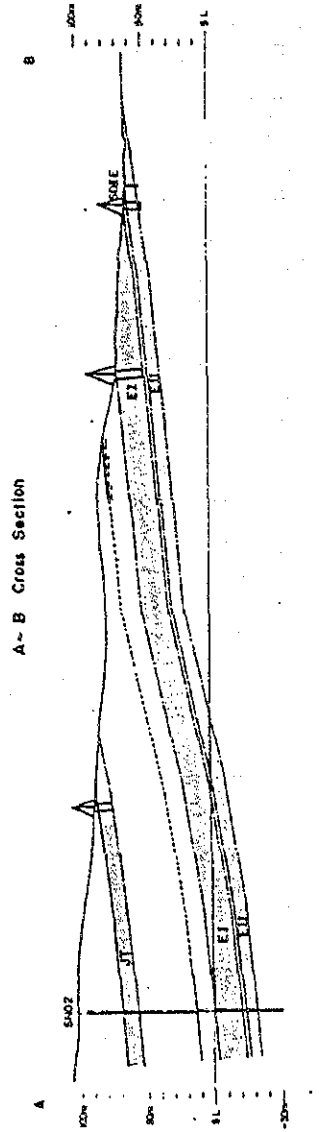
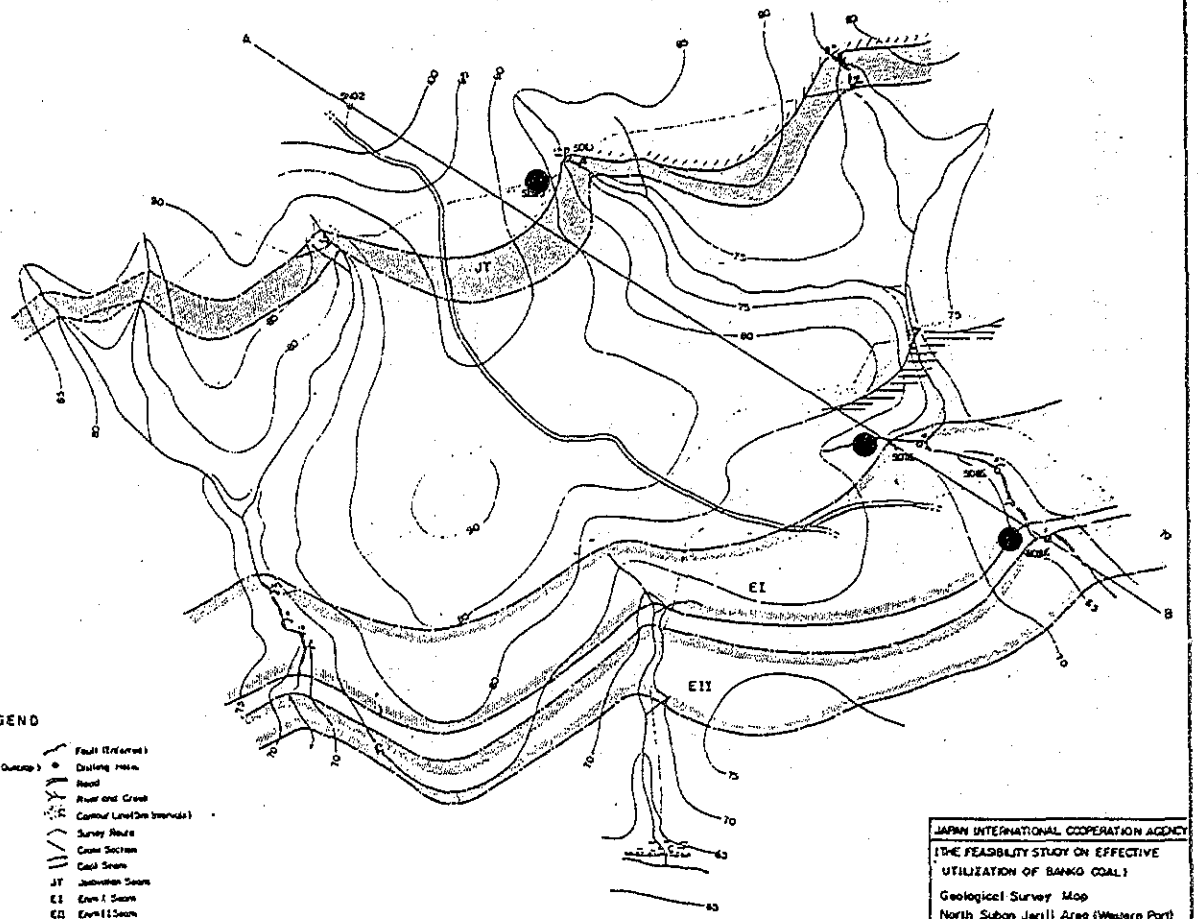


Fig. 6 - 4 - 2
Proposed Drilling Sites for Coal Sampling
Central Banko Area

Fig. 6 - 4 - 3

Proposed Drilling Sites for Coal Sampling
North Suban Jeriji Area





LEGEND

- Coal Outcrop
- Carbonaceous Shale(B: Outcrop)
- Claystone(C: Outcrop)
- Mudstone(M: Outcrop)
- Sandstone(S: Outcrop)
- Contact
- Bedding (Coal)
- Bedding (Other Rocks)
- Boundary (Observed)
- Boundary (Presumed)
- Boundary (Inferred)
- Fault (Inferred)
- Drilling Hole
- Road
- River and Creek
- Contour Line (20m Interval)
- Survey Route
- Coal Seam
- JT Jeebunten Seam
- EI Eram I Seam
- EII Eram II Seam

Proposed Drilling Sites

JAPAN INTERNATIONAL COOPERATION AGENCY
THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL
Geological Survey Map
North Suban Jeriji Area (Western Part)

7. PRELIMINARY EVALUATION OF ECONOMIC FEASIBILITY

7-1 COAL MINING COST

The preliminary evaluation of the mining cost of N.W. Banko coal has been investigated. The mining cost of N.W. Banko coal is estimated to be 14.5$/ton-coal by shovel and truck system.

1) Main Parameters and Assumptions

Coal reserves: N.W. Banko
Annual production: 3 million tons/year
Mining method: Shovel and truck system
Strip ratio: 1.63-1.95

2) Capital Investment Cost

Initial investment costs:	125 million $
Replacement costs:	186 million $
Total	311 million $

3) Coal Mining Cost

14.48$/ton-coal

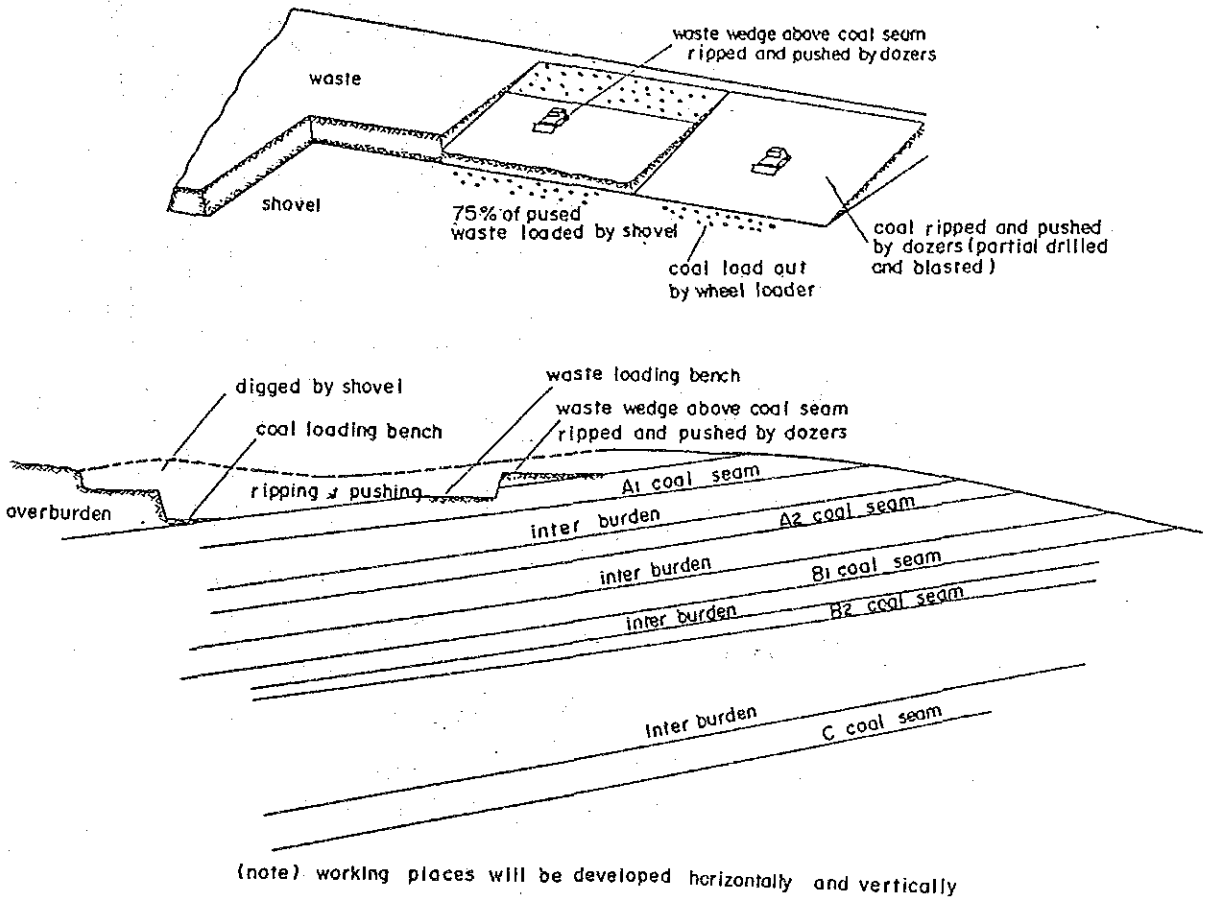
4) Sensitivity Analysis

Increase of strip-ratio(%): 10, 20, 30
Increase of mining cost(%): 1.2, 5.4, 8.9

5) Evaluation

Previous evauation in 1985 shows 14.85$/ton.
Minus factors of mining cost are decrease of miscellaneous mining losses. On the other hand, plus factors of mining cost are change of preconditions such as addition of infrastructural cost and technical service fee.
A detailed study shall be done at the 3rd stage on the basis of selected coal reserves and type of expected coal production entity to be decided on by the Counterpart.

Fig. 7-1-1 Idealized Mining System in Three Dimensions



(note) working places will be developed horizontally and vertically

Fig. 7-1-3 Pit Outline at the Beginning of Production Period

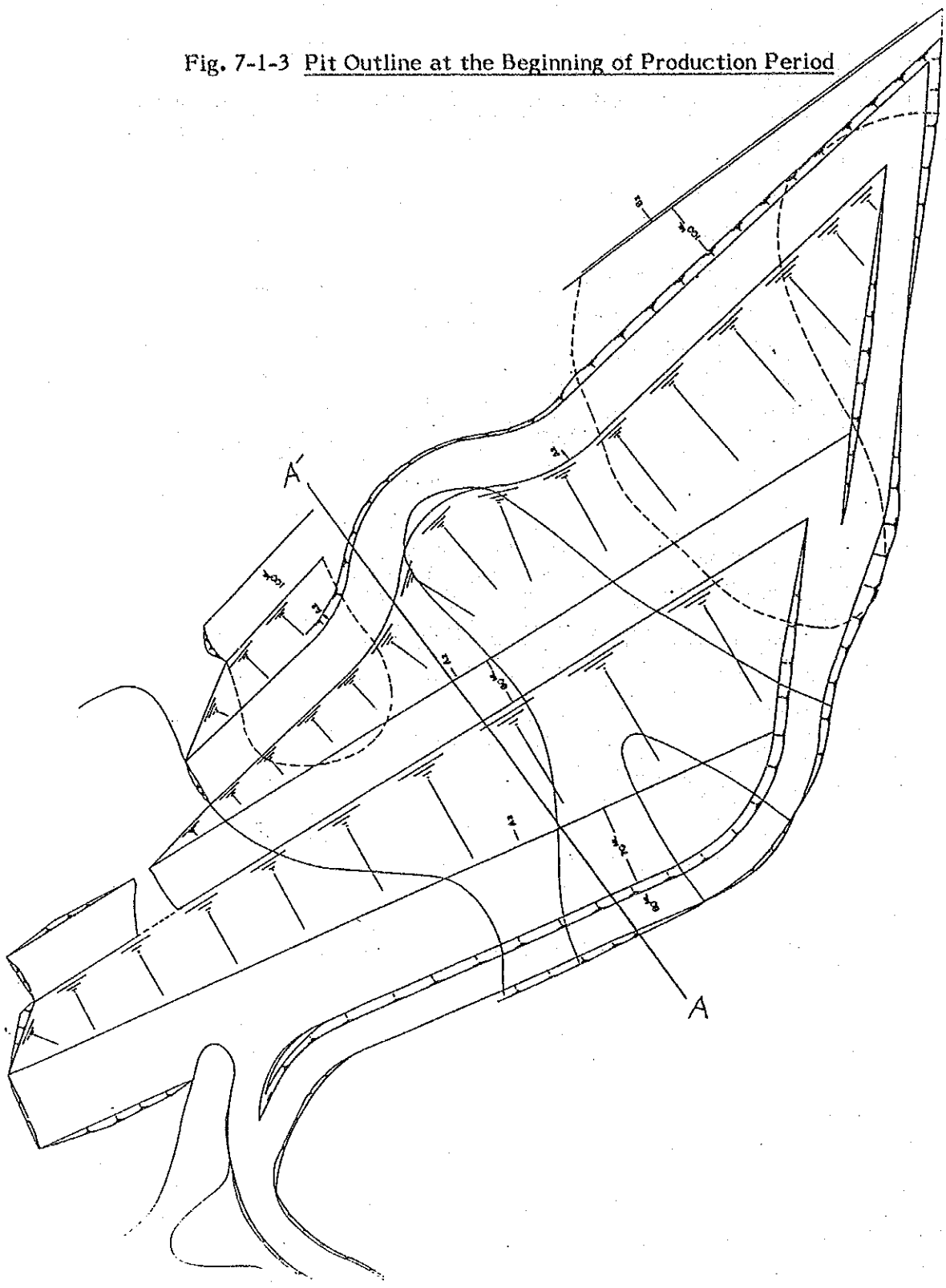
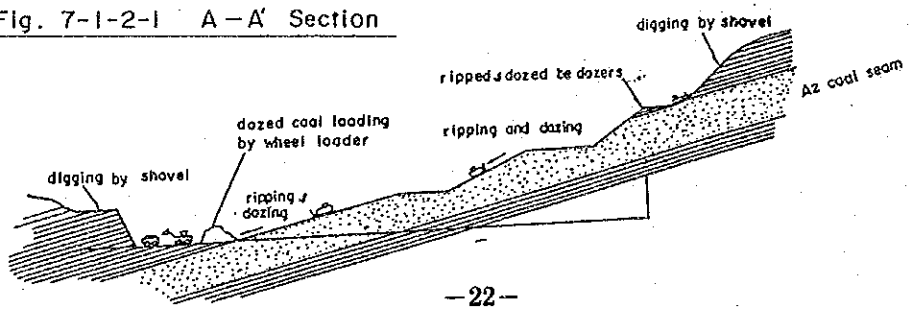


Fig. 7-1-2-1 A—A' Section



7-2 UREA PRODUCTION COST

A preliminary evaluation of urea production cost has been carried out on the basis of master plan-case 2A. (See attached Fig. 9-2-5.)

1) Main Parameters and Assumptions

Coal feed rate:	$4{,}120 \times 10^3$ t/y
Produced gas volume:	510×10^3 Nm^3/H
Methanol production:	$1{,}300 \times 10^3$ t/y
Urea production:	560×10^3 t/y

2) Capital Investment Costs (as of 1985)

	10^6 Rupiah
Coal gasification plant:	413,000
Methanol plant:	163,000
Urea plant:	154,000
Support facilities:	476,000
Total	1,206,000

3) IRR on Total Investment Costs

Urea sales price (at plant gate)		IRR
Rp/Kg	($/t)	(%)
111	100	10.6
160	150	12.3
222	200	13.8

Note a) Sales price (at plant gate) of methanol is 194Rp/Kg and fixed for each case.

b) IRR of methanol production in case of 194Rp/Kg is 13.5%.

4) Evaluation

i) The FOB cost at Palembang will be around 215$/ton including 25$/ton of inland transportation cost. On the other hand, the international FOB price in 1984 was 170-180$/ton at a crude oil price of 30$/bbl.

ii) The economics of urea production is inferior to that of methanol, and therefore it can be concluded that case 2 of the master plan (co-production of methanol and urea) will be eliminated from further study in the 3rd stage.

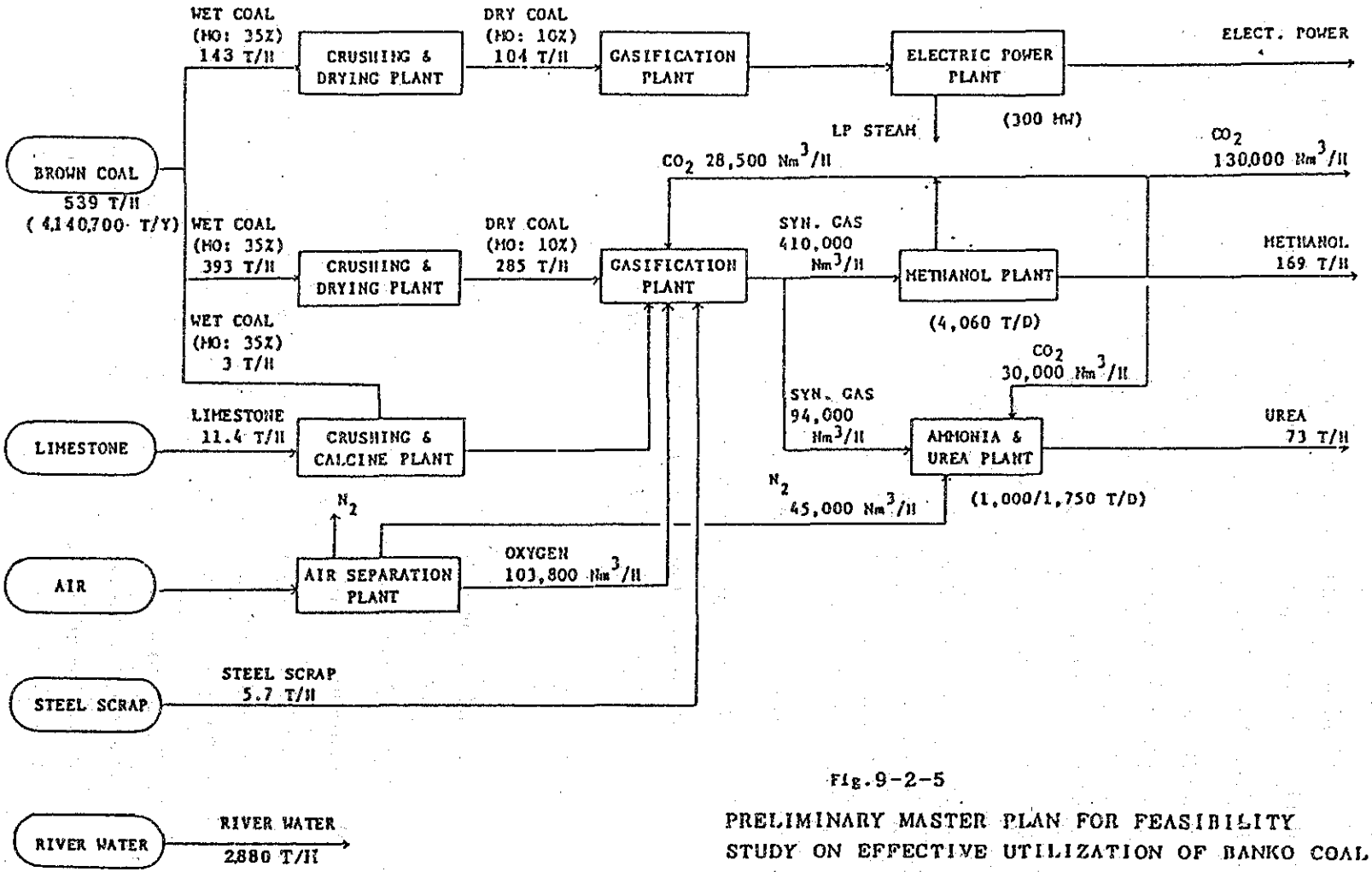


Fig.9-2-5

PRELIMINARY MASTER PLAN FOR FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL

CASE 2-A

7-3 ELECTRICITY GENERATION COST

The preliminary evaluation of electricity generation cost has been studied on the basis of master plan-Case 1A. To compare the economics with that of methanol production, the coal feed rate was assumed to be the same as in the methanol production case (Case 1A. molten iron bath process).

1) Main Parameters and Assumptions

Maximum coal feed rate	:	495T/H
Average load factor	:	66% (average in Indonesia)
Average coal consumption	:	2.5 million tons per year
Power generation capacity	:	835MW
Power generation system	:	Coal gasification-combined cycle

2) Capital Investment Costs (as of 1985)

	10^6 Rupiah
Coal gasification plant: (including its support facilities)	502,000
Power plant: (including its support facilities)	438,000
Total	940,000

3) IRR on Total Investment Cost

	Electricity sales price (Rp/KWH at gate)	IRR (%)
Sales in Jakarta	43	6.9
	53	10.3
Sales in Banko	64	13.5
	78	17.0

Note a) The sales price is assumed to be 98 Rp/KWH as of 1985. Loss of distribution and overhead cost were changed for each case.

4) Evaluation

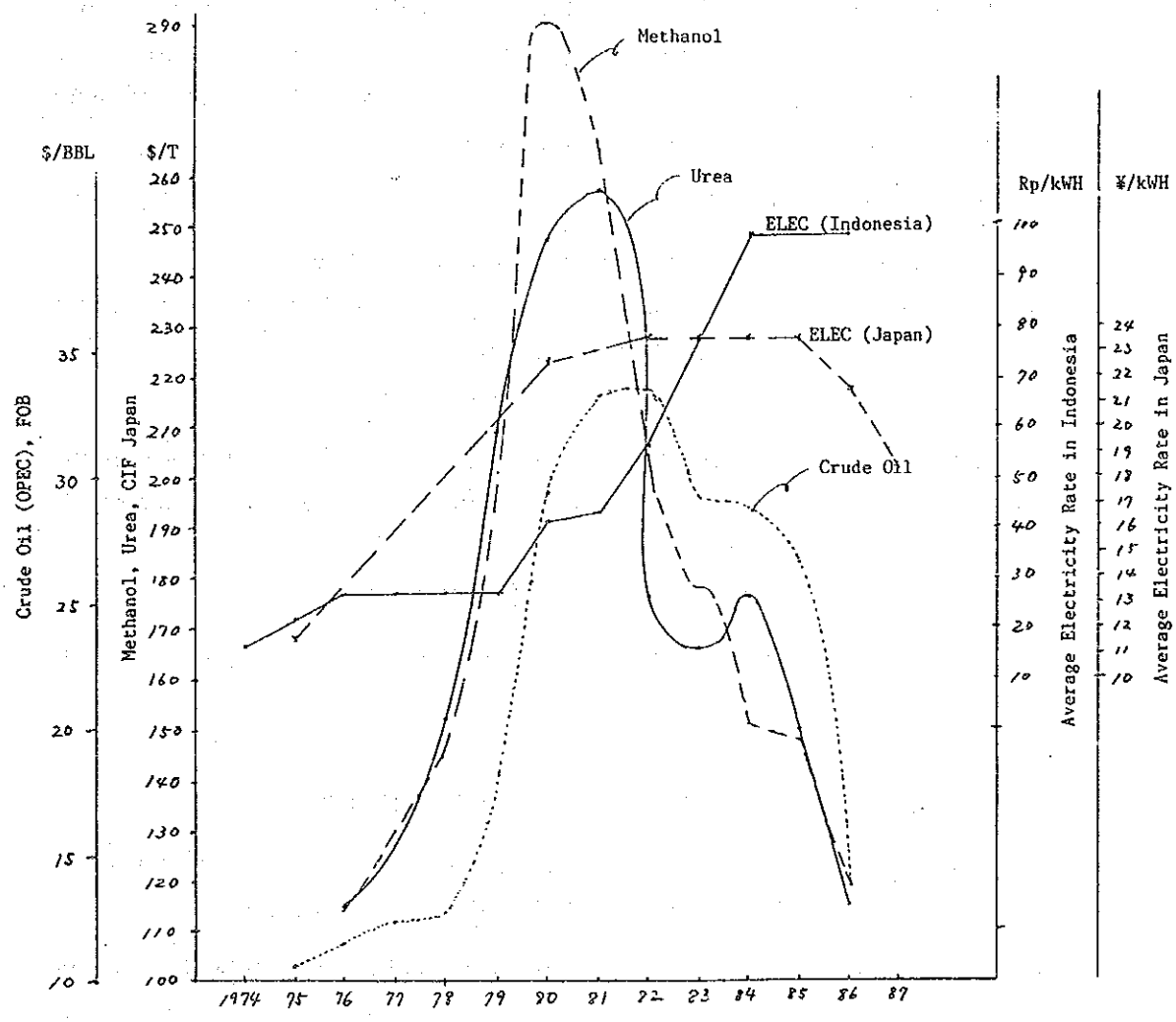
i) If the electricity is distributed to the Banko area, including the Project site, the IRR is expected to be 13.5% and almost the same as that of the methanol production case. In this case, it is evaluated to be viable in view of economic feasibility.

ii) IRR of sale in the Jakarta area is estimated to be 6.9-10.3% on the basis of 98 Rp/KWH of the sales price in Jakarta as of 1985. The economics may be inferior to that of methanol production.

iii) Fig. 7-2-8 illustrates the trend of prices of methanol, urea and electricity. The price of methanol and urea has great correlation with that of crude oil, however the price of electricity shows a different trend because the electricity sales price is decided on the basis of the energy and economic policies of each country.

iv) It is concluded that lower cost finance than 6.9%/year will be required for electricity plant and the study shall be investigated in more detail in the 3rd stage.

Fig. 7-2-8 Shifts in Price of Crude Oil (FOB OPEC), Methanol and Urea (CIF Japan), and Electricity Rate in Indonesia and Japan



8. RESULTS OF THE STUDY ON MARKET FOR FUEL ETHANOL AND ITS SUPPLY SYSTEM IN INDONESIA

8-1 INTERNATIONAL TRENDS ON FUEL ETHANOL UTILIZATION

1) Utilization Technology

Commercial utilization has been carried out in Brazil and the U.S.A. Ethanol has no special problems of toxicity and pollution of the environment and therefore, is most easily available as an alternative fuel for conventional oil products for automotive use. And also, only minimum modification of existing engines is necessary.

2) Consumption of Fuel Ethanol

Fuel ethanol is being used mainly as an automotive fuel.

U.S.A.: i) Fuel ethanol introduction is a countermeasure for surplus agricultural production and octane boosting

ii) Consumption is 1.7 million Kl/yr. (1983)

Brazil: i) Effective utilization for a by-product of sugar production and saving foreign currency on oil imports are the purpose of introduction.

ii) Consumption is 8.0 million Kl/yr(1985)

Others: In Philippines, Cuba, Ireland and South Afrca, fuel ethaol is reported to be used.

8-2 POTENTIAL DEMAND FOR FUEL ETHANOL IN INDONESIA

1) About 160×10^3 Kl/yr. in the Jakarta region and 950×10^3 Kl/yr as blend to gasoline in the long-term in all Indonesia are estimated.

2) Fuel ethanol is considered to be most feasible from technological and economical point of view. And therefore, no other use of fuel ethanol seems to be feasible from its cost competitiveness.

8-3 PROGRAM FOR INTRODUCING FUEL ETHANOL

1) Penetration Stage

i) Feedstock

Molasses as a by-product of sugar production

(170 x 10^3 Kl/yr of fuel ethanol equivalent is possible)

ii) Demand

Potential demand of 160 x 10^3 Kl/yr in case of 10% ethanol blend in gasoline in Jakarta and its surrounding region

iii) Facilities to be newly installed, on production and its distribution

a) Production facility of hydrous ethanol from molasses (10 x 10^3 Kl/yr x 16)
b) De-hydration facility (30 x 10^3 Kl/yr x 5)
c) Blending facility to gasoline
d) Upstream distribution facility of ethanol

2) Ultimate Stage

i) Feedstock

Cassave in transmigration area

ii) Demand

Potential demand of 950 x 10^3 Kl/yr in the long-term in case of 20% blending in gasoline in all Indonesia.

iii) Facilities to be newly installed, on its production and its distribution

a) Producion facility of hydrous ethanol from cassave (10 x 10^3 Kl/yr x 79)
b) De-hydration facility (160 x 10^3 Kl/yr x 6)
c) Blending facility to gasoline
d) Upstream supply facility of ethanol

8-4 ISSUES, POLICY AND MEASURES FOR INTRODUCING FUEL ETHANOL

1) Introducing fuel ethanol offers no problems of toxicity and pollution of the environment.

2) Introducing fuel ethanol causes no economic feasibility problems under a crude oil price of 30$/bbl from its financial analysis because of its high production cost.

3) It is substantially important how to evaluate such merits as environment-improving effect by use of unleaded gasoline, impact on transmigration policy and energy conservation, which are not included in the financial analysis.

4) In economic evaluation, such items as labor cost, tax, profit etc. can be classified as benefits of the project for Indonesia.
Under such conditions, ethanol production from molasses is evaluated as feasible in case of a crude oil price of 30$/bbl.

8-5 POLICY OF INTRODUCING FUEL ETHANOL

1) Entity for Producers and Distributors
Design of the organizations concerned about ethanol production and marketing should be planned as shown in Fig. 8-6-1.

2) Offering incentives for producers and consumers of fuel ethanol belong to policy matters. It requires coordination with conventional oil products in price competitiveness. And also, the following measures are required by the Government of Indonesia.

   i) Standards and planning towards unleaded gasoline

   ii) Standards for exhaust gas emission from automobiles

   iii) Incentives for producers and consumers to promote introduction of fuel ethanol

As to item iii) mentioned above, the following measures can be suggested:

   i) Incentives for molasses producers

      a) Ethanol producer (enterprise B) gives an assurance to purchase molasses constantly
      b) Price of molasses to be purchased is set to be equal to the export price
      c) Preferential measure of tax for facilities of production and distribution of ethanol
      d) Low interest-rate loan for enterprises concerned

   ii) Incentives for cassava producers

      a) Assurance to purchase cassava at the price which is set to assure transmigrants life
      b) Low interest-rate loan for facilities of casssava production and transportation

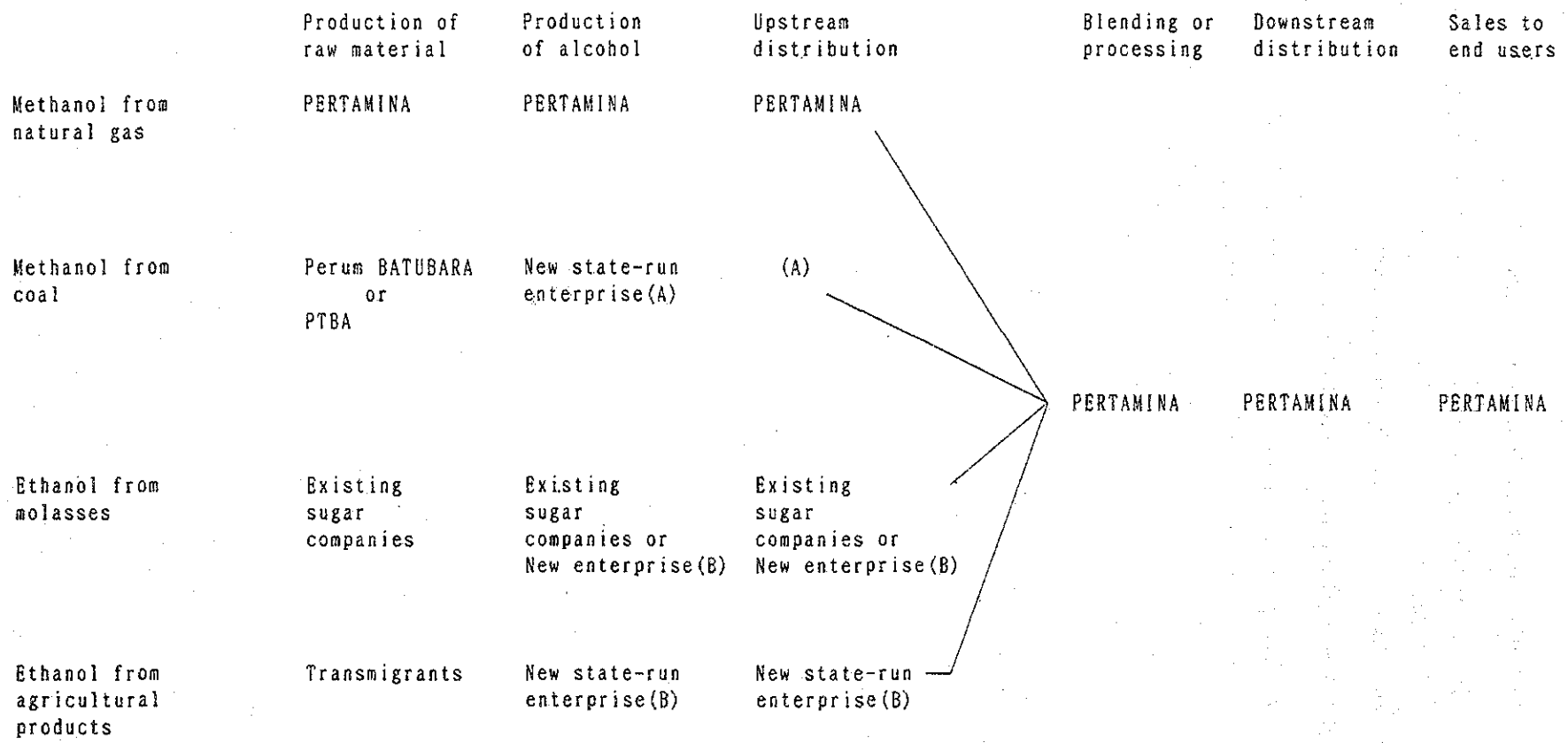
iii) Incentives for fuel ethanol consumers

a) Preferential price-setting (ex. price increase of conventional oil products)
b) Tax reduction for alcohol-fueled vehicle

iv) Incentive for producers of fuel ethanol

a) Tax preferential measures for production facilities
b) Lower interest-rate for production facilities

Fig. 8-6-1 Suggested Production and Distribution Entity



8-6 IMPACTS OF INTRODUCING FUEL ETHANOL

1) Impacts on Consumpton of Oil Products

   950×10^3 Kl/yr of potential demand for fuel ethanol might be judged to have smaller impacts compared with the volume of methanol introduced. However, the impacts on oil refining will be great because of the role of octane booster.

2) Impacts on Effective Utilization of Energy Resources

   It can contribute to restrain consumption of exportable energy resources.

   As a result, it can contribute to

   a) Preservation of exportable energy resources
   b) Saving the development cost concerned

3) Impacts on Transmigration Policy

   It can give cash for transmigrants, which contributes to the promotion of transmigration policy and settlement of transmigrants.

4) Impact on Environmental Policy

   It is very effective as a measure for clean exhaust gas.

8-7 CONCLUSIONS AND RECOMMENDATIONS

1) The most preferable utilization of fuel ethanol is as an automobile fuel in low blend gasoline.

2) The production of fuel ethanol from molasses is desirable compared with that from cassava.
   However, it is estiamted to be difficult to be commercialized by private sector because of less profitability in view of financial analysis. In the case of production from cassava, the financial analysis shows rather worse economics than that from molasses.

3) On the other hand, the production and utilization of fuel ethanol can contribute to the policies of the Indonesian Government such as transmigration policy, energy policy and environmental policy.

9. RESULTS OF THE STUDY ON MARKET FOR FUEL METHANOL AND ITS SUPPLY SYSTEM IN INDONESIA

9-1 INTERNATIONAL TRENDS ON FUEL METHANOL UTILIZATION

1) Utilization Technologies in Gasoline Engines Base

i) Low blending with gasoline (M-3 or less) has already been done in R&D in the U.S.A. and West Germany, mainly for decreasing lead in gasoline or unleaded gasoline and as a gasoline extender.

ii) A Middle blending with gasoline requires modification of conventional engines and new distribution facilities and also has a small effect on gasoline substitution. Therefore, R&D efforts were stopped internationally.

iii) High blend (M-85, 90) or neat use of methanol is already completed as regards technology development. However, it is not commercialized yet because of its poor economics.

2) R&D on Utilization Technologies in Diesel Engines Base

i) R&D efforts have already been stopped in the field of low-and medium-blending to diesel oil because of poor economics.

ii) As to high blend or neat use, dual fuel method and ignition assist method have been developed in West Germany, Japan and the U.S.A., and they are in fleet test stage. These two methods seem to be promising in reducing exhaust gas emission like NOx and soot from conventional diesel engines.

3) R&D on Utilization Technology of Fuel Methanol in Non-vehicular Uses

i) Large scale power generation plant

-Boiler: finished R&D activity but economics seems to be a main obstacle

-Gas turbine: same as mentioned above

-Reforming-type gas turbine: 10% increase in thermal efficiency catches much attention. The technology is combination of existing ones and seems to be commercialized without big trouble.

ii) Small scale diesel-type power generation

It is the same as automotive engines in principle. High thermal efficiency of reforming-type catches much attention.

iii) Fuel cell

The phosphoric acid type is in the demonstration stage. However, the molten carbonate type and solid electrolyte type are still in the R&D stage. Fuel cells seem to be promising as a scattered-type small scale power sources. Methanol can be used as a power generating fuel through reformation.

iv) Feedstock of MTBE (Methyl Tertiary Butyl Ether)

Producing technology of MTBE is already completed, which can be used as an octane booster.

v) Feedstock of city gas

The technology has already been completed. A local gas utility company can use this technology instead of LPG or naphtha in the long term.

9-2 EXISTING DEMAND FOR FUEL METHANOL

1) Automobile Use

i) Low blend (less than 3%)

- U.S.A.: 520×10^3t (1984) (for blending into gasoline)
- West Germany: 300×10^3t (1983)

ii) High blend or neat use of methanol

There is no commercial demand for methanol. Small amount of methanol is being used for fleet test in several countries.

- U.S.A.: 300 vehicles by Bank of America
  600 vehicles by CEC (California Energy Commission)
  Small number of cars by DOE
- West Germany: 300 vehicles of M-93 for fleet test
- Japan: 120 modified vehicles started 3-year fleet test in 1986 by Ministry of Transport. Also, MITI has a plan of fleet test.

2) Other Uses

i) MTBE

World-wide production capacity is 4.9 million t/yr and 3.14 million t/yr of methanol demand is expected for this. However, the share of fuel of MTBE use is not clarified.

ii) Other uses

Recorded no commercial demand

9-3 POTENTIAL DEMAND FOR FUEL METHANOL IN INDONESIA

1) Demand for Oil Products

i) Oil share is still dominant at 72% of the energy supply in 1984 in Indonesia.

ii) The growth rate in total commercial energy was decreased to about 3% p.a. the last few years. Oil product demand in 1995 is estimated to level off according to ASCOPE estimation, where the increase in gasoline is remarkable.

Table 8-3-12 Estimates of Oil Products Demand in 1995

10^3 KL/yr

	Sales Volume		Actual Data
	Pelita IV Base	ASCOPE	1985
Avgas	123.0 (0.3)	147.6 (0.6)	103.4 (0.4)
Avtur	604.7 (1.6)	620.5 (2.4)	619.0 (2.6)
Premium Gas	139.6 (0.4)	167.8 (0.7)	116.9 (0.5)
Regular Gas	4757.7 (13.0)	5720.3 (22.3)	3997.3 (16.5)
Kerosene	11751.5 (32.1)	7040.1 (27.4)	6983.3 (28.9)
ADO	11824.1 (32.3)	7163.3 (27.9)	7491.5 (31.0)
IDO	1968.5 (5.4)	1541.7 (6.0)	1612.3 (6.7)
Fuel Oil	5489.5 (15.0)	3250.0 (12.7)	3361.8 (13.9)
BBM Total	36658.6 (100)	25651.5 (100)	24192.4 (100)

NOTE: Ascope figures are taken from the document in the 3rd Conference of ASCOPE, Dec. 1985, the title of which is "Long Range Outlook of Petroleum Product Supply and Demand and Utilization of Refining Capacity in the ASEAN Region"

2) Prospects of Long-term Demand for Fuel Methanol

i) In case of a crude oil price of less than 25$/bbl, there is no demand for fuel methanol.

ii) In the case of a crude oil of price of 30$/bbl, there can be demand of 1.6 million ton for fuel methanol in 1995, if methanol can be supplied at less than 111 $/kl. 111 $/kl of methanol is the price corresponding to IRR 9.5% (8.0% of interest rate), and does not seem to be an attractive project. Low interest-rate finance is eagerly required.

iii) Fig. 8-3-3 shows the relation between crude oil price and fuel methanol volume to be introduced.

3) Potential Demand for Fuel Methanol

i) Transportation sector and power generation sector

a) Penetration stage: 50 - 80 x 10^3 kl/yr. of demand for blending into gasoline is expected in Jakarta and/or Surabaya regions.

b) Ultimate stage: 1100 x 10^3 kl/yr. of demand for power generation is expected in gas turbine and diesel power generators. (both will be retrofitted to reforming-type)

ii) Industrial sector

Estimation of potential demand in this sector is rather difficult because energy consumption in this sector is not sufficiently clear, and there will be 1400 x 10^3 kl/yr. of methanol demand if 10% of this sector demand for diesel oil would be converted to methanol.

iii) Household sector

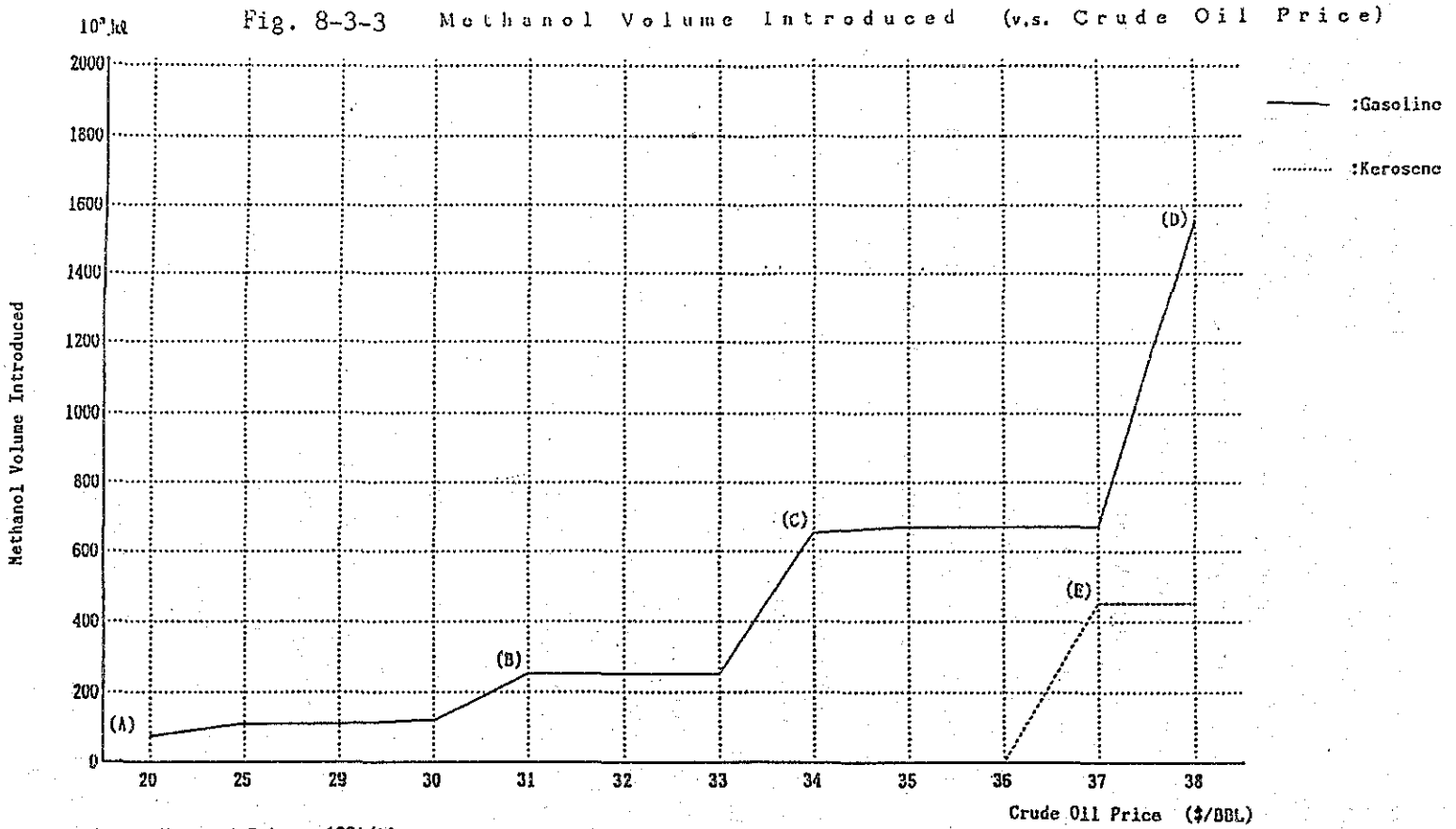
Fuel methanol is toxic and therefore, direct use in the household sector can not be expected. The results of long-term prospects show that the kerosene consumed in this sector will be substituted by electricity generated by fuel methanol.

iv) Summarizing above mentioned demands, total potential for fuel methanol is shown in the following table.

x 10^3 kl/yr.

	Penetration stage	Ultimate stage
Transportation sector	48 - 76	5650
Power generation sector	87	1100
Industrial sector	-	1400
Household sector	-	-
Total	140 - 160	8150

Fig. 8-3-3 Methanol Volume Introduced (v.s. Crude Oil Price)



Note: 1 Assumptions; Methanol Price 139$/kℓ
Domestic Oil Product Demand ASCOPE Case

2 Through methanol introduction, gasoline delivery for demand area 3 from Cilacap is reduced at such points as (A) (B) (C) (D).

At points (A) (B) (C), gasoline delivery for demand area 4 from Cilacap is increased and that from Dumai is decreased, leaving gasoline production in Dumai reduced.

At point(C), reformate export from Dumai is to start. At point(D), gasoline delivery for Area 5 from Cilacap is increased and gasoline production in Balikpapan is decreased, starting reformate export from that refinery.

At point(E), kerosene delivery for Area 2 from Plaju is to be replaced by methanol. This causes delivery for Area 3 from Plaju increased, that for Area 3 from Cilacap decreased, that for Area 4 from Cilacap increased and finally, that for Area 4 from Balikpapan decreased.

And as a result, kerosene production from Balikpapan is to be decreased.

9-4 PROGRAM FOR INTRODUCING FUEL METHANOL IN INDONESIA

1) Penetration Stage

Transportation sector: Methanol introduction is to be carried out in the form of low blend to gasoline in those regions of Jakarta and Surabaya.
Power generation sector: Along with rural electrification policy, methanol use is to be promoted in gas turbines and small scale diesel power generators.

In this stage, installed supply capacity of Bunyu seems to be sufficient to meet the amount of methanol demand.

2) Ultimate Stage

Transportation sector: Methanl is to be introduced as a substitution for ADO and gasoline in the form of high blend or neat use.
Power generation sector: Methanol is to be introduced as a fuel in the form of retrofitting conventional gas turbines (methanol-reforming type) and small scale diesel power generators.

Towards this ultimate stage, fixing and arrangement of distribution delivery system seems to be an important issue.

3) Facilities for Distribution and Delivery System

Existing distribution and delivery system for chemical methanol can be applied in its fundamental sense. However, increasing the size of barges, 1st depots and newly installed 2nd depots is to be sufficiently planned.

9-5 ISSUES AND MEASURES FOR INTRODUCING FUEL ALCOHOL IN INDONESIA

1) Production cost (139 $/kl : 13.5% IRR) is cheaper than that of ethanol because of its economy of scale. However, total investment costs are substantially big. (1000 billion Rp for 1.6 million t/yr. as of 1985 value)

2) It is necessary for the crude oil price to be more than 38 $/BBL to introduce 1.6 million ton of methanol from Banko coal under 139 $/kl of methanol price.
If one assumes 30 $/BBL of crude oil, the FOB price of methanol must be lower than 111 $/kl (corresponding to IRR of 9.5%) In that case, lower cost finance is required than 8% of interest.

9-6 POLICY AND MEASURES FOR INTRODUCING FUEL METHANOL

1) Entity for Producers and Distributors

It seems to be desirable to plan organizations as shown in Fig. 8-6-1.

2) Offering incentives for producers and consumers of fuel methanol belong to policy matters. However to control conventional oil products in price competitiveness and to actualize the policies of the Government of Indonesia. The following will be required:

i) Standards and planning towards use of unleaded gasoline

ii) Standards of exhaust gas emission from automobiles

iii) Safety mesures (methanol producers, distributors and consumers)

iv) Incentives for producers and consumers to promote introduction of fuel methanol

As to item iv) mentioned above, the following measures can be suggested:

a) Incentives for coal producers (probably Perum BATUBARA or PTBA) and planning for development of new coal field

b) Incentives for methanol producers for only low grade coal

- Though coal cost shares very small percentage in methanol production cost, acquired cost of coal should be kept as low as possible. (10% reduction of coal cost leads to 2-3% increase of IRR)
- In view of capital intensiveness, low cost financing from public sector or loan from international organizations are required.

c) Incentive for consumers of fuel methanol

- Reasonable price setting (ex. increase in prices of conventional oil products)
- Tax reduction for methanol fueled vehicle

9-7 IMPACTS OF INTRODUCING FUEL METHANOL

1) Impacts on Consumption of Oil Products

In case of a crude oil price of more than 25$/bbl, partial introduction of methanol from coal come to be feasible and that leads to reduction of oil products consumption.

Total volume of methanol from Banko coal come to be feasible in cases of more than 38 $/BBL of crude oil or less than 111 $/kl of methanol (price corresponding to 9.5% of IRR).

In these cases, the methanol share in oil related products is equal to 14% of gasoline production and 3% of kerosene production.

2) Impacts on Utilization of Energy Resources

It can restrain consumpton of domestic exportable energy resources and also can,

- Utilize low rank coal with little commercial value
- Utilize small scale natural gas in remote areas which can not be used for LNG

As a result, it can contribute to

- preservation of exportable energy resources
- saving resources concerned

3) Impact on Transmigration Policy

In addition to the conventional transmigration policy for agriculture, fishery and forestry, transmigration for industrial development is a new subject.

4) Impacts on Environmental Policy

Introducing fuel methanol can be expected to be effective for improving air quality in urban regions as a lead-reducing measure in gasoline and an improving measure for exhaust emission from diesel engines.

9-8 CONCLUSIONS ON FUEL METHANOL

1) It is recommended to utilize fuel methanol as automobile fuel (M3 gasoline) and fuel for existing gas turbine generators at the penetration stage.

Application of fuel methanol will be extended to gasoline engines base (M85-M90) and diesel engines base (neat). Such application will be beneficial to city buses and trucks of large cities, diesel engine generators and reformed type gas turbine generators in the long-term.

In the industrial sector, methanol has the possibility to be used as one of the power generating fuels.

2) A methanol plant (esp. from coal) is rather difficult for the private sector to commercialize because of its capital intensiveness.

3) The policy and incentives for introducing fuel methanol are worthy of concrete examination from the point of the national interests of Indonesia.

THE INTERIM REPORT III

ON

THE FEASIBILITY STUDY

ON

EFFECTIVE UTILIZATION OF BANKO COAL

IN

THE REPUBLIC OF INDONESIA

(FY 1986)

THE INTERIM REPORT III ON THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL IN THE REPUBLIC OF INDONESIA

CONTENTS

1. INTRODUCTION

In response to the request of the government of the Republic of Indonesia, the Govenment of Japan decided to conduct the Feasibility Study (the Study) on Banko Coal Effective Utilization in South Sumatra (the Project) as one of the international cooperation programs for the social and economic development of developing countries.

Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical coopeation programs of the government of Japan, and The Institute of Energy Economics, Japan (IEE, Japan), as the consultant for the implementation of the Study, are undertaking the Study in close cooperation with the authorities concerned of the government of the Republic of Indonesia.

Agency for the Assessment and Application of Technology (Badan Pengkajian dan Penerapan Teknologi: BPPT) is acting as a counterpart agency to the Japanese study team (the Team) and also coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

The agreement (Scope of Work) between Japan International Cooperation Agency (JICA) and Agency for the Assessment and Application of Technology (Badan Pengkajian and Penerapan Teknologi: BPPT) was concluded on February 24, 1984. The 1st Stage (strategic investigation stage) of the Study was carried out in FY 1984 and the 2nd Stage (coal gasification test stage) has started in FY 1985.

This Interim Report has been prepared to figure out the background and the study results in FY 1986.

2. BACKGROUND OF THE STUDY

2-1 BACKGROUND OF THE WHOLE STUDY

During the past decade, the environment of energy problems has greatly changed with the two oil crises as turning points. That is, the oil crises triggered

sharp oil price increases followed by worldwide recessions and developments of alternative energy resources, resulting to urge for oil producing countries to cut its crude oil prices as well as the amount of export. These structural changes in oil supply-demand and prices have naturally produced great impacts on national alterntive energy development policies throughout the world.

In particular, development plans of synthetic fuel, from coal through gasification and liquefaction, which have brilliantly started after the first oil crisis under the initiative taken by Japan, the United States and West Europe, are recently exposed to a severe trial because of surplus and price down of crude oil.

However, during the past decade, conventional alternative energies, including coal, natural gas and nuclear power, have constantly expanded their shares in primary energy, thus greatly contributing to save the oil consumption.

On the other hand, alternative energy development in developing countries has various aspects different from development plans designed for advanced countries. In other words, alternative energy development in developing countries should not merely pursue introduction of energy sources to substitute for oil but be closely related to their industrialization plans.

This means needs to promote industries, expand employment and improve income levels through energy development. In this point Indonesia is not exceptional.

To maintain exports of oil and natural gas at the maximum possible level, the Indonesia Government has been taking the policies to save domestic consumption of those energy resources and to facilitate the development of alternative energies.

Among national programs, given priorities by the Indonesian Government are to develop alternative energies, to promote the transmigration and to develop industries.

Banko coal available in South Sumatra is the most potential natural resources in view of above mentioned programs, because its estimated reserves are abundant (See FIG.-I and II) and South Sumatra is nominated as one of the most prospective sites for the transmigration from Jawa.

On the other hand, Banko coal, classified into brown coal which has low calorific value as fuel and troublesome features so called as spontaneous combustion, denies long-distance transport from both technical and economic aspects.

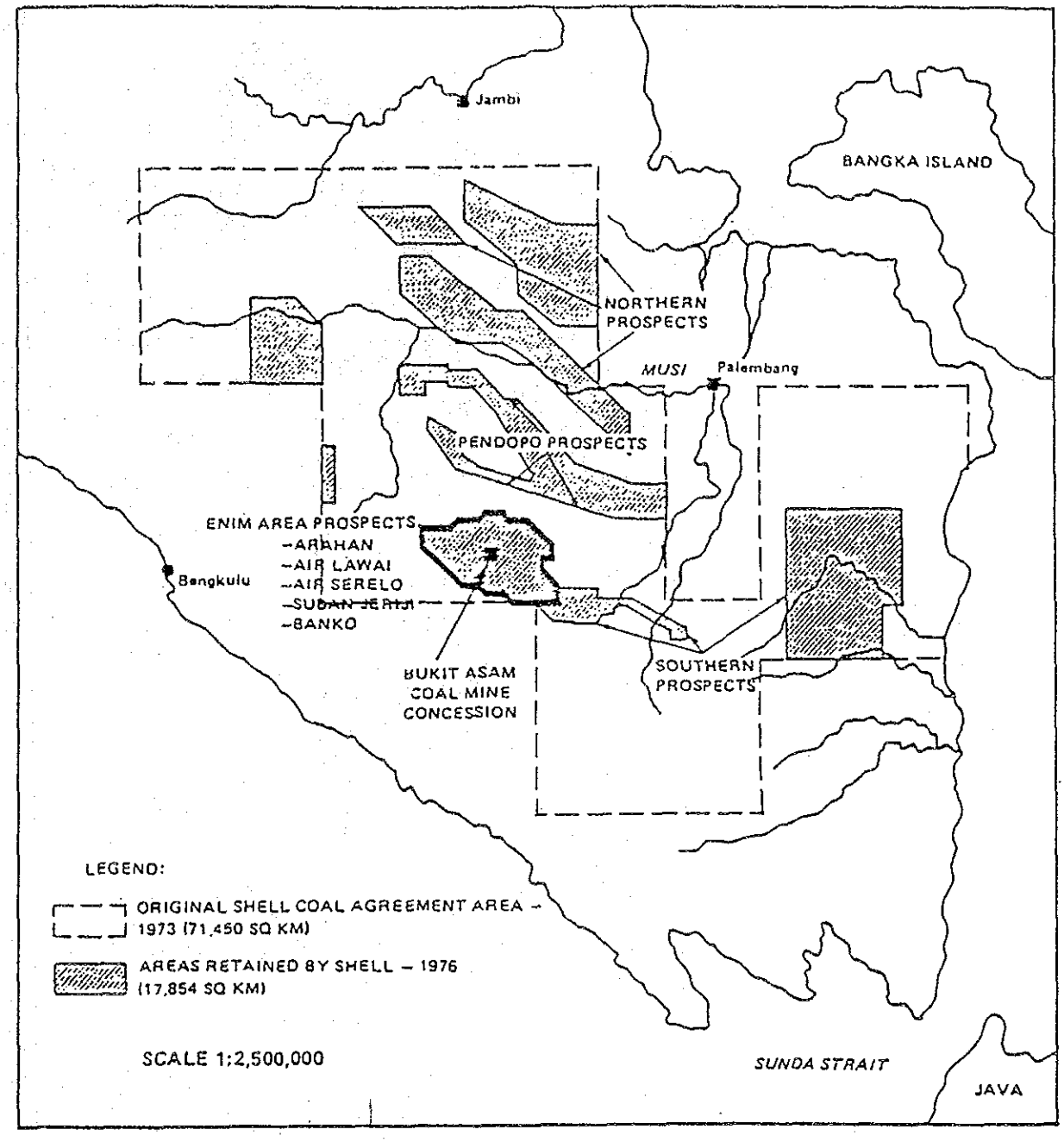


FIG. I Shell Coal Exploration in South Sumatra

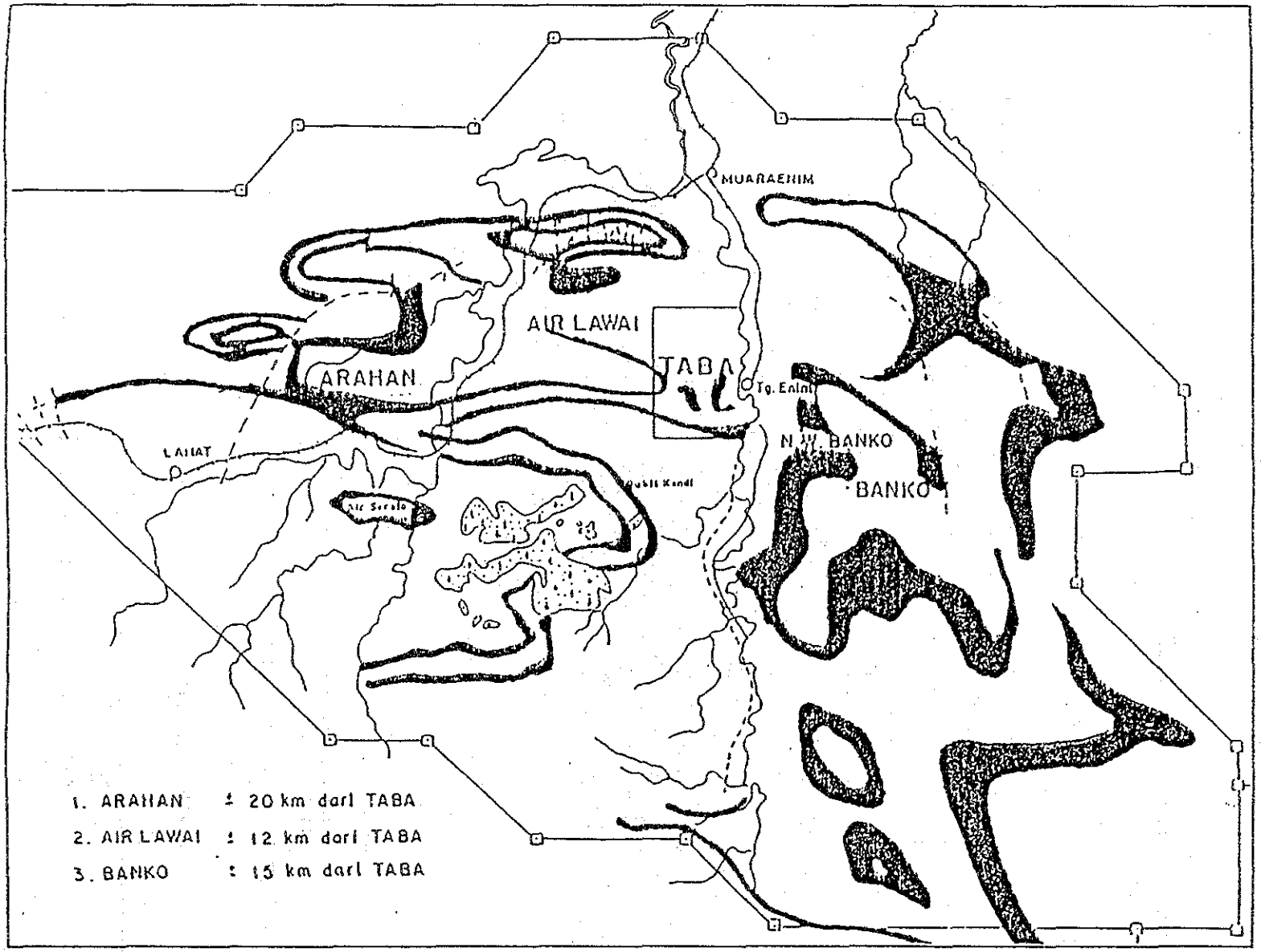


FIG. II Coal resources in Western part of South Sumatra area.

Therefore the typical utilization as fuel for electric generation or industrial heat source is practically difficult in view of technical and economic aspects.

From technical stand point of view, gasification of Banko coal and production of the derivatives seem to be a potential plan. (See FIG.-III)

From these prospects, the Indonesian Government requests to the Japanese Government to conduct development survey which will be essential for the preparation of the Banko coal development and its utilization plan.

2-2 BACKGROUND OF THE STUDY IN FY 1986

(1) Study in FY 1984

In FY 1984, the following studies were carried out in view of stragetic point.

1) Survey on background of the project
2) Preliminary survey on markets of brown coal and its derivatives
3) Survey on Banko coal resources and its preliminary mining cost estimation
4) Survey on brown coal utilization technology
5) Strategic investigation on Banko coal effective utilization
6) Study for coal gasification test

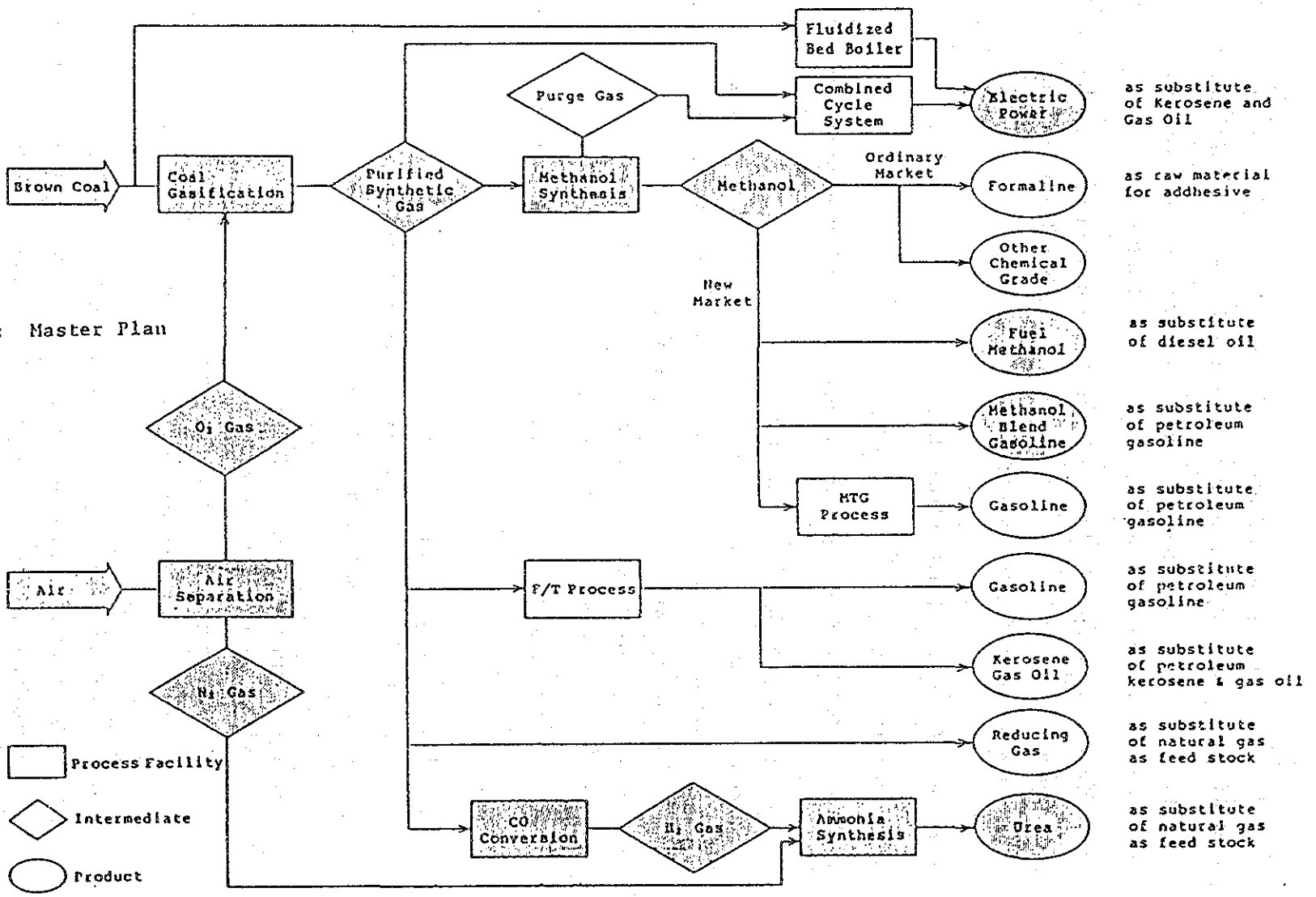
As the results of the above strategic investigation, the following conclusions were obtained.

1) The most possible utilization of Banko coal is production of fuel methanol, urea and electricity generation by coal gasification in view of market, technology, economics and Indonesian Government policy.

2) The measured reserves of Banko coal is enough for commercialization, 435 million tons. However, the quality of Banko coal is "non-transportable-problem coal" because of spontaneous combustion and fragility during transportation and stock as well as high sodium-in-ash.

3) The preliminary mining cost of Banko coal is estimated as 14 $/t (wet base) by non-continuous mining method. The selling price is estimated as approximately 25 $/t (dry base) on the basis of "cost and profit" for coal mining.

FIG. III Preliminary Flow Scheme and Master Plan for Brown Coal Utilization



4) Molten iron bath gasifier for synthesis gas production and fluidized bed gasifier for electricity generation are evaluated as the most superior technology for the time being.

5) It was revealed that spark assist diesel engine designed for neat methanol as fuel is ready for commercialization and has flexibility for fuel selection, diesel oil or neat methanol.

6) Master plan and preliminary proposed projects for Banko coal effective utilization were proposed. (See Fig.-III)
However, such a plan and projects must be studied furthermore in due course.

7) Economic possibility of Banko coal utilization was studied on the basis of the estimated selling price of Banko coal and production cost data obtained from published literatures.
Production of fuel methanol is "hopeful", but MTG (Mobil) and urea depend on price of crude in future and Government price policy for petroleum gasoline and natural gas.
Possibility of electricity generation by CGCC depends on future technical development.

8) As conclusion of the strategic investigation, the effective utilization of Banko coal seems to be feasible in technical and economic stand point.

(2) Study in FY 1985

In FY 1985, the study of the 2nd stage shown on FIG.-IV has started.
The scope of study in FY 1985 was as follows:

1) Detailed design on coal gasification test facilities
2) Survey on coal quality
3) Preliminary evaluation of economic feasibility

All of the studies in FY 1985 have successfully been completed and results were concluded as follows.

1) Detailed design of the coal gasification test facilities has been carried out and completed in September, 1985.
JICA has started the procurement of the equipment in accordance with the Scope of Work.
BPPT has continued the construction work of the pilot plant building in PUSPIPTEK and almost completed, excepting maintenance facilities.

2) Coal sampling study was carried out including shallow boring and deep boring in North West Banko and West Banko (partially).

The following were clarified:

i) The outcrop lines and coal seam structure in NW Banko and West Banko were grasped in detail.

ii) Sodium content in coal is maximum 0.6%, however sodium in ash is in the range of 0 - 40%.

iii) Coal samples (200 kg/sample x 10 samples) for the coal gasification test will be taken in NW Banko using two sets of 101 mm core drilling machines in FY 1986.

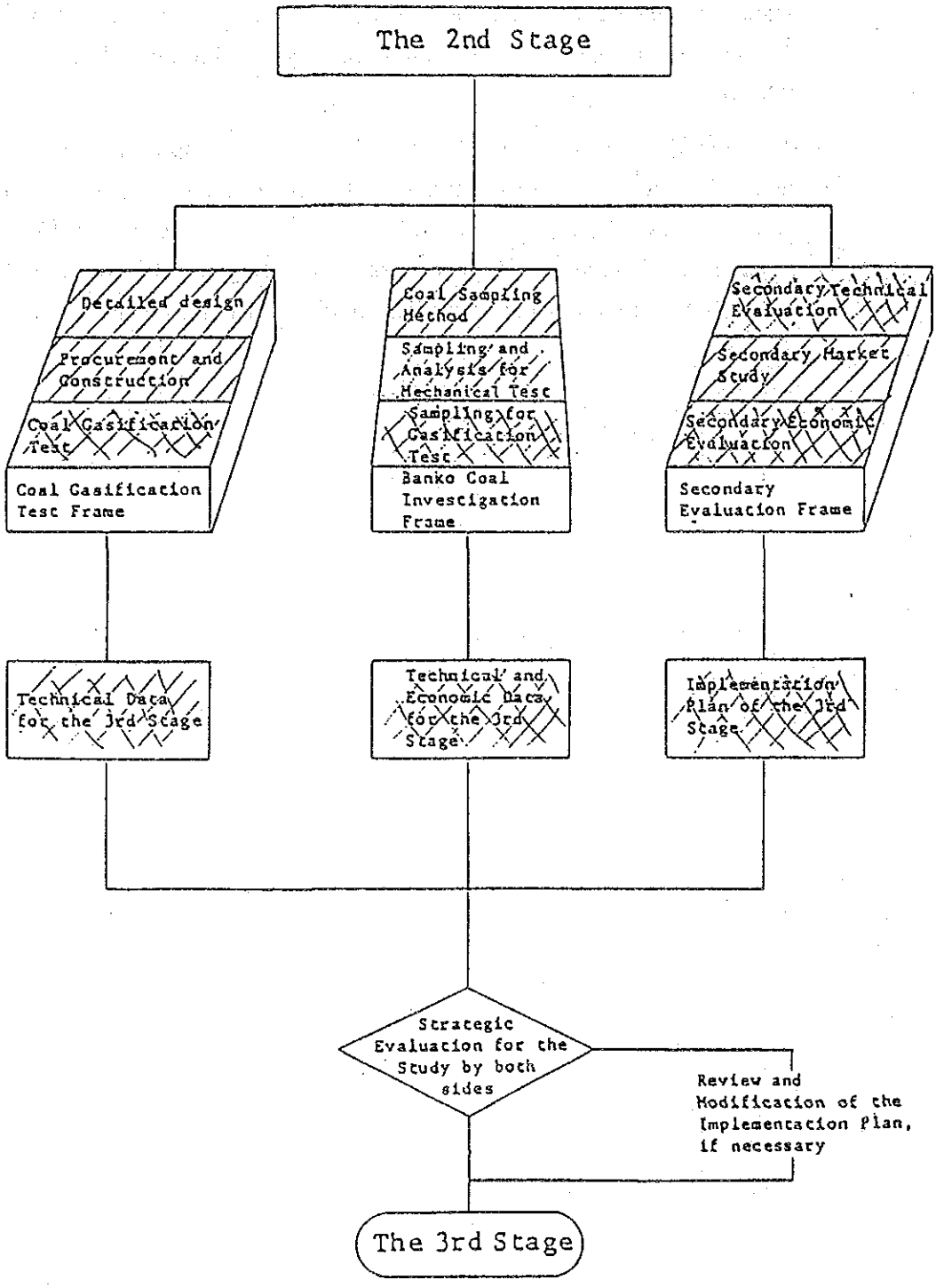
3) The project, producing 1,600,000 ton/year of methanol from Banko coal, was preliminarily evaluated in terms of financial viability and profitability.

i) The results show relatively low IRR of 13.5% (before tax) because the sales price of methanol (35¥/kg at gate, before tax) was assumed to be rather low, reflecting the current crude oil prices which have been

extremely declined. Since the viability as well as profitability of the project highly depends on the sales price, there is a possibility that this project is appraised as viable in case of higher oil price than 30$/bbl.

ii) Provided that produced methanol is imported to Japan as transportation fuel, the estimated methanol sales price in Japan (44¥/l before tax) is between those of gasoline (96¥/l) and diesel oil (81¥/l), considering difference of overall energy efficiency for automobiles, while fuel methanol serves benefits to air pollution improvement.

Fig. IV Flow Chart of Implementation Plan of the 2nd Stage



: Scope of the Study in 1985

: Scope of the Study in 1986

3. SCOPE OF WORK OF THE STUDY

3-1 OBJECTIVE

The objective of the whole Study is to establish an appropriate master plan of effective utilization of Banko coal and to examine its technical, economic and financial feasibility, including coal gasification study, and to prepare the reports synthesizing the result of overall investigations and studies.

The objective of the 2nd stage (the coal gasification test stage) is to grasp characteristics of gasification of Banko coal and select coal basin to be studied in the 3rd stage.

The another objective is to carry out the secondary strategic evaluation on Banko coal effective utilization.

The study in FY 1986 is that for the 2nd year of the 2nd stage.

3-2 SCOPE OF THE STUDY

Scope of the whole Study

The Study will be carried out in the following three (3) stages:

1) Strategic Investigation Stage : 1.0 year
2) Coal Gasification Test Stage : 2.5 years
3) Feasibility Study Stage : 1.5 years

The strategic investigation stage is to establish a master plan of Banko coal effective utilization and to select optimum technology for the Banko coal gasification test stage.

The coal gasification test stage is that for grasping characteristics of gasification of Banko coal and selecting coal basin to be studied in the following stage.

The feasibility study stage encompasses analysis and synthesis of collected information and data at the previous stages, investigation of various project plans of Banko coal effective utilization, and preparation of the proposed Project.

Fig. V Flow Chart of IMPLEMENTATION PLAN

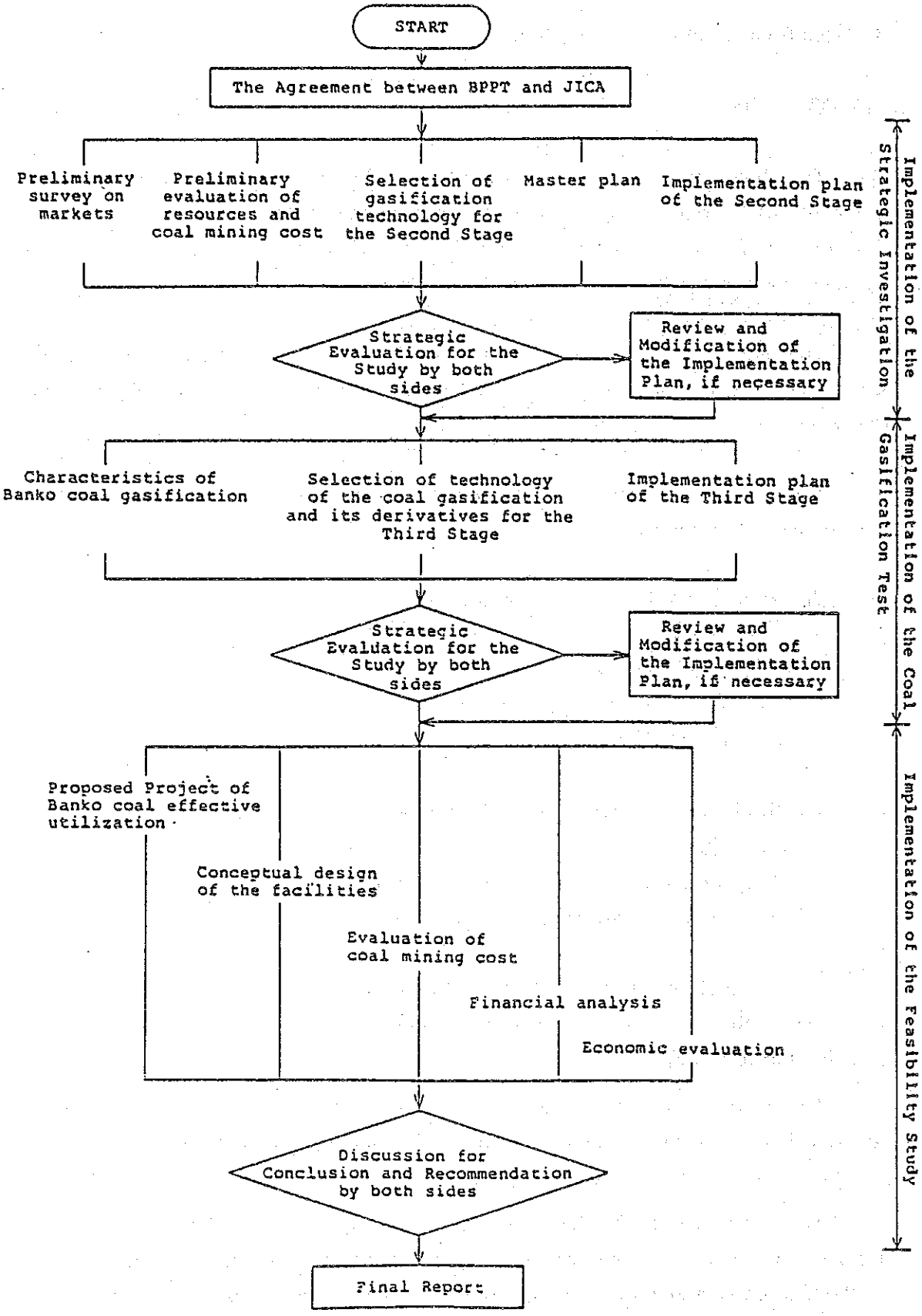


Fig. V shows flow chart of the implementation plan of the whole study.

3-3 SCOPE OF THE STUDY IN FY 1986

The scope of work of the 2nd stage is shown on Fig. (IV).
The scope of study in FY 1986 is as follows:

1) Fabrication, construction and mechanical test operation of coal gasification test facilities including the pilot plant building and utilities supply system.

2) Coal sampling work (1st phase)

3) Preliminary evaluation of economic feasibility on coal mining, urea production and electricity generation.

4) Study on market for fuel alcohol and its supply system in Indonesia.

4. OUTLINE OF THE SITE SURVEY

4-1 STUDY TEAM

The staff and his area of expertise of the Japanese study teams which are dispatched to Indonesia in FY 1986 are summarized on Appendix-IV.
The objective and special notes of the each study team are as follows:

i) Study Team (A)

Objective: Explanation and discussion with Counterpart on items 2.10.3 and 2.6.2.

2.10.3 Kick-off meeting of "Fuel Alcohol Project"
(Study on the Marketing and Distribution System of Fuel Alcohol in Indonesia)

2.6.2 Acceptance and Inspection of equipment and materials transported from Japan

Note: 2.10.3, 2.6.1 etc. mean the item number of scope of study described in Scope of Work.

ii) Study Team (B)

Objective: Coal sampling for gasification test

2.9.1 Reconnaissance/scientific survey of Banko coal resources

2.9.2 Selection of sampling points and sampling of coal

2.9.3 Packing and transportation of coal samples

iii) Study Team (C)

Objective: Survey on "Fuel Alcohol Project"

2.10.3

- Survey on utilizing technology for fuel alcohol
- Demand for petroleum products in Indonesia
- Potential demand for fuel alcohol in Indonesia
- Production and upstream distribution cost of fuel alcohol
- Issues and countermeasures for introducing fuel alcohol
- Programme for introducing fuel alcohol in Indonesia
- Policy and measures for introducing fuel alcohol

iv) Supervision Team

Objective: Supervision of field work of the coal gasification test facilities

2.6.2 Acceptance inspection of equipment and materials for the field work

2.6.3 Construction of the facilities

v) Operation Team

Objective: Test operation of coal gasification test facilities

2.7.1 Final inspection of the field work

2.7.2 Mechanical test of the facilities

2.7.3 Operations test and adjustment using specified coal

2.7.4 Final drawing, operation manual, and maintenance manual

vi) Study Team (D)

Objective: Explanation and discussion with counterpart on following items based upon draft report of F.Y. 1986.

- coal sampling for gasification test
- mining cost estimation of N.W. Banko coal
- study on "Fuel Alcohol Project"
- test operation of the facilities

4-2 SCHEDULE OF THE SITE SURVEY

Six (6) of JICA missions organized by the staffs of above mentioned team were dispatched to Indonesia for the site survey.

1st mission	June 16 - June 27	Jakarta, Serpong
2nd mission	June 30 - Oct. 4	Jakarta, Bandung, Banko
3rd mission	Aug. 13 - Sept. 11	Jakarta, Kupong, Balikpapan Palembang, Cilacap
4th mission	Oct. 6 - Nov. 11	Serpong
5th mission	Dec. 23 - March 15	Serpong
6th mission	March 1 - March 17	Jakarta, Serpong

The detailed schedule, organization and program visited by the each mission are attached as APPENDIX II.

4-3 SPECIAL NOTES OF THE SITE SURVEY

(1) 1st mission

The 1st mission was organized by the staffs of the study team A and B.

1) Implementation plan of the study in FY 1986 was discussed on the basis of the Inception Report and was agreed by both parties.

2) Budget for the study in FY 1986 was explained by both parties and confirmed that the study in FY 1986 will be proceeded on the same mode with Scope of Work.

3) Detailed implementation plan of coal sampling work in FY 1986 was discussed. Both sides agreed and confirmed the revised coal sampling

schedule which topographic survey and drilling operation would be started from 6th of July and 17th of July respectively.

4) Construction procedure and schedule of the coal gasification test facilities were discussed and agreed on:

   i) The JICA's procedure of "bidding and order" of the construction work of the facilities to be installed at PUSPIPTEK in Serpong.

   ii) The expected schedule as follows:

o Explanation meeting to tenders	:	20 June
o Closing date of quotation	:	15 July
o Order of the work	:	end of August
o Arrival of JICA equipment	:	Middle of Sept.
o Start of the work	:	Beginning of Oct.
o Completion of construction	:	End of Jan. '87

5) Implmentation plan of the study on "market for fuel alcohol and its supply system in Indonesia" was discussed with the counterpart including relevant organizations.
   Questionnaire of this study was explained at the first joint meeting held on June 20, 1986.

(2) 2nd mission

The 2nd mission was organized by the experts of the study team B and carried out the coal sampling work at N.W. Banko as well as topographic survey at Suban Jeriji and Central Banko.

(3) 3rd mission

The 3rd mission was organized by the study team C, and carried out data collection and opinion building though discussions with the counterpart and relevant organizations including such site visits as Cilacap refinery, Balikpapan refinery, diesel power plants in Kupang, and ethanol plant in Sulsuban.

i) In Indonesia, introduction project CNG (compressed natural gas) on fleet cars starts April, 1987 in Jakarta city using natural gas from Cirebon gas pipe line.

ii) Ethanol is prospective as fuel because molasses from sugar plants and cassava from transmigrated areas will be produced in accordance with related Government policies. Fleet test of low blending gasoline has been done by BPPT.

iii) Methanol utilization has been studied in PERTAMINA and LEMIGAS for blending into gasoline with/without an additive.

(4) 4th mission

The 4th mission is the supervision team and supervised the construction work of coal gasification test facilities, which was completed by the end of January 1987.

(5) 5th mission

The 5th mission is the operation team and carried out mechanical test and process test operation of the coal gasification test facilities. Technology transfer has proceeded using operation manual and maintenance manual as well as process test operation.

(6) 6th mission

The 6th mission was organized by the study team A, B, C and D.

i) The draft Interim Report (FY1986) was discussed and agreed upon.

ii) The implementation plan of the study in FY 1987, including overall review and evaluation for the result of the coal gasification test stage, was discussed and confirmed mutually that both sides shall continue necessary preparation work for the study in FY 1987.

5. RESULTS OF THE ENGINEERING STUDY ON THE CONSTRUCTION WORK OF THE COAL GASIFICATION TEST FACILITIES

The engineering study on the construction work of the coal gasification test facilities that is constructed in PUSPIPTEK, SERPONG, The REPUBLIC of INDONESIA has successfully finished in FY 1986.

The following were mainly studied:

1) Project Specification
2) Requisition
3) Request for Quotation
4) Operation Procedure & Maintenance Manaul

5-1 PROJECT SPECIFICATION

The installation work of the coal gasification test facilities regarding the following items are specified.

1) Opening of the packed facilities which had been transported there
2) Arrangements
3) Supplementation of acceptance
4) Transportation in site
5) Temporary laying
6) Indoor foundation work
7) Painting (only touch up)
8) No-load test run
9) Attendance of individual load test
10) Attendance of synthetic load test run
11) Cleaning

and so forth.

The details are given in APPENDIX V and VI-1.

5-2 REQUISITION

This requisition regards the purchase conditions, the general conditions and the technical conditions.

The details are given in APPENDIX VI-2.

5-3 REQUEST FOR QUOTATION

Japan International Cooperation Agency INDONESIA Office requested the bidder to quote in accordance with the applicable documents for the construction of the coal gasification test facilities. It was understood that unless exceptions, deviations or alternatives were clearly defined and listed separately, the documents would be deemed to be accepted by the bidder.

The details are given in APPENDIX VI-3.

5-4 OPERATION PROCEDURE & MAINTENANCE MANUAL

The operation procedure shows separately the procedure of start, daily operation, stop and emergency stop of the coal gasification test facilities.

The maintenance manual shows the procedure of maintenance and trouble-shooting for the individual equipments of the coal gasification test facilities.

The details are given in APPENDIX VII.

6. RESULTS OF THE COAL SAMPLING WORK AND GEOLOGICAL SURVEY

6-1 COAL SAMPLING WORK IN NORTHWEST BANKO

6-1-1 Coal Sampling Plan

(1) Purpose of Sampling

The purpose of coal sampling in FY 1986 is to take following samples for the gasification tests to be carried out at Serpong.

i) 2 tons of bulk coal sample for mechanical and process test run of the gasification facilities prepared by JICA and installed in FY 1986.

ii) Total 2 tons of different coal samples from different area for regular coal gasification tests. Total number of samples amounts to ten as weight of one sample is required at least 200 kg.

(2) Sampling Sites

Sampling sites in this year were selected in the Northwest Banko area, because distribution of coal seams in the area has been investigated in detail and coal outcrops in the main part have been confirmed during geological survey in FY 1985. Coal samples for the regular tests were planned to be taken from A1 and A2 (Mangus) Seam, B1 and B2 (Suban) Seam and C (Petai) Seam in both northern and southern parts of the area.

(3) Sampling Method

Coal samples for the regular tests were planned to be taken by drilling machine using large diameter core barrel (core diameter: 101 mm) with metal bit, reamer and accessories prepared by JICA. In order to take typical, fresh and unweathered coal samples, weathered zone around 5 meters below the surface was planned to be excluded from object of sampling. Bulk coal sample for the test run was planned to be taken from pits dug near outcrop of coal seam, because allotted period for the sampling was not enough to take bulk coal sample by drilling.

6-1-2 Work Allotment

The following works related to the coal sampling were performed by the Indonesian counterparts (BPPT and PPTM).

(1) Drilling work to take coal samples from each coal seam for the regular tests.
(2) Pitting work to take bulk coal sample for the test run.
(3) Surveying to locate sites of drilled holes and pits dug.
(4) Proximate, ultimate and ash components analyses of the coal samples.

Twelve engineers and technicians of the Indonesian counterpart were engaged in the fieldwork. The Japan International Cooperation Agency dispached six engineers to cooperate with the Indonesian counterpart.

6-1-3 Progress of Work

(1) Coal Sampling

Coal sampling work was carried out in the Northwest Banko area based on the above-mentioned plan, however, actual sites for coal sampling have been selected at the site which is as close as possible to the existing road, taking the following circumstances and factors into consideration.

i) Budget prepared by BPPT
ii) Period allotted for the fieldwork
iii) Weather conditions
iv) Execution of effective and practical sampling work.

Coal samples of C (Petai) seam in the both northern and southern parts of the area have been taken by digging a couple of pits instead of drilling. Because it was very difficult to carry drilling machine into the planned site, as the seam occurs far away from the existing road. Samples of B2 (Suban) seam in the northern part were also taken from dug pits, as sampling by coring will result in delay of the work because of its thin layer confirmed by drilling.

Total 4,902.80 kg of coal samples were taken in this year, 2,235.80 kg of which is for regular gasification tests and 2,667.00 kg is for test run of the facilities. Outline of coal samples is summarized below.

i) Coal samples for regular gasification tests.

Area	Coal Seam	Weight of Sample (kg)	Sampling Method
Northern Part	A1	241.70	Coring
	A2	189.70	"
	B1	204.80	"
	B2	254.00	Pitting & Coring
	C	236.00	Pitting
	Total	1,126.20	
Southern Part	A1	207.60	Coring
	A2	206.50	"
	B1+B2	481.50	"
	C	214.00	Pitting
	Total	1,109.60	
Total		2,235.80	

ii) Coal samples for test run

Area	Coal Seam	Weight of Sample (kg)	Sampling Method
Northern Part	C	2,667.00	Pitting
Total		2,667.00	

Table 6-1-1 shows details of coal samples taken for gasification tests. Fig. 6-1-1 shows sampling sites for each coal seam and Fig. 6-1-2 outlines columnar section of boreholes taken coal samples.

Core recovery of coal in length showed fairly good as around 90% on an average in this year. The recovery occasionally decreased when coal seam was pulverized by fracture, joint and cleat.

Coal samples were kept in plastic tubes of about 110 mm diameter sealed with wax and sent to Serpong for the tests. Details of the samples are shown in Table 6-1-2.

(2) Coal Analysis

Coal samples for analysis were taken from each borehole and pit representing each coal seam prior to seal the samples in the plastic tube. The samples were divided into two parts for sending one part to the headquarters of PPTM in Bandung and the other to Serpong for cross-checking.

Main items of the assay were proximate, ultimate and ash components analysis and calorific value. Table 6-1-3 and 6-1-4 show analytical results of the coal samples assayed by PPTM.

Average quality on dry basis of the coal seams in the Northwest Banko area examined this year is quite similar to those obtained by Shell and analytical results tested in last year as follows;

Ash (%)	:	2.2 - 11.4
Volatile Matter (%)	:	41.7 - 45.5
Gross C.V. (Kcal/kg)	:	6,380 - 7,090
Total Sulfur (%)	:	0.20 - 0.84

Based on the classification of ASTM (American Society for Testing and Material), the Northwest Banko coal is classified into subbituminous B in rank.

Sodium dioxide content in ash shows generally low as varying from 0.01% to 0.97% except a part of A2 and B2 seams which contain around 3% Na_2O in ash.

Table 6-1-1 Coal Samples Taken for Gasification Tests

A. For Regular Test (1)

Area	Coal Seam	Hole Number	Total Length (m)	Length of OBS & Rocks (m)	Length of Coal (m)	Coal Recovered (m)	Core Recovery (%)	Weight of Coal Sample (Kg)	Sampling Method
Northern Part	A1	1	10.40	4.14	6.26	4.79	76.5	40.20	Coring
		2	10.35	4.35	6.00	6.00	100.0	47.20	"
		3	10.65	4.65	6.00	6.00	100.0	52.00	"
		4	10.70	4.60	6.10	6.10	100.0	54.00	"
		5	10.70	4.70	6.00	6.00	100.0	48.30	"
		Sub Total	52.80	22.44	30.36	28.89	95.2	241.70	
	A2	1	21.95	10.40	11.55	11.55	100.0	95.00	Coring
		2	21.35	9.75	11.60	9.90	85.3	94.70	"
		Sub Total	43.30	20.15	23.15	21.45	92.70	189.70	
	B1	1	10.30	5.50	4.80	4.80	100.0	25.00	Coring
		2	9.80	5.00	4.80	4.80	100.0	29.90	"
		3	9.70	4.70	5.00	5.00	100.0	27.00	"
		4	9.70	4.80	4.90	4.60	93.9	24.00	"
		5	9.85	4.77	5.08	4.60	90.6	27.00	"
		6	10.45	5.65	4.80	3.70	77.1	24.50	"
		7	10.20	5.40	4.80	3.70	77.1	24.90	"
		8	10.00	5.20	4.80	3.60	75.0	22.50	"
		Sub Total	80.00	41.02	38.98	34.80	89.3	204.80	
	B2	1	6.00	6.00	-	-	-	-	-
		2	6.20	2.85	3.35	1.80	53.7	14.00	Coring
		1	2.00	-	2.00	2.00	-	120.00	Pitting
		2	2.00	-	2.00	2.00	-	120.00	"
		Sub Total	16.20	8.85	7.35	5.80	-	254.00	
	C	1	2.00	-	2.00	2.00	-	130.00	Pitting
		2	2.00	-	2.00	2.00	-	106.00	"
		Sub Total	4.00	-	4.00	4.00	-	236.00	
	Total		196.30	92.46	103.84	94.94	90.7	1,126.20	

Remarks : 1. OBS = Overburden soil.
2. Samples of A2 seam were taken to deepen No.1 and No.2 holes for A1 seam.

Area	Coal Seam	Hole Number	Total Length (m)	Length of OBS & Rocks (m)	Length of Coal (m)	Coal Recovered (m)	Core Recovery (%)	Weight of Coal Sample (Kg)	Sampling Method
Southern Part	A1	1	16.70	4.26	12.44	12.44	100.0	104.45	Coring
		2	16.78	4.56	12.22	12.22	100.0	103.15	"
		Sub Total	33.48	8.82	24.66	24.66	100.0	207.60	
	A2	1	14.66	4.79	9.87	7.70	78.0	52.30	Coring
		2	15.05	4.45	10.60	8.25	77.8	53.30	"
		3	14.40	3.99	10.41	8.80	84.5	51.50	"
		4	15.55	5.05	10.50	8.70	82.9	49.40	"
		1'	14.00	14.00	-	-	-	-	-
		2'	13.00	13.00	-	-	-	-	-
		Sub Total	86.66	45.28	41.38	33.45	80.8	206.50	
	B1+B2	1	19.50	6.15	13.35	11.88	89.0	113.00	Coring
		2	17.50	4.15	13.35	13.35	100.0	127.00	"
		3	17.30	3.95	13.35	12.75	95.5	123.00	"
		4	16.75	3.80	12.95	12.95	100.0	118.50	"
		Sub Total	71.05	18.05	53.00	50.93	96.1	481.50	
	C	1	2.00	-	2.00	2.00	-	79.00	Pitting
		2	2.00	-	2.00	2.00	-	78.00	"
		3	2.00	-	2.00	2.00	-	57.00	"
		Sub Total	6.00	-	6.00	6.00	-	214.00	
	Total		197.19	72.15	125.04	115.04	91.6	1,109.60	
Grand Total			393.49	164.61	228.88	209.98	91.2	2,235.80	

Remarks : 1. OBS = Overburden soil.

B. For Test Run

(3)

Area	Coal Seam	Hole Number	Total Length (m)	Length of OBS & Rocks (m)	Length of Coal (m)	Coal Recovered (m)	Core Recovery (%)	Weight of Coal Sample (Kg)	Sampling Method
Northern Part	C	1,2	4.00	-	4.00	4.00	-	2,667.00	Pitting
	Total		4.00	-	4.00	4.00	-	2,667.00	"

Fig. 6 – 1 – 1 Location of Coal Sampling for Gasification Tests, Northwest Banko Area

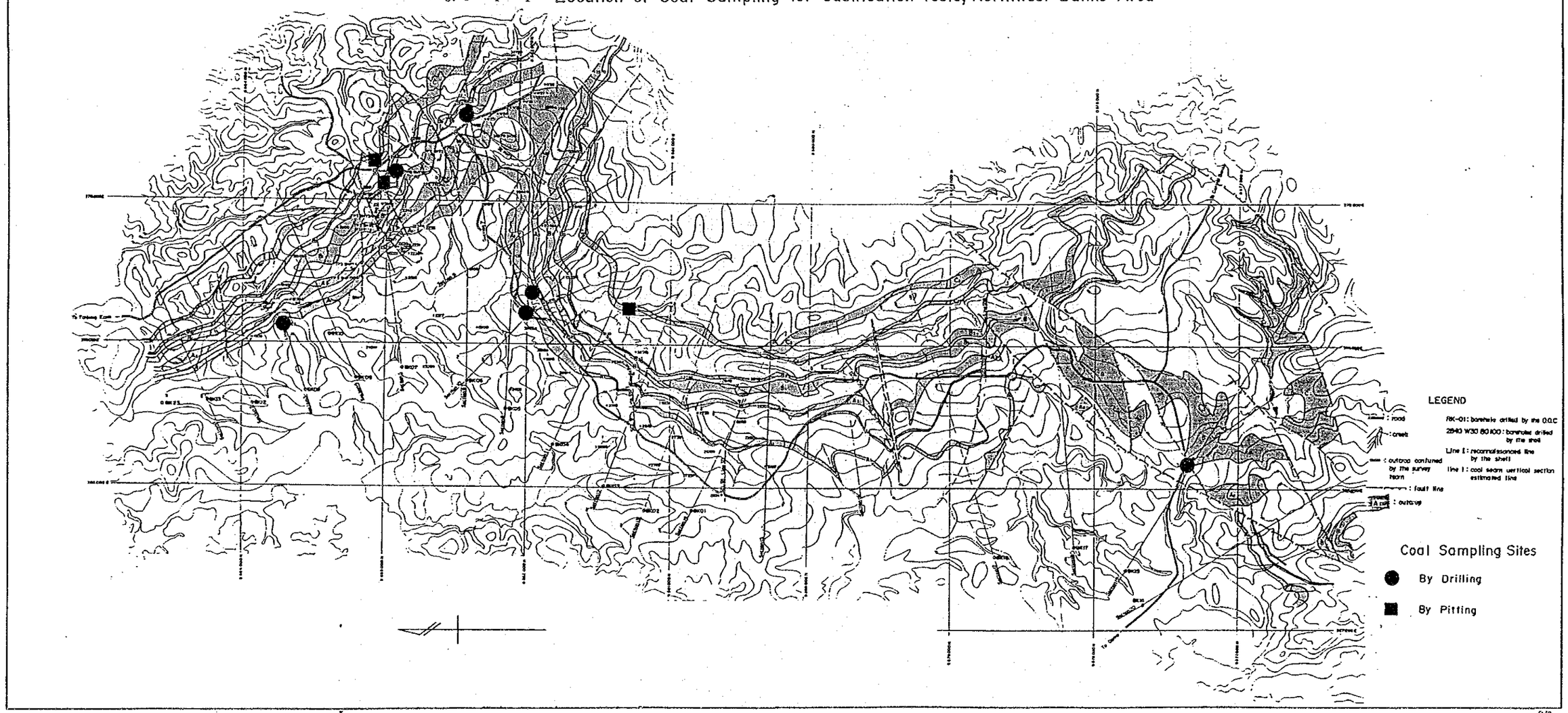
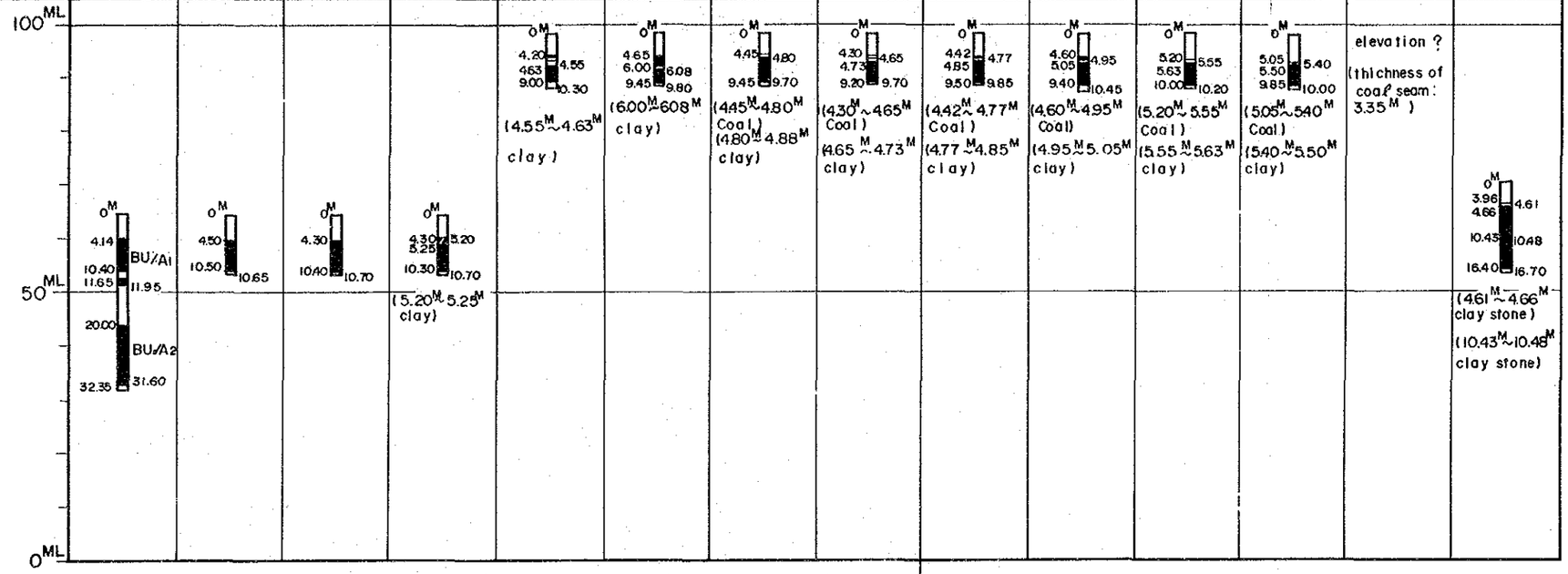


Fig.6-1-2 Colamner Section of Boreholes Taken Coal Samples

孔番号	BU I A1/A2	BU II A1	BU IV A1	BU V A1	BU I B1	BU II B1	BU III B1	BU IV B1	BU V B1	BU VI B1	BU VII B1	BU VIII B1	BU II B2	Bs.I A1
X	369149.9	369150.9	369151.4	369151.4	370642.2	370640.7	370641.3	370641.7	370640.9	370640.6	370640.3	370639.9	?	369253.2
Y	95837384	95837374	95837374	9583736.9	9582466.0	9582464.7	9582465.2	9582465.6	9582466.2	9582465.9	9582465.5	9582465.1	?	9582020.5



BS II A1	BS I A2	BS II A2	BS III A2	BS IV A2	BS I B1/B2	BS II B1/B2	BS III B1/B2	BS IV B1/B2	SD I E	SD II E	SD III E	SD I I
369253.2	3693804	369381.2	369381.7	369382.6	368098.0	368097.0	368096.8	368098.0	373506.5	373570.0	373602.4	372246.8
95820195	9582010.9	95820114	9582010.5	9582011.0	9577373.4	9577373.2	9577374.2	9577374.3	95861784	9586160.5	95861054	9586395.2

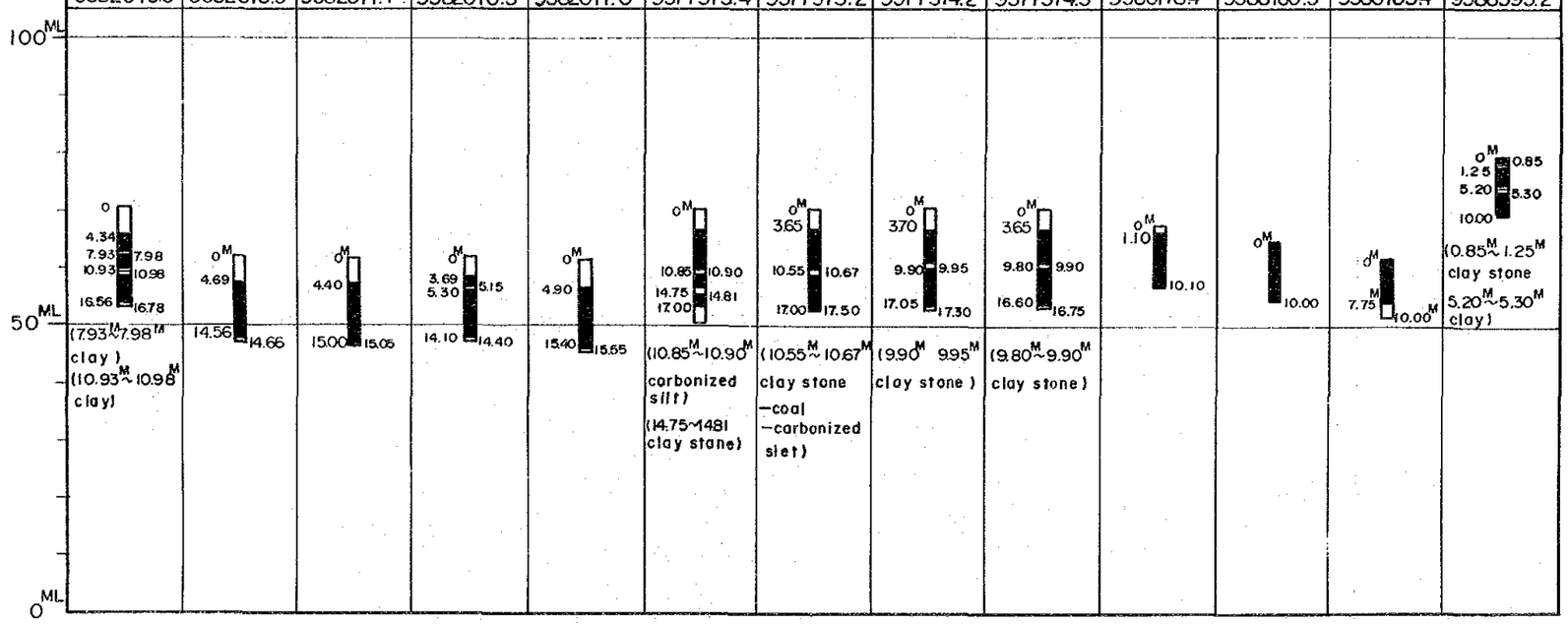


Table 6-1-2 Coal Samples Sent to Serpong for Regular Gasification Tests

Sample No.			Number of Tube	Area	Coal Seam
BU I	A1	1-11	11	Northern Part	A1 seam
Bu II	A1	1-10	10	"	"
BU III	A1	1-13	13	"	"
BU IV	A1	1-11	11	"	"
BU V	A1	1-10	10	"	"
BU I	A2	1-19	19	"	A2 seam
BU II	A2	1-24	24	"	"
BU I	B1	1- 4	4	"	B1 seam
BU II	B1	1- 6	6	"	"
BU III	B1	1- 3	3	"	"
BU IV	B1	1- 4	4	"	"
BU V	B1	1- 6	6	"	"
BU VI	B1	1- 4	4	"	"
BU VII	B1	1- 5	5	"	"
BU VIII	B1	1- 4	4	"	"
BU II	B2	1- 3	3	"	B2 seam
BU III	B2	1-53	53	"	"
BU I	C1	1-33	33	"	C seam
BU II	C1	1-27	27	"	"
BS I	A1	1-18	18	Southern Part	A1 seam
BS II	A1	1-18	18	"	"
BS I	A2	1-11	11	"	A2 seam
BS II	A2	1-12	12	"	"
BS III	A2	1-11	11	"	"
BS IV	A2	1-10	10	"	"
BS I	B	1-16	16	"	B1+B2 seam
BS II	B	1-20	20	"	"
BS III	B	1-21	21	"	"
BS IV	B	1-22	22	"	"
BS I	C1	1-19	19	"	C seam
BS II	C1	1-19	19	"	"
BS III	C1	1-12	12	"	"

Table 6-1-3 Analytical Results of Coal Samples for Gasification Tests (1)

Sample Number	Coal Seam	Proximate Analysis				Calorific Value	Total S	Ultimate Analysis			
		Moisture (%)	Ash (%)	V.M. (%)	F.C. (%)	(cal/g)	(%)	C (%)	H (%)	N (%)	O (%)
BU I A1	A1	22.40	7.49	33.94	36.17	4,998	0.31	51.49	6.38	0.80	33.53
BU II A1	"	22.02	2.92	36.11	38.95	5,419	0.38	57.54	6.70	0.81	31.65
BU III A1	"	23.71	1.38	34.73	40.18	5,413	0.51	55.63	6.68	0.86	34.94
BU IV A1	"	23.06	13.84	27.86	35.24	4,489	0.62	46.02	5.82	0.87	32.83
BU V A1	"	22.81	1.66	35.48	40.05	5,473	0.36	55.63	6.98	0.77	34.60
BS I A1	"	23.22	4.19	35.81	36.78	5,215	0.51	54.16	6.57	0.82	33.75
BS II A1	"	23.71	4.41	34.38	37.50	5,230	0.41	53.40	6.52	0.82	34.44
BU I A2	A2	22.94	0.36	36.66	40.04	5,547	0.21	58.20	6.69	0.78	33.76
BU II A2	"	21.17	5.61	34.76	38.46	5,230	0.21	55.46	6.28	0.77	31.67
BS I A2	"	18.96	7.29	34.91	38.84	5,385	0.19	55.29	6.02	0.79	30.42
BS II A2	"	23.26	3.37	34.09	39.28	5,214	0.25	54.32	6.45	0.79	34.82
BS III A2	"	20.73	1.69	36.13	41.45	5,554	0.15	58.17	6.45	0.83	32.71
BS IV A2	"	25.22	1.23	35.82	37.73	5,405	0.17	54.94	6.91	0.80	35.95
BU I B1	B1	23.82	8.07	29.95	38.16	4,878	1.19	49.71	6.26	0.87	33.90
BU II B1	"	26.98	0.87	32.31	39.84	5,225	0.64	53.43	6.77	0.96	37.33
BU III B1	"	19.52	23.24	26.31	30.93	4,120	0.71	41.38	5.15	0.75	28.77
BU IV B1	"	27.11	0.66	32.17	40.06	5,136	0.78	53.67	6.74	0.94	37.21
BU V B1	"	27.49	2.16	33.17	37.18	5,119	0.70	52.63	6.77	0.84	36.90
BU VI B1	"	26.79	1.03	32.74	39.44	5,196	0.85	53.46	6.90	0.94	36.82
BU VII B1	"	26.45	8.95	29.02	35.58	4,635	0.95	47.48	6.41	0.81	35.40
BU VIII B1	"	26.43	0.97	34.09	38.51	5,281	0.89	53.99	6.84	0.88	36.43
BS I B	B1+B2	25.40	2.38	34.75	37.47	5,158	0.19	53.17	6.77	0.78	36.71
BS II B	"	26.61	5.30	31.21	36.88	4,850	0.17	50.02	6.68	0.82	37.01
BS III B	"	23.87	4.70	36.85	34.58	5,187	0.18	52.64	6.83	0.81	34.84
BS IV B	"	15.43	37.89	23.03	23.65	3,353	0.32	33.60	4.32	0.63	23.24
BU II B2	B2	24.39	7.66	32.16	35.79	4,906	0.48	50.06	6.53	0.93	34.34
BU I C	C	22.11	2.22	35.34	40.33	5,468	0.47	57.65	6.68	1.03	31.95
BU II C	"	21.34	1.61	35.88	41.17	5,543	0.37	58.37	6.54	1.01	32.70
BS I C	"	20.38	0.84	36.29	42.49	5,684	0.42	59.81	6.50	1.08	31.35
BS II C	"	25.07	1.02	33.29	40.62	5,416	0.29	55.56	6.74	1.06	35.33
BS III C	"	20.87	2.40	36.11	40.62	5,611	0.39	58.23	6.54	1.12	31.32

Remarks: 1. Sample numbers are the same as those in Table 6-1-2
2. Analyzed at the coal laboratory, PPTM, Bandung

Table 6-1-4 Analytical Results of Coal Samples for Gasification Tests (2)

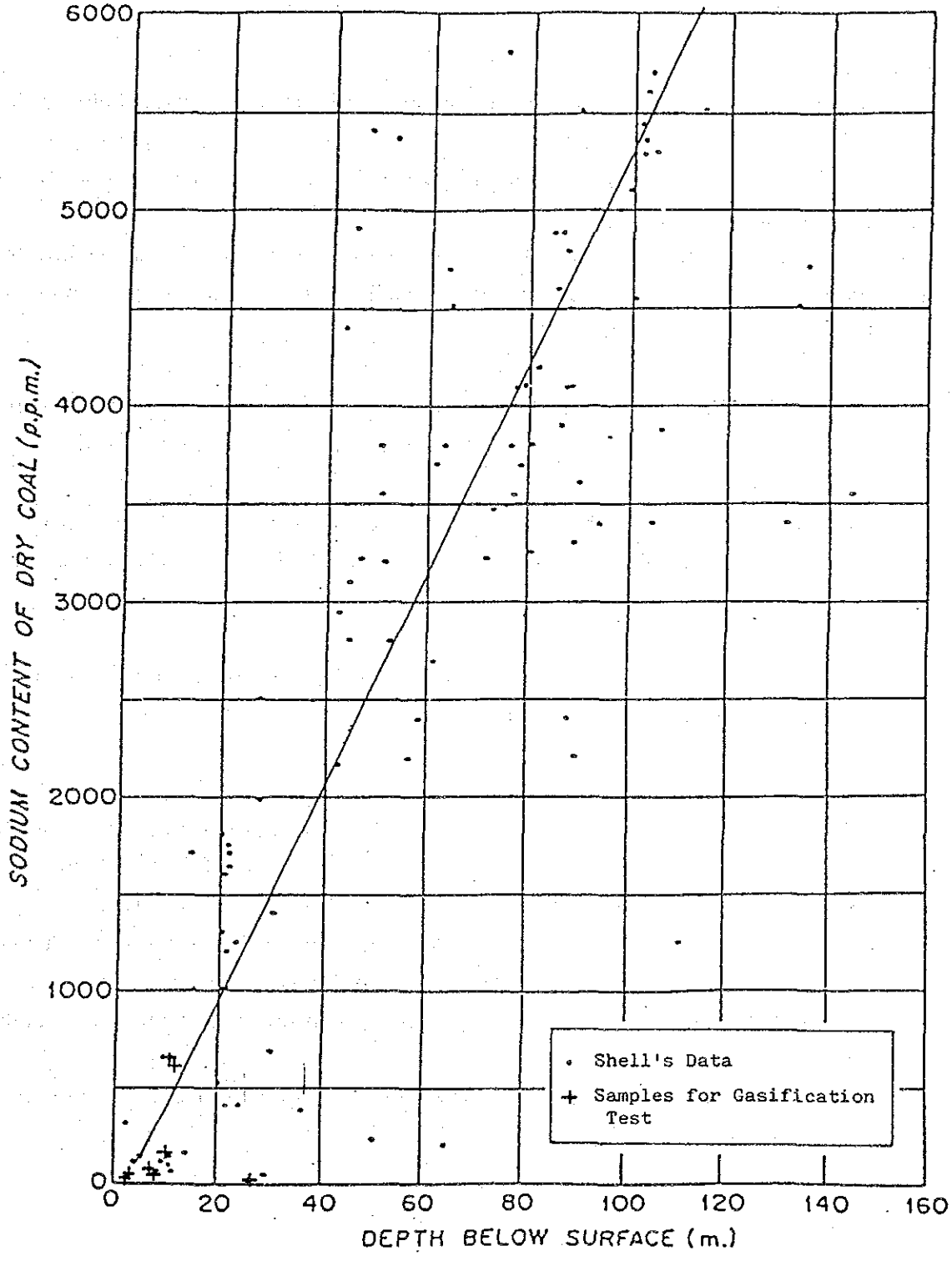
Sample Number	Coal Seam	Analysis of Ash Components									
		SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	K_2O (%)	Na_2O (%)	SO_3 (%)	P (%)
BU I A1	A1							0.35	0.19		
BU II A1	"							0.26	0.03		
BU III A1	"							0.22	0.09		
BU IV A1	"							0.04	0.03		
BU V A1	"							0.17	0.35		
BS I A1	"							0.62	0.60		
BS II A1	"							0.30	0.13		
BU I A2	A2							0.32	0.38		
BU II A2	"							0.04	0.03		
BS I A2	"							0.44	1.30		
BS II A2	"							0.30	1.68		
BS III A2	"							0.34	3.88		
BS IV A2	"							0.87	4.65		
BU I B1	B1							0.19	0.04		
BU II B1	"							0.43	0.29		
BU III B1	"							0.02	0.01		
BU IV B1	"							0.30	0.19		
BU V B1	"							0.23	0.09		
BU VI B1	"							0.53	0.21		
BU VII B1	"							0.17	0.07		
BU VIII B1	"							0.28	0.17		
BS I B	B1+B2							0.18	0.33		
BS II B	"							0.56	0.67		
BS III B	"							0.51	0.97		
BS IV B	"							0.44	0.48		
BU II B2	B2							0.92	3.20		
BU I C	C							0.21	0.08		
BU II C	"							0.58	0.23		
BS I C	"							0.45	0.23		
BS II C	"							1.05	0.05		
BS III C	"							0.27	0.20		

Remarks: 1. Sample numbers are the same as those in Table 6-1-2
2. Analyzed at the coal laboratory, PPTM, Bandung

Average sodium content of dry coal in the major seams sampled in this year for the gasification test are shown in Fig. 6-1-3 in relation with depth below the surface. Sodium content of dry coal in the Northwest Banko area tends to increase in proportion to vertical depth below the surface as mentioned in the previous report.

The results indicate that sodium contents of the samples are generally low, less than 1,000 ppm as they occur in shallow. However, behavior of sodium in deep part has to be noted because of the above-mentioned tendency.

Fig. 6-1-3 Relationship Between Sodium Content and Coal Seam Depth Below The Surface



6-2 GEOLOGICAL SURVEY IN CENTRAL BANKO

6-2-1 Purpose of the Survey

(1) Purpose

Geological survey in the Central Banko area in FY1986 was carried out by the joint team composed of JICA, BPPT and PPTM as same as the preeceding year. The purpose of the survey was to select appropriate sites for coal sampling to be executed in the area in FY 1987.

In order to perform the sampling work effectively, practically and smoothly, the geological survey has been executed based on the following principles in relation to the sampling works in this year;

i) Drilling sites for the sampling shall be as close as possible to the existing access road so that drilling machine can be brought in the site easily.

ii) The drilling sites shall be within a distance from a water reservoir covered by supply capacity of water pump which will be prepared by the Indonesian counterpart.

iii) The drilling sites shall be in gently sloped places so as to bring drilling machine into the proposed site easily.

(2) Maps Provided by Indonesian Counterpart

Compiled map of the area on a scale of 1: 5,000 was prepared on the basis of topographic map and outcrop/suboutcrop map on a scale of 1 : 10,000 made by Shell Mijnbouw N.V. and provided by BPPT prior to start of the geological survey.

The Directorate of Coal (DOC) provided columnar sections of borehole drilled by them in the area. DOC, BPPT, PPTM and PTBA (PT. Tambang Batubara Bukit Asam) provided geological information and data which are beneficial and valuable for geological survey in the area.

Sincere thanks are extended to those authorities concerned with their kind assistance and cooperation.

6-2-2 Progress of Work

(1) Coal Seam

Main coal seams to be investgated in the Central Banko area are A1 and A2 (Mangus) seams, B1 and B2 (Suban) seams, and C (Petai) seam of the Muara Enim Coal Formation. The Merapi and Kladi seams below the Petai seam are partially distributed in the area, however, those coal seams are excluded from the target of coal sampling as the seams are found very far from the existing access road.

Stratigraphy of the main coal seam in this area is shown in Table 6-2-1 compared with that in the Northwest Banko and North Suban Jeriji areas.

Table 6-2-1 Stratigraphy of Main Coal Seams in Muara Enim Coal Formation

Division	Central Banko Area	Northwest Banko Area	North Suban Jeriji Area
Upper Coal	-	-	Jelawatan Seam
	-	-	Enim I Seam
	-	-	Enim II Seam
Middle Coal	Mangus 1 Seam (A1)	Mangus 1 Seam (A1)	-
	Mangus 2 Seam (A2)	Mangus 2 Seam (A2)	-
	Suban 1 Seam (B1)	Suban 1 Seam (B1)	-
	Suban 2 Seam (B2)	Suban 2 Seam (B2)	-
	Petai Seam (C)	Petai Seam (C)	-
Lower Coal	(Merapi Seam)	-	-
	(Kladi Seam)	-	-

Remarks: Coal seam in brackets is excluded from object of sampling.

(2) Geological Survey

Geological survey for selecting coal sampling sites in the area was carried out on the basis of the following steps in order to perform the work effectively.

i) To select several places for each coal seam which are considered to be appropriate for the sampling based on available geological information.

ii) To carry out geological survey in the places selected. The survey is made by using Brunton compass and measuring tape. Geological survey is carried out at a scale of 1 : 500 or 1 : 1,000 and the results are presented in basic map at a scale of 1 : 1,000. Main routes are surveyed using theodolite in order to obtain more accurate data.

iii) To select the optimum spot for each coal seam after studying results of the geological survey.

iv) To carry out shallow hole drilling for confirming thickness of overburden at the selected spot where core drilling to obtain coal sample for gasification tests will be done in FY 1987.

The places investigated were those in the western, northern and eastern parts of the area. Test pit opened by Shell Mijnbouw in the central part was also investigated.

(3) Results of the Survey

The Central Banko area is situated about 6 kilometers to the southeast of the Northwest Banko area where coal samples were taken in this year. This area is bordered on the north to east by the southwest flank of the Talang Babat Anticline and on the north to west by the east flanks of the Kiahan and Banko Anticlines. (See Fig. 6-2-1)

Distribution of coal seams in the area is very complicated as compared with that in the Northwest Banko area where coal seams occur in homocline gently folded structure. Many sets of fault are found in the area which cut coal seams and resulted in complexity of the distribution of coal seam.

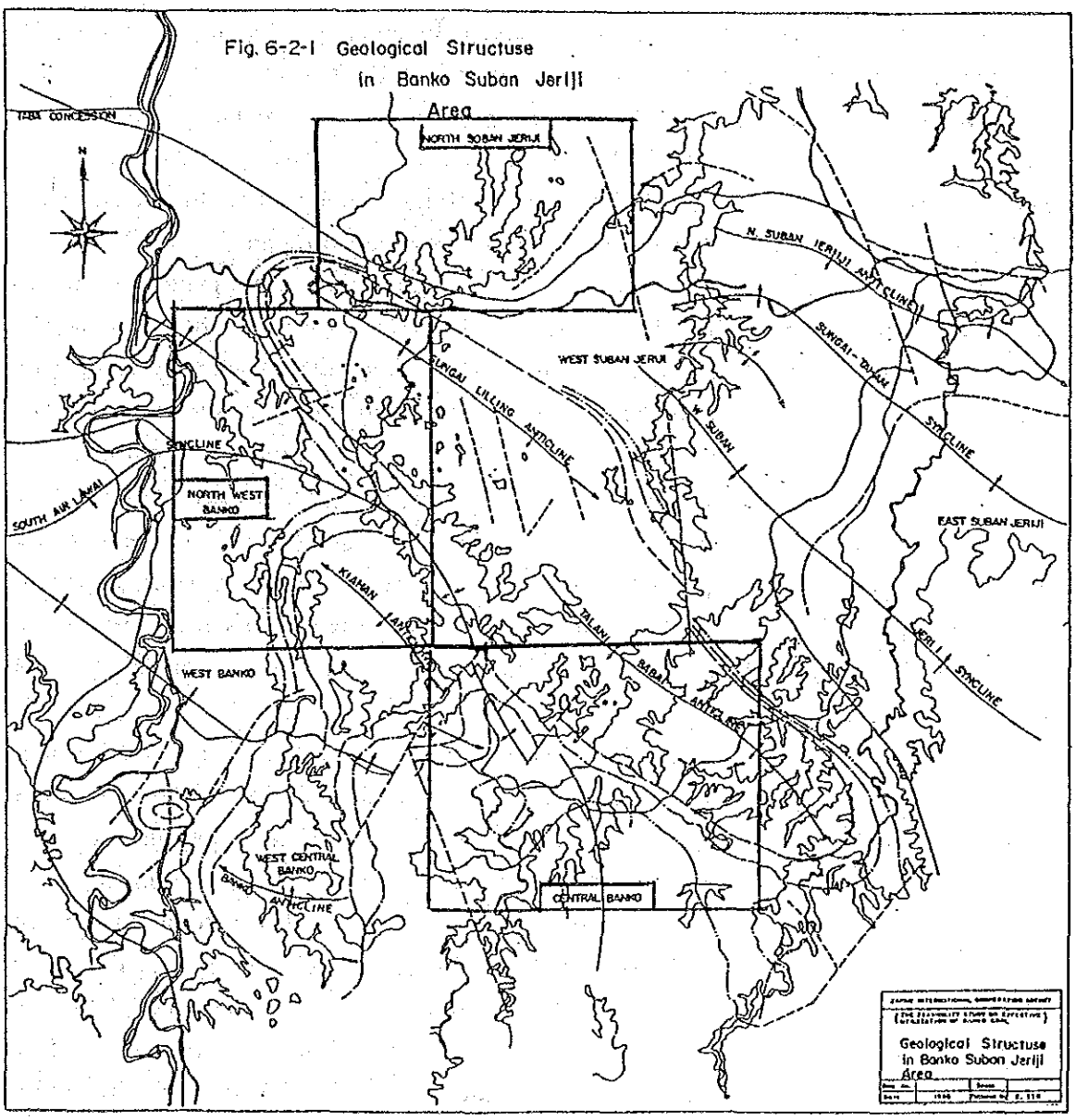


Fig. 6-2-1 Geological Structuse
in Banko Suban Jerlji
Area
TABA CONCESSION
NORTH SUBAN JERIJI
N. SUBAN JERIJI ANTICLINE
SUNGAI - TALANI
SYNCLINE
WEST SUBAN JERIJI
SUNGAI LILING ANTICLINE
N. SUBAN
SYNCLINE
NORTH WEST BANKO
SOUTH AIR LAHAI
EAST SUBAN JERIJI
KIAMAN ANTICLINE
TALANI
BABAT ANTICLINE
JERIJI SYNCLINE
WEST BANKO
WEST CENTRAL BANKO
BANKO ANTICLINE
CENTRAL BANKO
Geological Structuse
in Banko Suban Jerlji
Area

NNE-trending and NE-trending faults are predominant in the area, and NNW-trending and ENE-trending faults are also found partially. Fig. 6-2-2 shows distribution of coal seam in the area.

Dips of coal seams in the area are generally very gentle, nearly flat to 22 degrees in maximum. Most of them are between 5 to 10 degrees.

Dip of the strata reflects on landform of the area. Slope of the land is mostly gentle and rivers running through the area are always marked with their thick muddy beds which cover exposures of coal and other rocks. In this respect, outcrops of coal are generally rare or absent in the area surveyed.

In the western part of the area surveyed, coal seams trend generally north-south with partial variation. The seams dip gently eastward varying from nearly flat to a maximum of 22 degrees. From west to east, distribution of main coal seams in ascending order (C1 to A1) has been confirmed during this survey. A part of the coal seams occurs repeatedly because of several faults exist in the area.

Fig. 6-2-3, 6-2-4 and 6-2-5 show results of the geological survey in this part.

In the central and northern parts of the area surveyed, coal seams trend generally north-south with partial variation. The seams dip gently west or nearly flat in general. Exposures of B1 seam were only confirmed in this area. Fig. 6-2-6 and 6-2-7 show results of the geological survey in the central and northern parts respectively.

In the eastern part of the area surveyed, coal seams are distributed forming very gentle anticline plunged to southeast. Exposures of A1 and A2 seams were confirmed during the geological survey. Outcrops of B1, B2 and C seams have not been found in the area because creeks and rivers are covered with thick muddy bed.

In order to confirm suboutcrop of C seam, several shallow hole drillings were tried in the eastern side of this part based on the geological map on a scale of 1 : 25,000 prepared by Shell Mijnbouw. The suboutcrop was not penetrated by the borehole. Consequently, the drilling will be continued in the next year after obtaining outcrop/suboutcrop map on a scale of 1 : 10,000 prepared by Shell. Because, it is only this area that C seam is distributed near the existing road. Fig. 6-2-8 and 6-2-9 show results of the geological survey in the area.

Thickness of the main coal seams expected at the selected sites will be as; A1 seam: Approx. 15 meters, A2 seam: Approx. 5 meters, B1 seam: Approx. 15 meters, B2 seam: Approx. 5 meters, and C seam: Approx. 15 meters.

Fig. 6 - 2 - 2

Coal Seam Distribution Map.
Central Banko Area

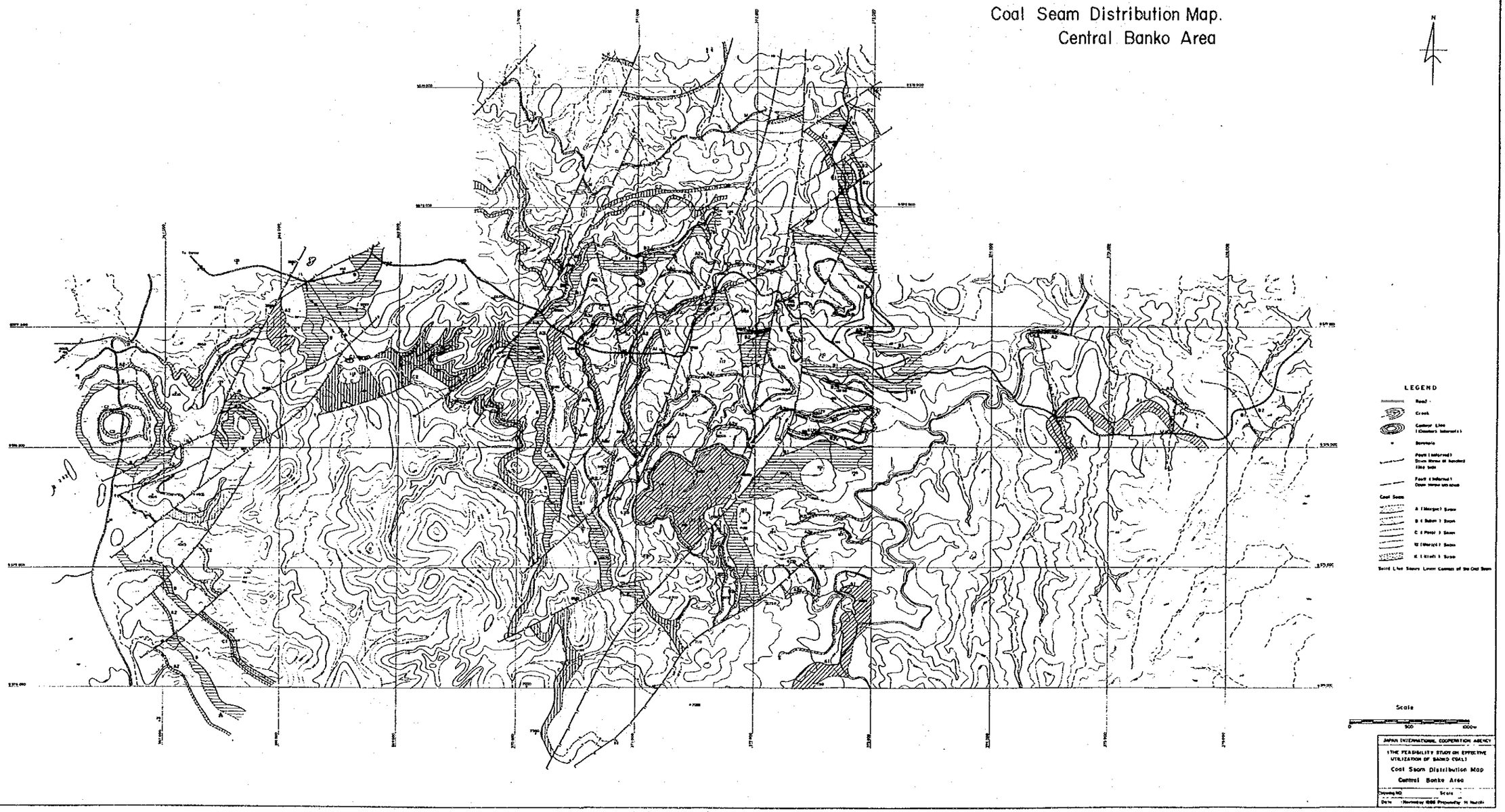


Fig. 6-2-3

Geological Survey Map.

Western Part of Central Banko Area (1)

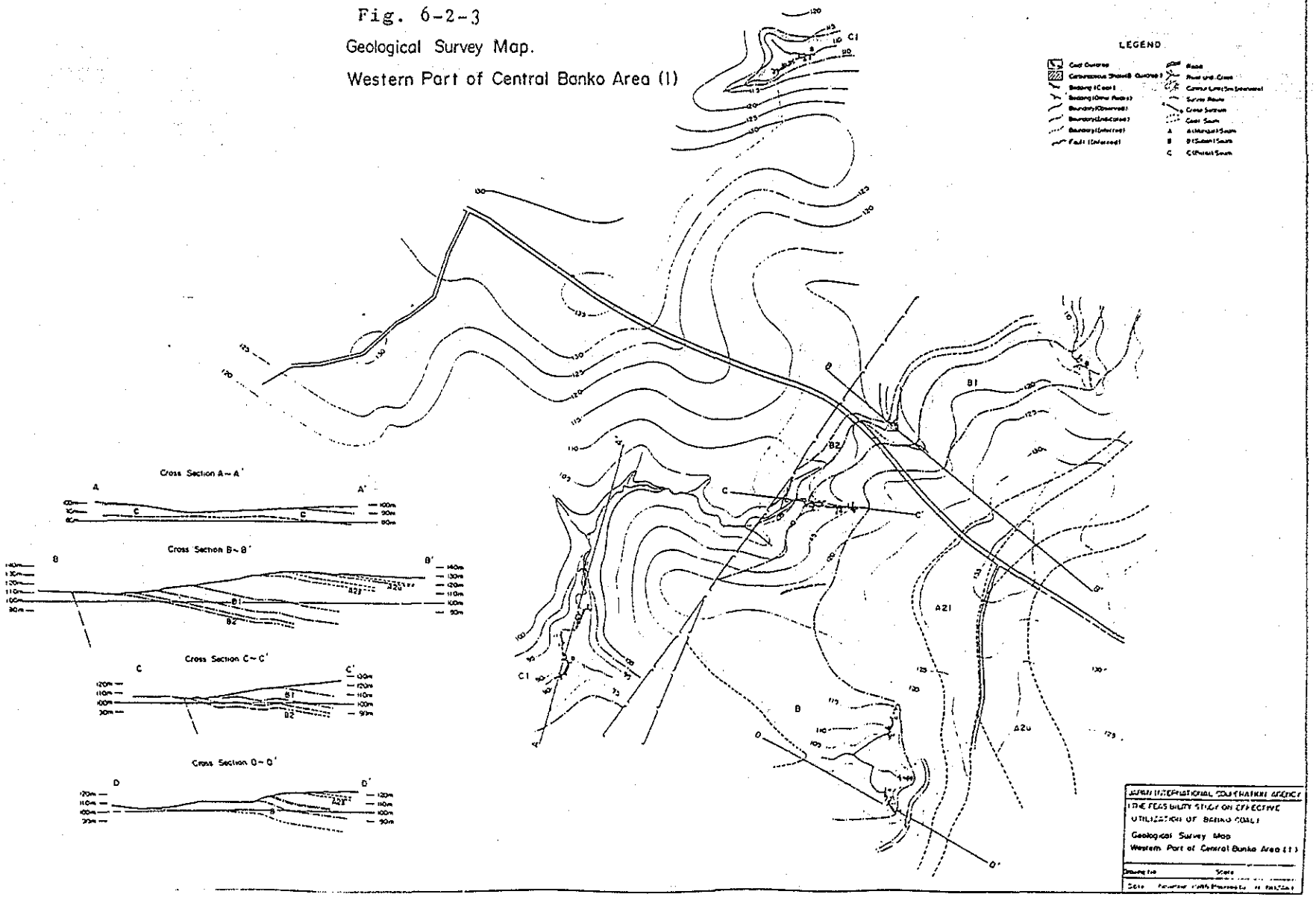


Fig. 6-2-4

Geological Survey Map.

Western Part of Central Banko Area (2)

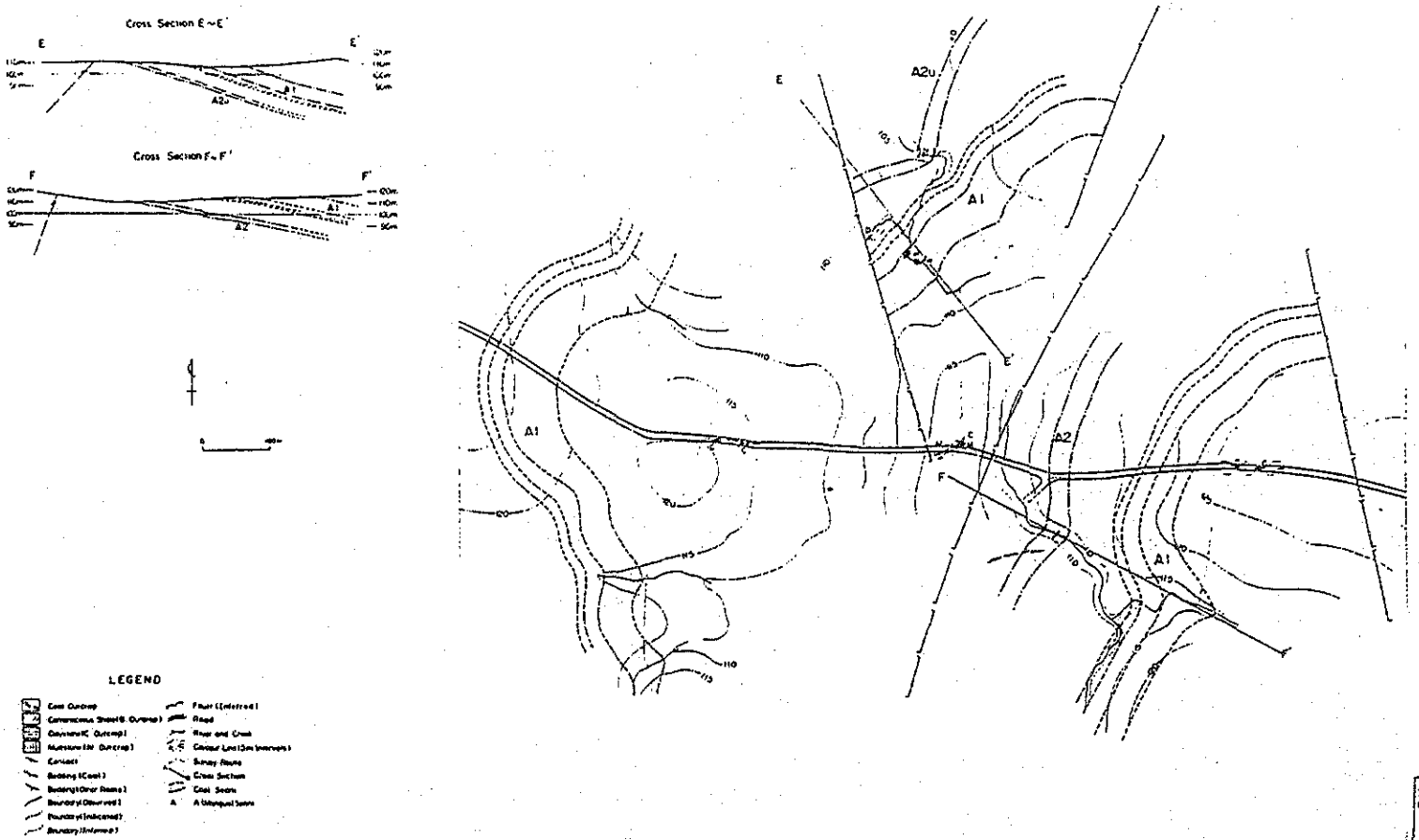


Fig. 6-2-5

Geological Survey Map.

Western Part of Central Banko Area (3)

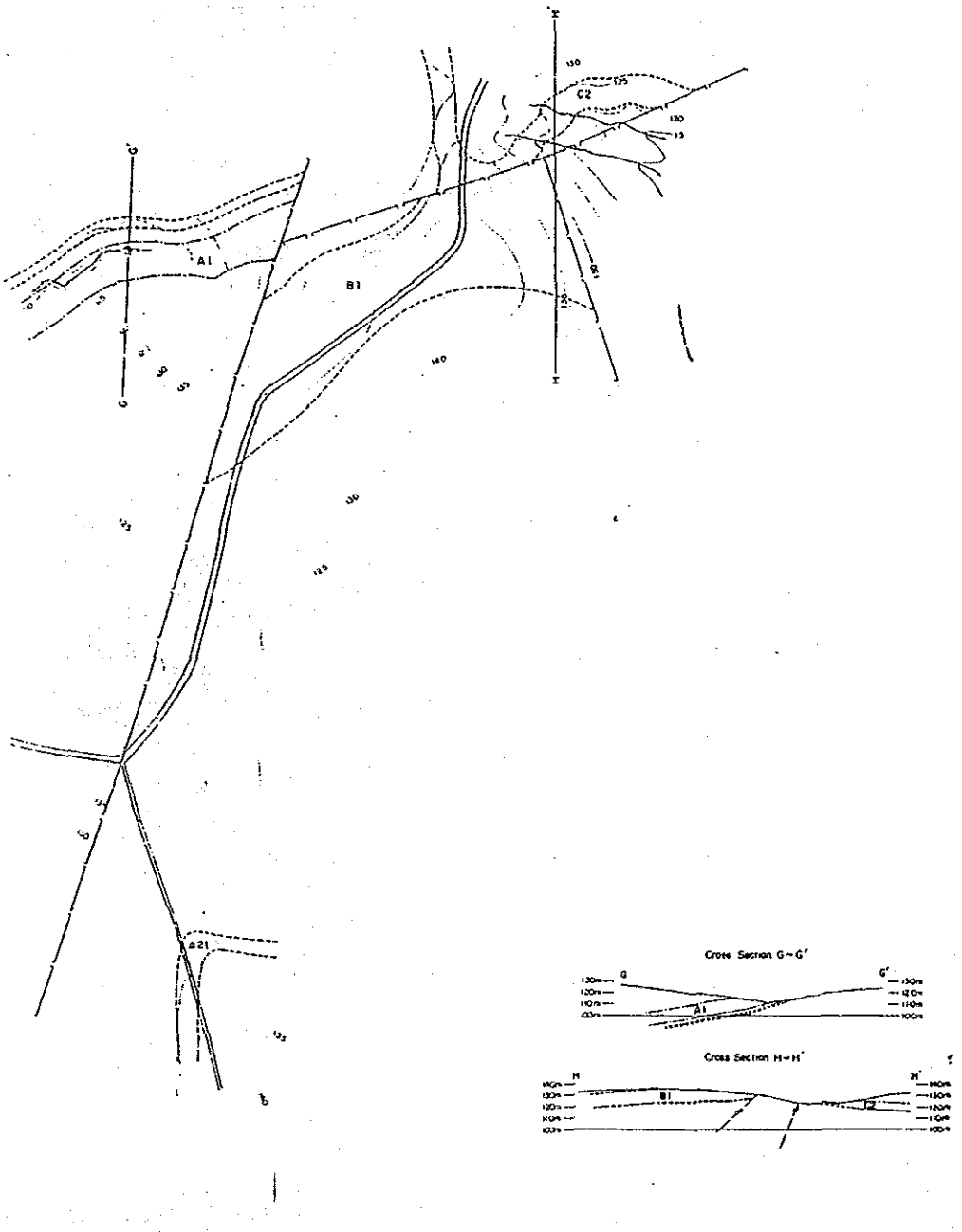
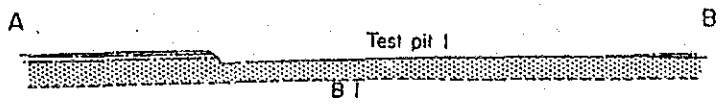


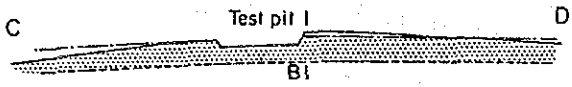
Fig. 6-2-6

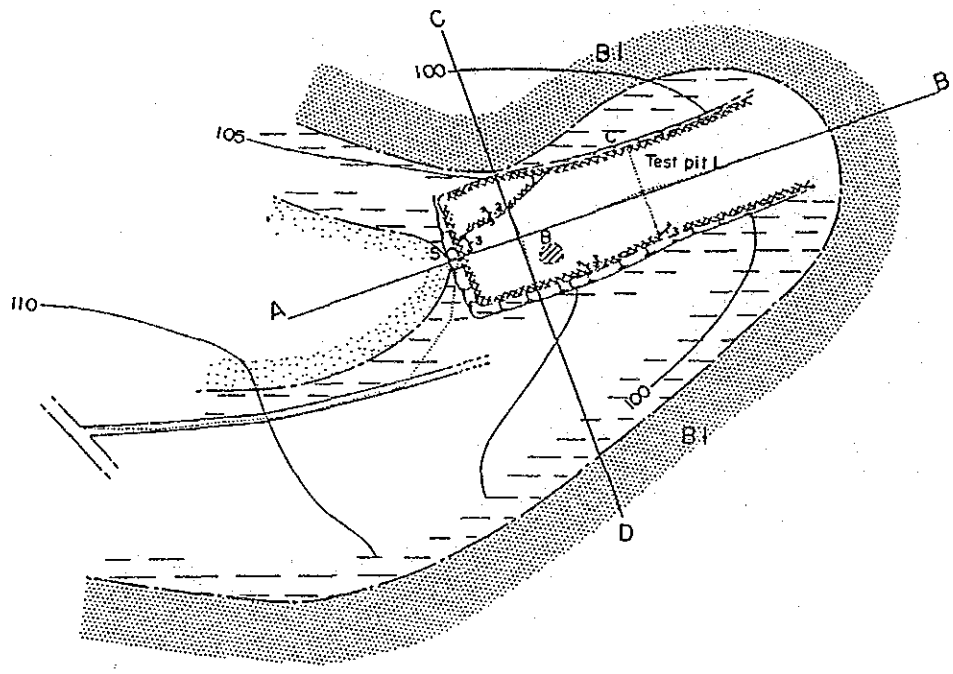
Geological Survey Map
Central Part of Central Banko Area

Cross Section A~B



Cross Section C~D





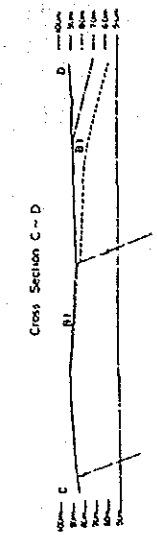
LEGEND

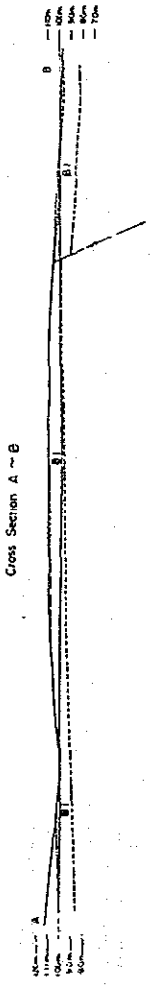
- Coal in Test Pit
- Carbonaceous Shale(B:Outcrop.)
- Claystone(C:Outcrop)
- Sandstone(S:Outcrop)
- Bedding (Coal)
- Bedding (Other Rocks)
- Boundary (Indicated)
- Boundary (Inferred)
- Road
- Contour Line(5m Intervals)
- Survey Route
- Cross Section
- Coal Seam
- B (Suban) Seam

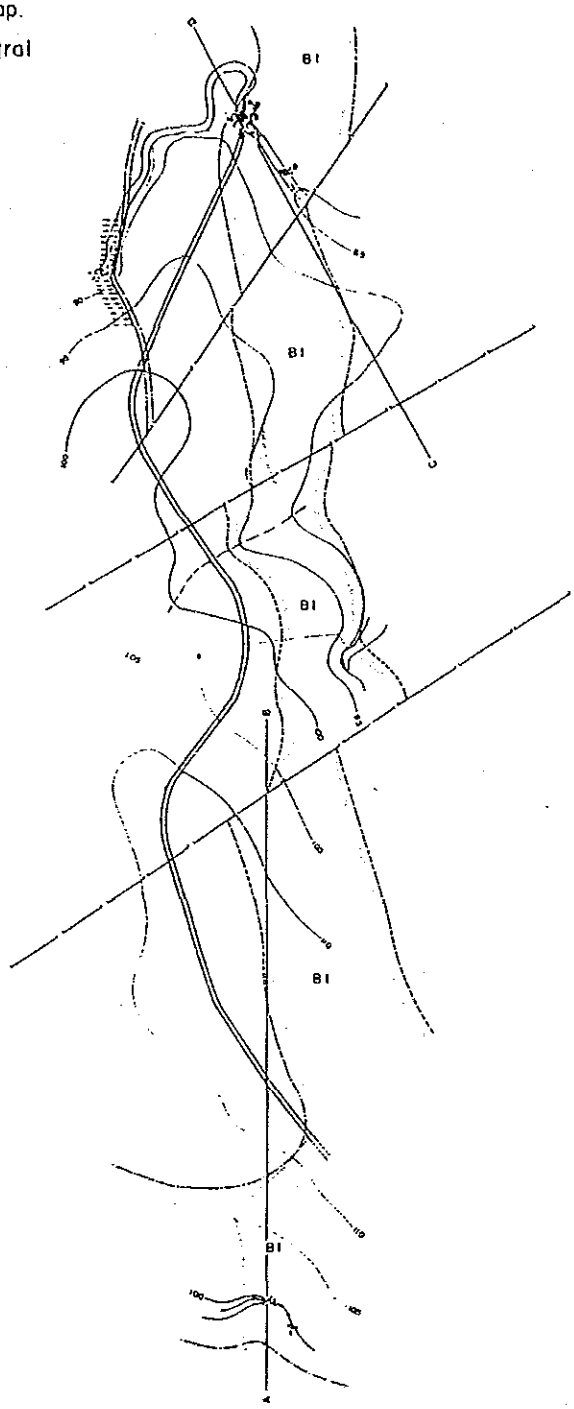
JAPAN INTERNATIONAL COOPERATION AGENCY			
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL) Geological Survey Map Central Part of Central Banko Area			
Drawing No.		Scale	
Date	November, 1986	Prepared by	H. NOZAKI

Fig. 6-2-7

Geological Survey Map.
Northern Part of Central
Banko Area







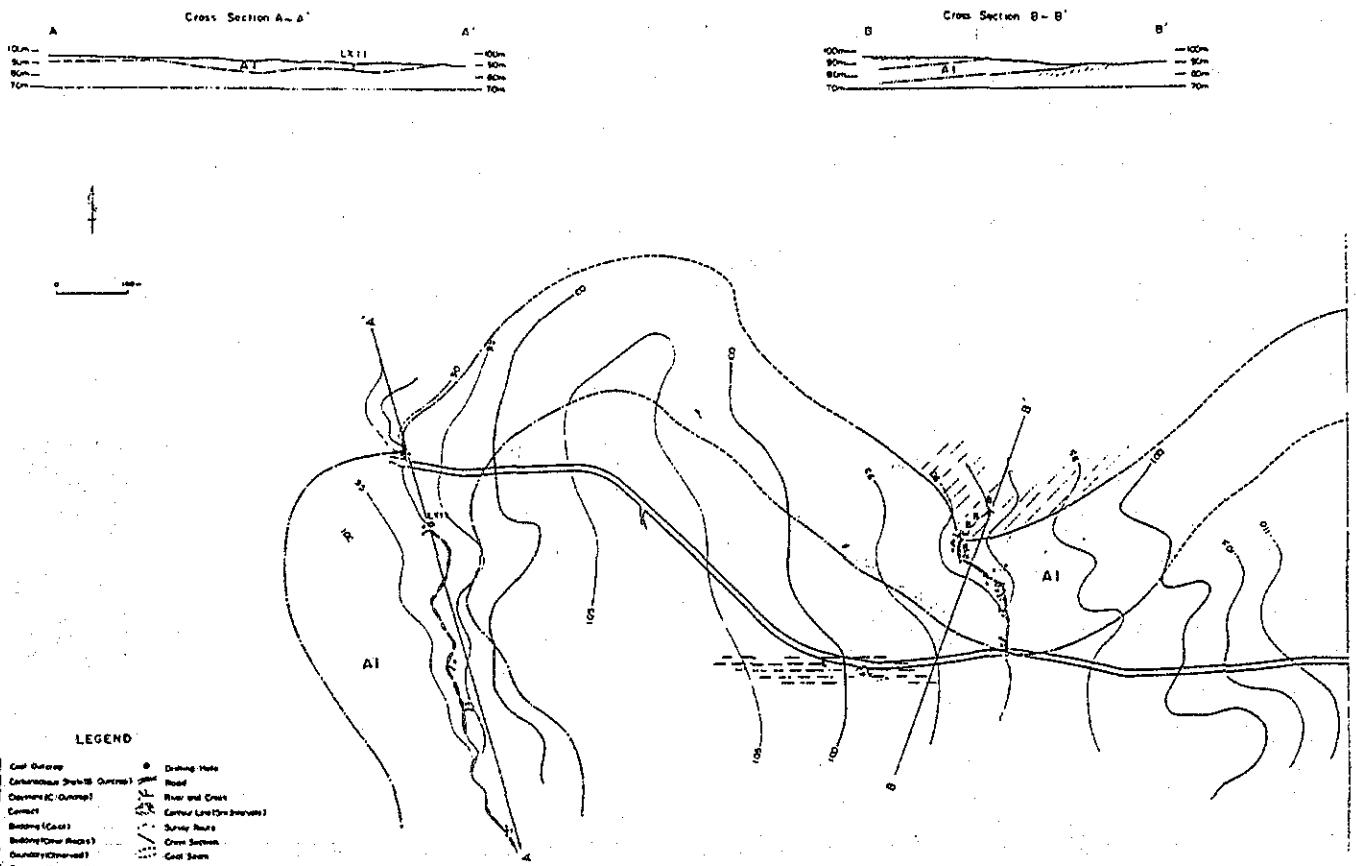
LEGEND

JAPAN INTERNATIONAL COOPERATION AGENCY
THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL
Geological Survey Map
Northern Part of Central Banko Area

Fig. 6-2-8

Geological Survey Map

Eastern Part of Central Banko Area (1)



JAPAN INTERNATIONAL COOPERATION AGENCY

THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL

Geological Survey Map
Eastern Part of Central Banko Area (1)

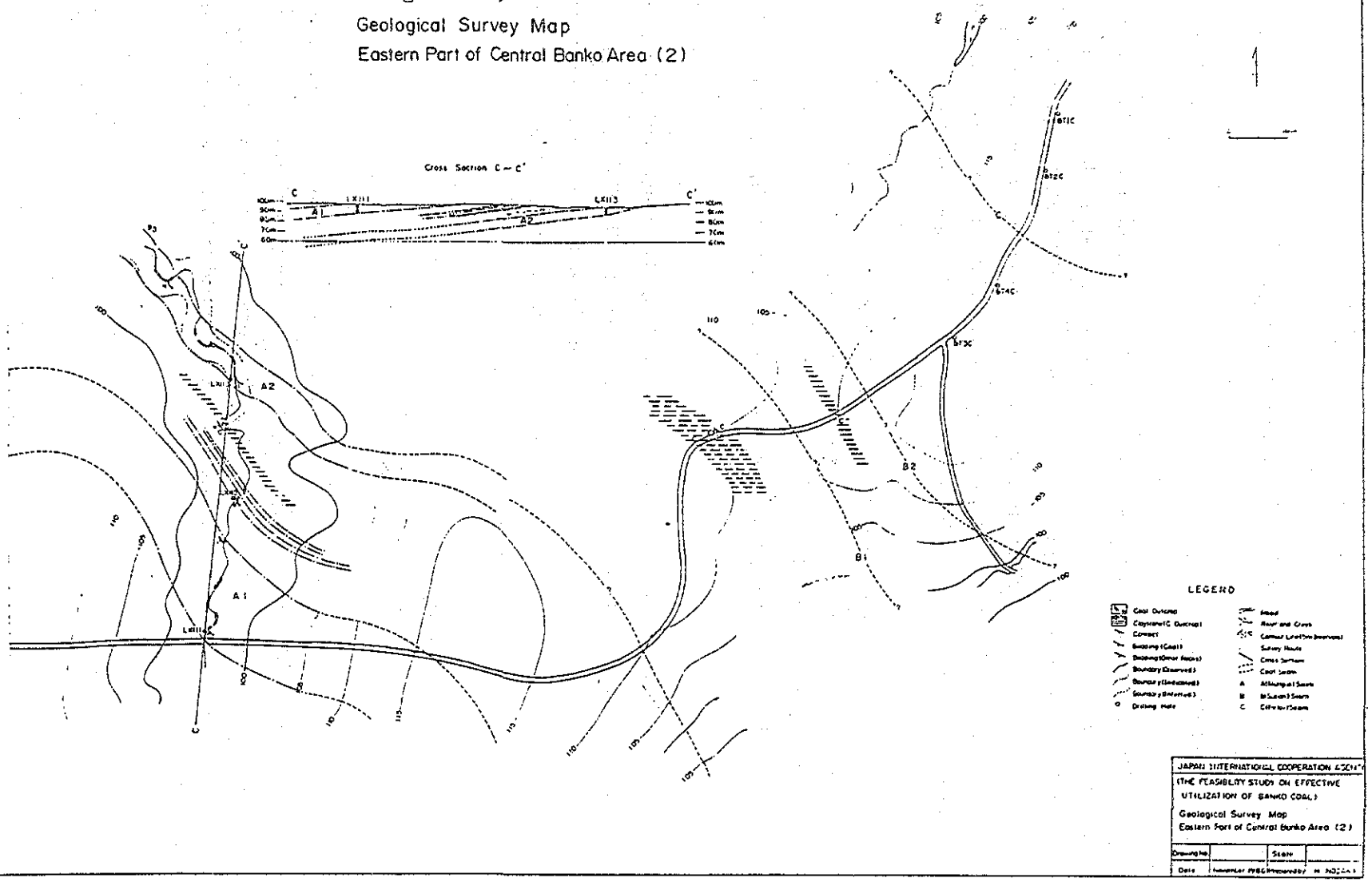
Drawing No. | Scale

Date | November, 1986 Prepared by H. HOZAKI

Fig. 6-2-9

Geological Survey Map

Eastern Part of Central Banko Area (2)



6-3 GEOLOGICAL SURVEY IN NORTH SUBAN JERIJI

6-3-1 Purpose of the Survey

Purpose of geological survey in the North Suban Jeriji area in this year was to select appropriate sites for coal sampling to be carried out in the area in FY 1987. The survey was made by the joint team composed of JICA, BPPT and PPTM.

In order to bring drilling machine into the sites easily and perform effective and smooth sampling work, the following were especially noted on execution of the geological survey as same as that made in the Central Banko area.

The drilling sites for the coal sampling shall be;

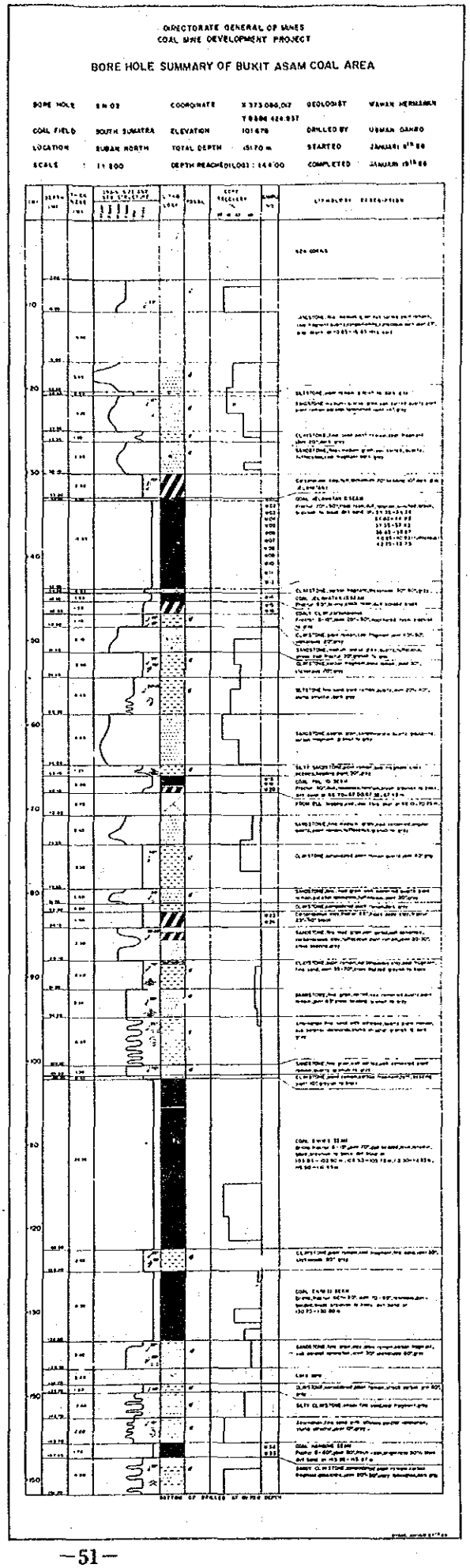
i) as close as possible to the existing access road,
ii) in gently sloped places, and
iii) within a distance from a water reservoir covered by supply capacity of water pump.

DOC kindly provided columnar sections of the boreholes drilled by them in the area and geological map of the area in a scale of 1 : 10,000. An example of the columnar section prepared by DOC is shown in Fig. 6-3-1. The geological map is very beneficial and valuable especially for geological survey in the area. Sincere gratitude is extended to DOC for their kindness.

6-3-2 Progress of Work

(1) Coal Seam

Jelawatan, Enim I and Enim II seams are the main coal seams to be investigated in the North Suban Jeriji area. The coal seams are embraced in the Upper Coal Division of the Muara Enim Coal Formation, which overlies coal seam of the Middle Coal Division investigated in the Central and Northwest Banko areas. (See Table 6-2-1)



DIRECTORATE GENERAL OF MINES
COAL MINE DEVELOPMENT PROJECT

BORE HOLE SUMMARY OF BUKIT ASAM COAL AREA

BORE HOLE	BA 03	COORDINATE	X 373.080,017 Y 9 806 426.937	GEOLOGIST	WAWAN HERMAWAN
COAL FIELD	SOUTH SUMATRA	ELEVATION	101.678	DRILLED BY	USMAN GANDI
LOCATION	SUBAN NORTH	TOTAL DEPTH	151.70 m	STARTED	JANUARI 8TH 88
SCALE	1 : 500	DEPTH REACHED/LOG1 : 144.00		COMPLETED	JANUARI 15TH 88

Fig. 6-3-1
An Example of Borehole Log Prepared by DOC.

(2) Geological Survey

Geological survey to select coal sampling sites in this area was carried out on the basis of same steps mentioned in the Paragraph 6-2-2 as follows;

i) Select several appropriate places for each coal seam

ii) Results of geological survey on the places are presented in basic map at a scale of 1 : 1,000

iii) Select the optimum spot for each coal seam based on geological study

iv) Carry out shallow hole drilling to confirm thickness of overburden at the spot

The places investigated were those in the western part of the area, as the existing road runs across the coal seams to be investigated only in the western part.

(3) Results of the Survey

The North Suban Jeriji area is situated about 6 kilometers to the northeast of the Northwest Banko area. This area is bordered on the west to south by the northeast flank of the Sungai Liling Anticline and on the south to east by the west flank of the North Suban Jeriji Anticline. (See Fig. 6-2-1)

Coal seams in the area trend generally east to east-northeast in the western part and east-northeast to northeast in the eastern part. The seams dip gently north varying from nearly flat to a maximum of 20 degrees which form homocline structure.

Enim I seam, the thickest coal seam in the area, tends to split into two seams in the eastern part. The other two main seams show no such tendency.

Fig. 6-3-2 shows distribution of coal seam in the area, and cross sections are shown in Fig. 6-3-3 and 6-3-4.

Geological survey for selecting coal sampling sites was made in the western part. Coal seams are fairly well-exposed along creeks and rivers in the surveyed area. Shallow holes to obtain coal samples for analysis and to examine thickness of the overburden were drilled in the area on the basis of data and information obtained.

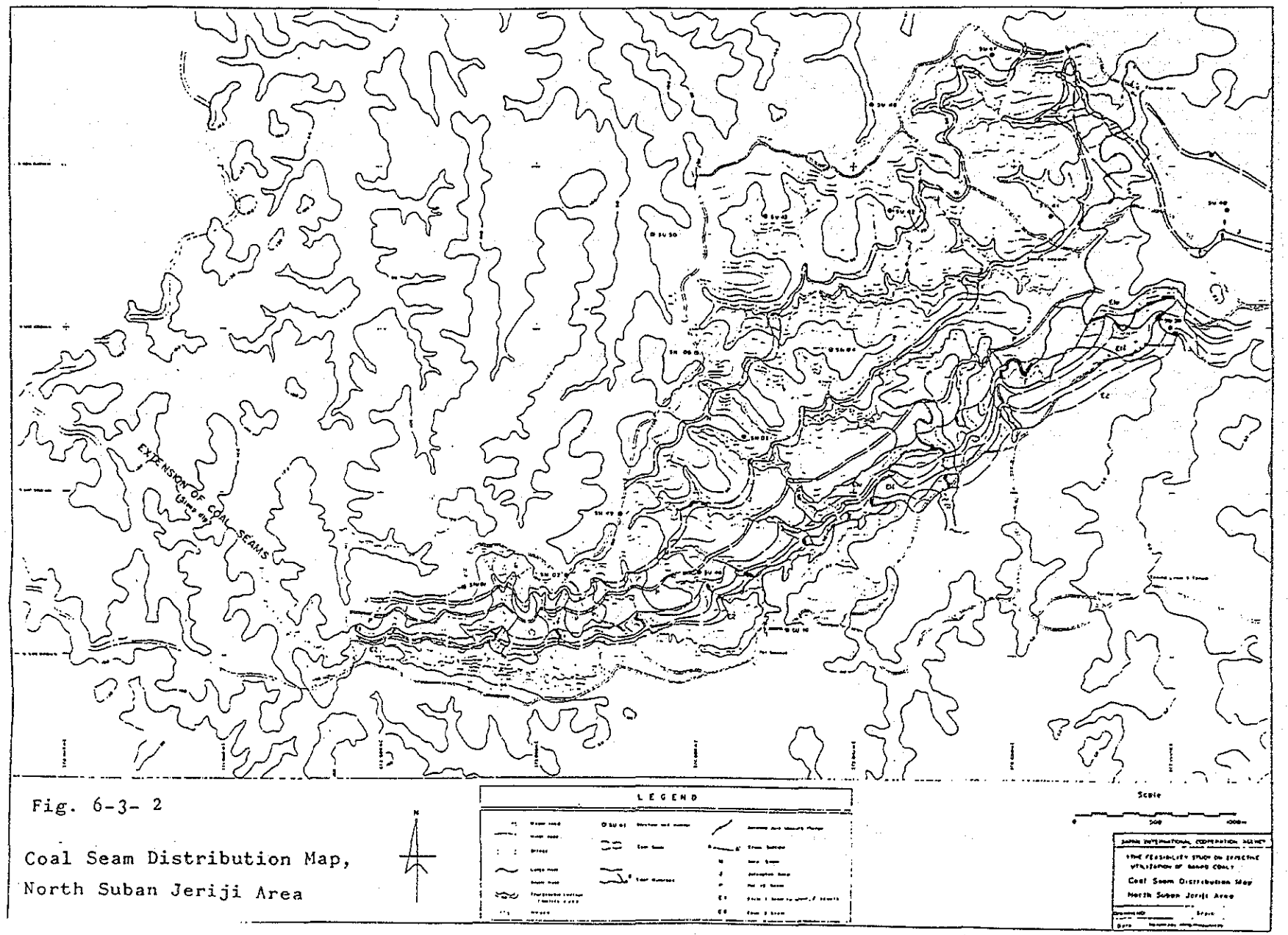


Fig. 6-3- 2

Coal Seam Distribution Map,
North Suban Jeriji Area

Fig. 6-3-3

Cross Sections A, B and C, North Suban Jeriji Area

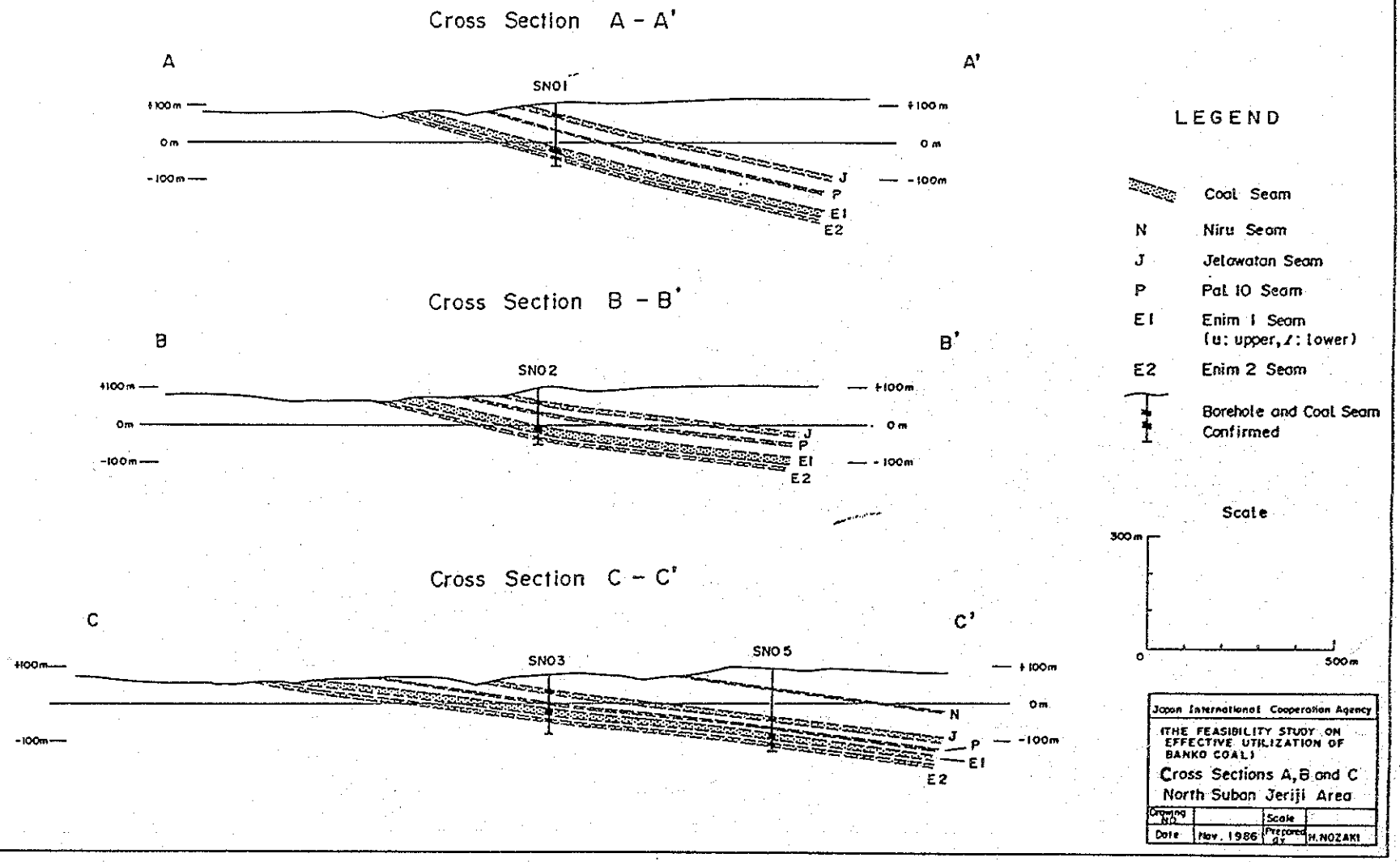
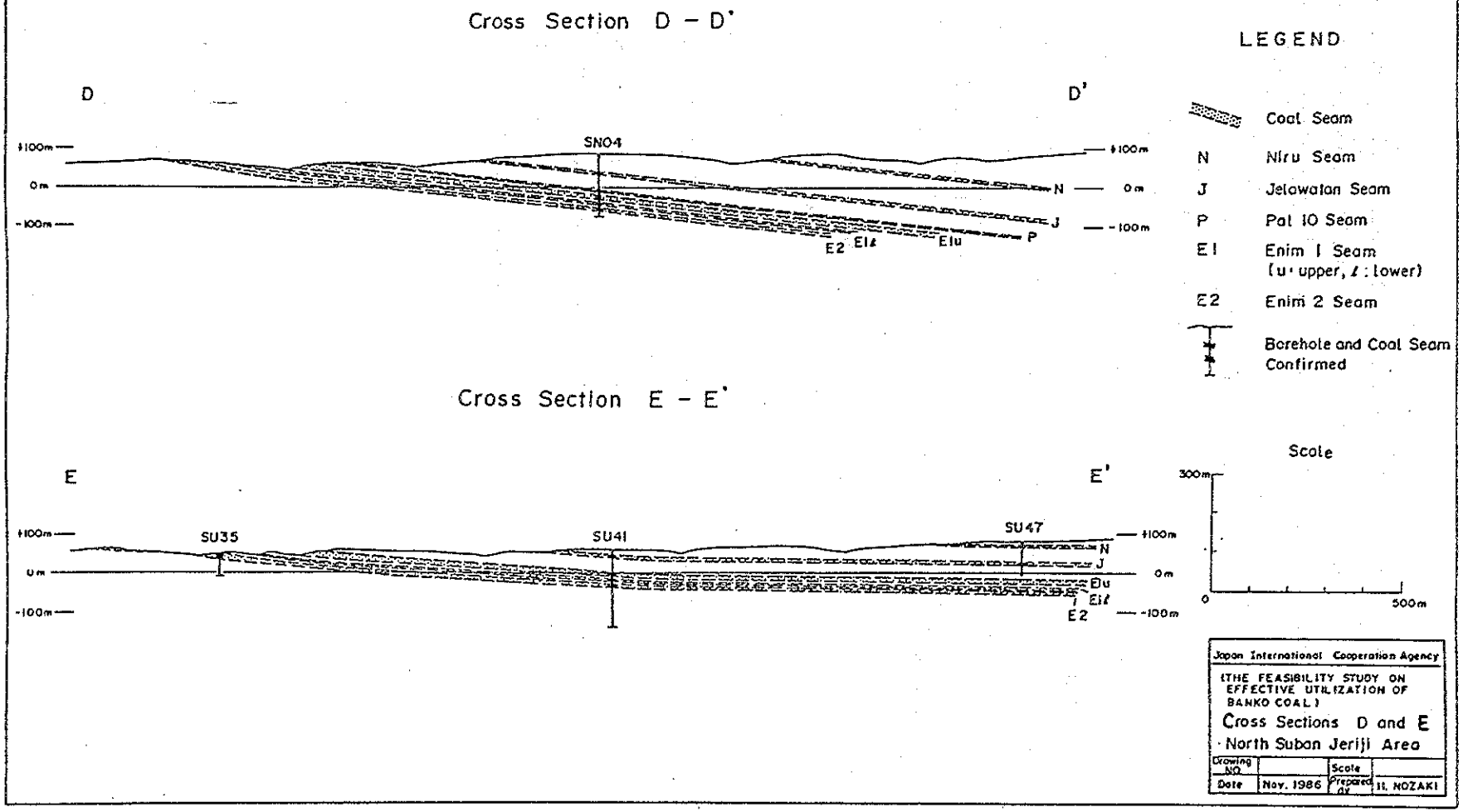


Fig. 6-3- 4

Cross Sections D and E, North Suban Jeriji Area



Japan International Cooperation Agency			
(THE FEASIBILITY STUDY ON EFFECTIVE UTILIZATION OF BANKO COAL)			
Cross Sections D and E North Suban Jeriji Area			
Drawing NO.		Scale	
Date	Nov. 1986	Prepared by	H. NOZAKI

Distribution and occurrence of the main coal seams for the sampling have been confirmed through this geological survey in the area. Thickness of the main coal seams expected at the selected sites will be as follows;

Jelawatan Seam	:	Approx. 10 meters
Enim I Seam	:	Approx. 20 meters
Enim II Seam	:	Approx. 10 meters

Fig. 6-3-5 shows results of the geological survey and location of the shallow holes.

Table 6-3-1 shows quality of coal samples, taken by shallow hole drilling at outcrop, analysed by PPTM, Bandung.

Average quality on dry basis of the coal seams in the North Suban Jeriji area analyzed this year is summarized below.

Ash (%)	:	3.8 - 9.0
Volatile Matter (%)	:	47.7 - 49.5
Gross C.V. (Kcal/kg)	:	6,135 - 6,530
Total Sulfur (%)	:	0.12 - 0.18

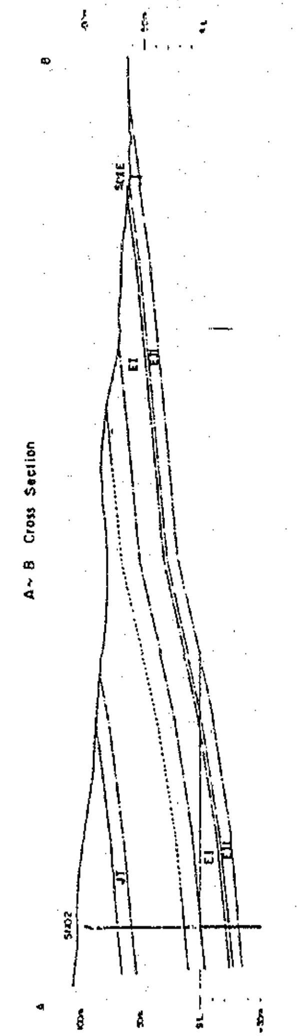
Sodium dioxide content in ash of the North Suban Jeriji coal shows very low as it varies from 0.23% to 0.34%.

According to the ASTM system of the coal classification, Jelawatan and Enim seams are classified into sub-bituminous C in rank. The rank of these coals is one grade down as compared with that of the Northwest Banko coal, this may be caused by their coalification related to stratigraphic horizon.

Fig. 6-3-5

Geological Survey Map

North Suban Jeriji Area (Western Part)



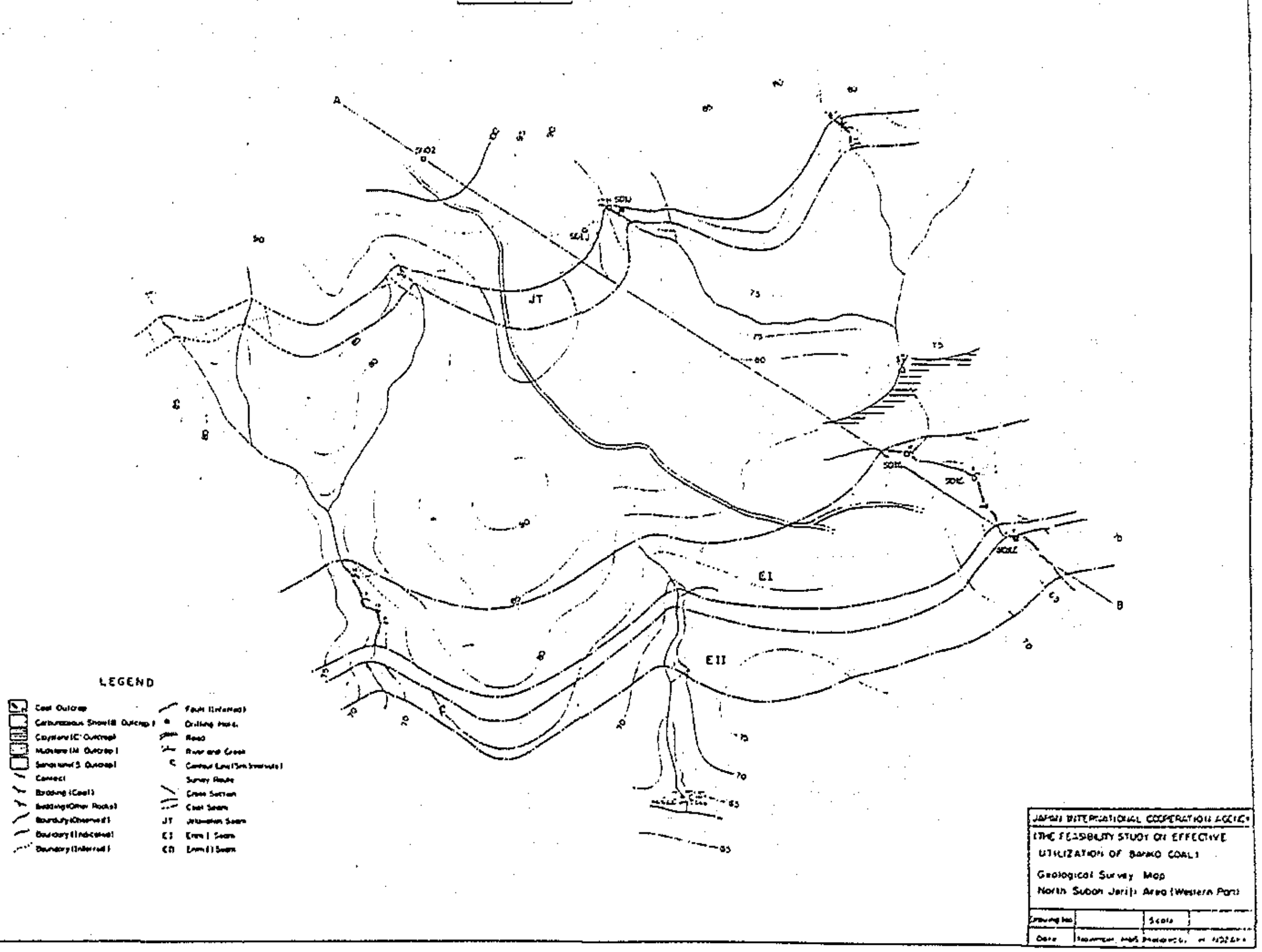


Table 6-3-1 Analytical Results of Coal Taken by Shallow-hole Drilling

Sample Number	SD I J			SD I E			SD II E			SD III E		
Depth (m)	0 - 3	3 - 6	6 -10	0 - 4	4 - 7	7 -10	0 - 3	3 - 6	6 -10	0 - 3	3 - 6	6 -7.75
Coal Seam	J	J	J	EI	EI	EI	EI	EI	EI	EII	EII	EII
Proximate Analysis												
Moisture (%)	32.21	18.23	32.64	19.36	32.91	23.07	38.59	15.15	32.35	26.91	30.54	36.39
Ash (%)	9.72	7.73	3.07	4.56	2.12	3.92	1.66	3.90	2.63	2.44	3.47	1.66
Volatile Matter (%)	30.66	38.88	33.52	39.42	33.31	37.45	31.82	42.49	33.16	35.49	32.89	31.26
Fixed Carbon (%)	27.41	35.16	30.77	36.66	31.66	35.56	27.93	38.46	31.86	35.16	33.10	30.69
Calorific Value (cal/g)	3,939	4,934	4,359	5,202	4,342	4,950	4,134	5,556	4,377	4,781	4,448	4,282
Total Sulfur (%)	0.19	0.20	0.15	0.18	0.11	0.11	0.08	0.15	0.11	0.20	0.14	0.15
Ultimate Analysis												
C (%)	39.81	51.46	44.54	56.25	45.01	51.66	40.87	57.00	44.79	49.53	46.05	42.86
H (%)	6.73	5.98	6.97	6.56	7.06	6.41	7.49	5.96	6.93	6.66	6.87	7.36
N (%)	0.62	0.67	0.63	0.67	0.54	0.65	0.57	0.77	0.63	0.65	0.65	0.67
O (%)	42.93	33.96	44.64	31.78	45.16	37.25	49.33	32.22	44.91	40.52	42.82	47.30
Ash Components												
SiO_2 (%)												
Al_2O_3 (%)												
Fe_2O_3 (%)												
TiO_2 (%)												
CaO (%)												
MgO (%)												
K_2O (%)	0.17	0.19	0.44	0.20	0.28	0.27	0.27	0.73	0.23	0.31	0.20	0.38
Na_2O (%)	0.08	0.21	0.40	0.20	0.29	0.22	0.26	0.53	0.26	0.40	0.17	0.29
SO_3 (%)												
P (%)												

Remarks : 1. Drilling sites are shown in Fig.6-3-4. 2. Coal seam indicates as; J:Jelawatan Seam, EI:Enim I Seam, and E II:Enim II Seam.