The Interim Report II on the Feasibility Study on Effective Utilization of Banko Coal in the Republic of Indonesia

May 1986

Japan International Cooperation Agency

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THE INTERIM REPORT II

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THE FEASIBILITY STUDY

ON

EFFECTIVE UTILIZATION OF BANKO COAL

IN

THE REPUBLIC OF INDONESIA

(FY 1985)

MAY 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

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

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1. BACKGROUND OF THE STUDY IN FY 1985

1-1 INTRODUCTION

In response to the request of the government of the Republic of Indonesia, the Government 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 cooperation 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 from FY 1985.

This Interim Report has been prepared to figure out the background and the study results in FY 1985.

1-2 BACKGROUND OF THE STUDY IN FY 1985

1-2-1 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 alternative 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 have 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.

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

1-2-2 Background of the Study in FY 1985

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

1) Survey on background of the project
2) Preliminary survey on markets of blown 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 and recommendation were obtained.

(1) Conclusion

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.

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 methal 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's 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) Recommendation

As the results of the strategic investigation of effective utilization of Banko coal, the following subsidiary subjects are proposed to be carried out in further study period, though these subjects are not described clearly in Scope of Work.

1) Maps of Banko area will be prepared for the further study of coal sampling spot and method.

2) Water resources data and soil data will be additionally required for selection of plant site.

3) Market survey on fuel methanol for gas turbine generator and diesel engine generator as well as city bus in Indonesia will be carried out to grasp practical specified demand of fuel methanol.

4) Preliminary feasibility study on high voltage-direct current transmission line between Banko area and Jawa will be carried out to evaluate mine mouth electricity generation.

After deep discussion, JICA and BPPT agreed upon the results of the study of the 1st stage (strategic investigation stage) in FY 1984 and decided to proceed the 2nd stage (the coal gasification test stage) in accordance with Scope of Work concluded on Feb. 24, 1984.

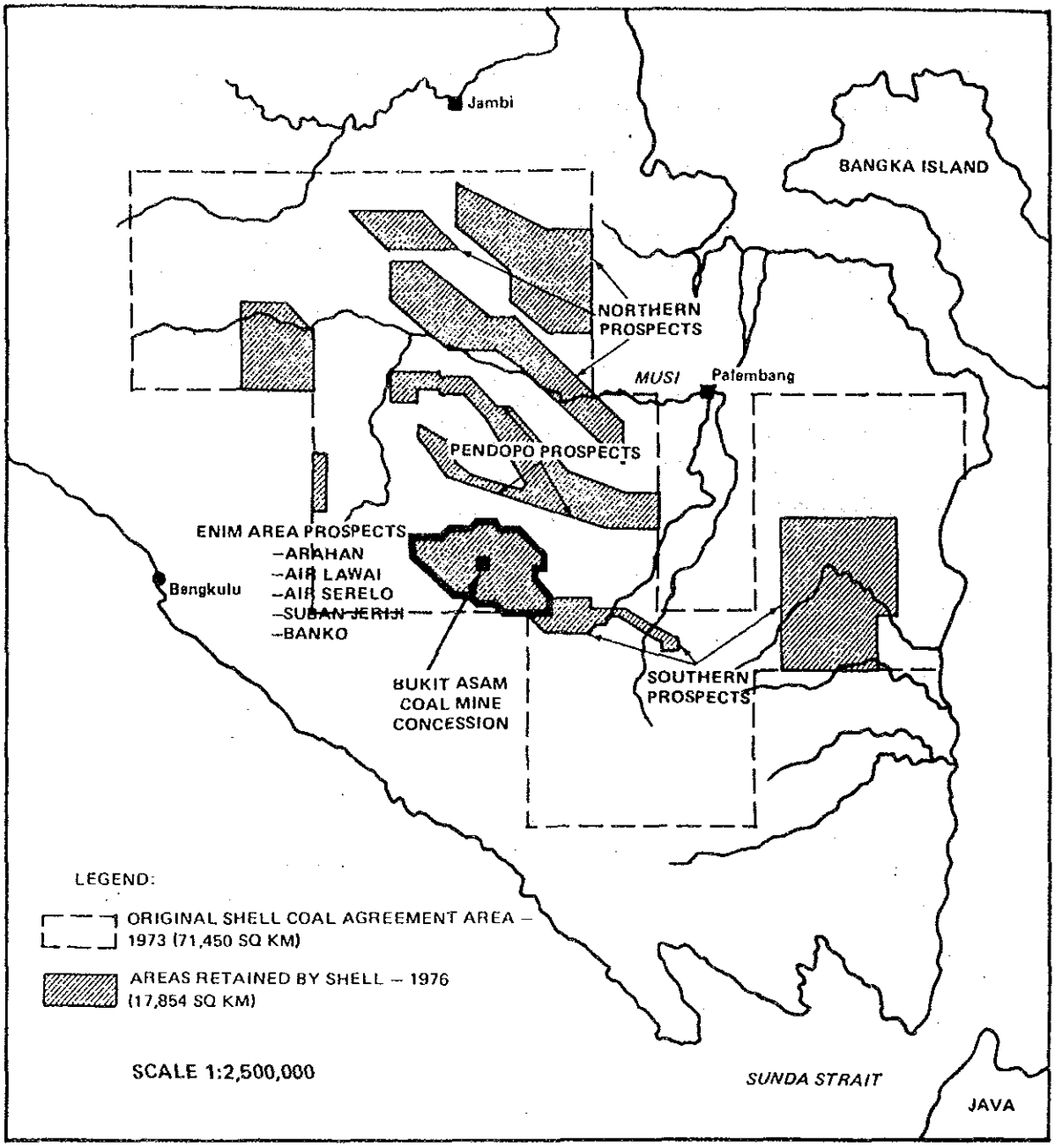


FIG. I Shell coal exploration in South Sumatra

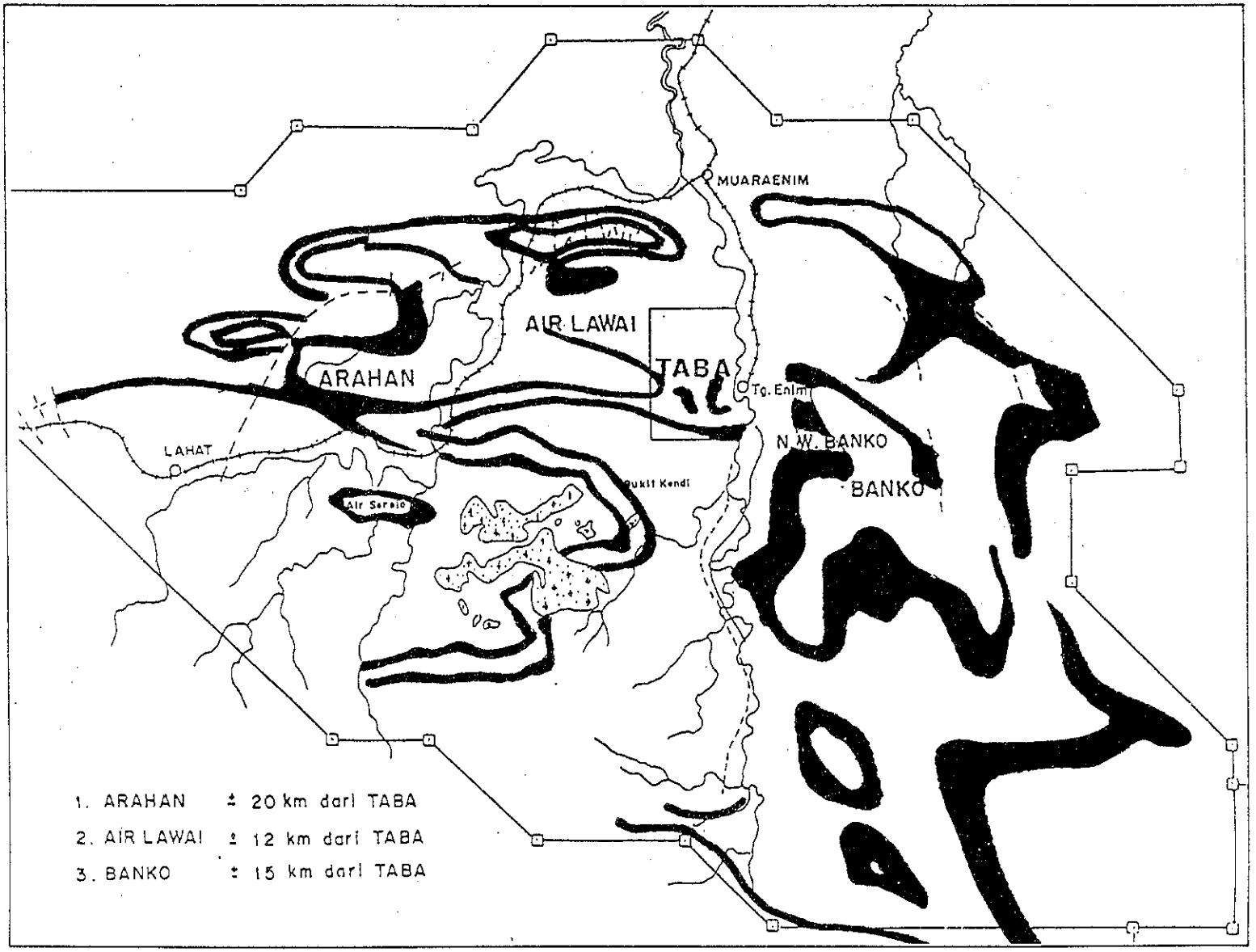
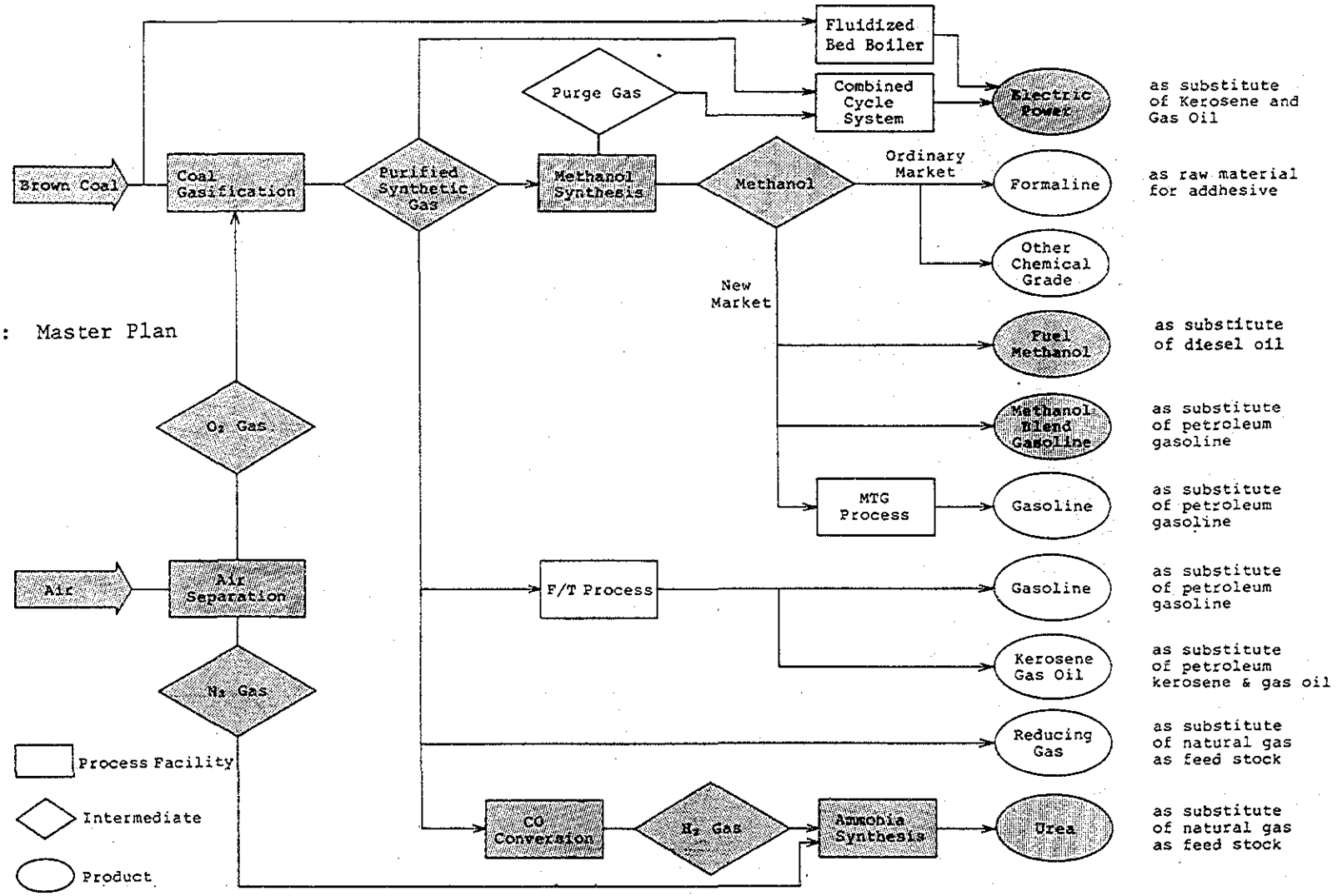


FIG. II Coal resources in Western part of South Sumatora area.

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



2. SCOPE OF WORK OF THE STUDY IN FY 1985

2-1 OBJECTIVE

The objective of the 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 1985 is the first year of the 2nd stage.

2-2 SCOPE OF THE STUDY

2-2-1 Scope of the 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 to grasp characteristics of gasification of Banko coal and to select 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.

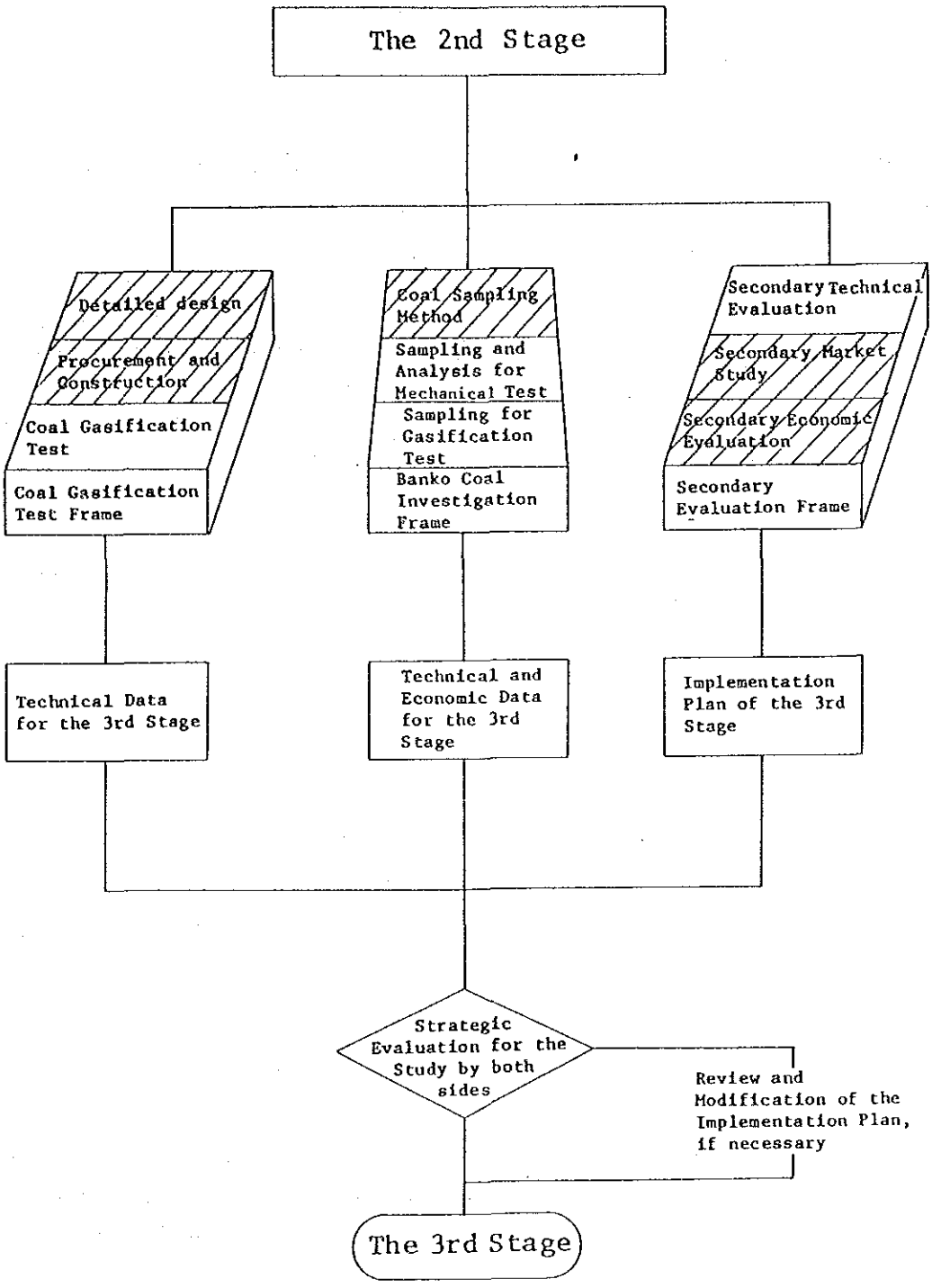
2-2-2 Scope of the Study in FY 1985

The scope of the study of the 2nd stage is shown on FIG. - IV.

The scope of study in FY 1985 is as follows:

(1) Detailed design on coal gasification test facilities
(2) Survey on coal quality
(3) Preliminary evaluation of economic feasibility
(4) Investigation of the market for final product

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



: Scope of the study in 1985, including partial study

3. OUTLINE OF THE SITE SURVEY

3-1 STUDY TEAM

The staff and his area of expertise of the Japanese study teams which are dispatched to Indonesia in FY 1985' are summarized on Appendix-V. The objectives and special notes of the each study team are as follows:

1) Study Team (A)

Objective; Explanation and discussion with counterpart on the coal gasification test facilities regarding the following items.

2.1 Design of the coal gasification test facilities (1st visit)
2.2 Engineering and procurement of the test facilities (2nd visit)

Note: 2.1, 2.2 etc mean the item number of Scope of Study described in Scope of Work.

2) Study Team (B)

Objective; Survey on coal quality by executing the following items.

2.3.1 Preliminary site survey (1st visit)
" Preparation of coal sampling (2nd visit)
" Coal sampling (3rd visit)
2.3.2 Supervision of coal sampling (4th visit)

3) Study Team (C)

Objective; Analysis and evaluation of the coal gasification test for the 2nd stage

2.10.3 Investigation of coal gasification technologies (1st visit)
" Investigation of the market for final products (2nd visit)
" Evaluation of economic feasibility for the 2nd stage (3rd visit)
" Evaluation of economic feasibility for the 2nd stage (4th visit)

4) Study Team (D)

Objective; Explanation and discussion with counterpart regarding coal sampling and coal gasification test facilities.

2.3 Survey on coal quality (1st visit)

2.4.2 Field work of coal gasification test facilities (2nd visit)

2.3.3 Coal sampling in FY 1986 (2nd visit)

3-2 SCHEDULE OF THE SITE SURVEY

Six (6) of JICA Missions organized by the staffs of above mentioned study teams (A-D) were dispatched to Indonesia for the site survey.

The Schedule of each mission was as follows:

1st mission	May/26 - June/2	Jakarta, Serpone, Bandung, Banko
2nd mission	July/2 - July/12	Jakarta, Bandung, Serpone
3rd mission	July/11 - Sept/29	Banko
4th mission	Aug/22 - Aug/30	Jakarta, Serpone
5th mission	Dec/1 - Dec/7	Jakarta
6th mission	Mar/12 - Mar/21	Jakarta, Bandung, Serpone

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

3-3 SPECIAL NOTES OF THE SITE SURVEY

During 1985, 6 of JICA Missions were dispatched to Indonesia as described on Chapter 3-2.

The special notes of each mission are as follows;

(1) 1st Mission

The 1st mission was organized by the experts of the study team B (survey on coal quality) and C (Analysis and evaluation of the coal gasification test).

The 1st mission has visited Jakarta, Serpone, Tanjung Enim and Banko areas for site survey.
The special notes of the site survey are as follows;

1) Implementation plan of the 2nd stage was agreed by both parties

2) Budget for the study in FY 1985 was explained by both parties and confirmed that the study in FY 1985 will be proceeded on the same mode with Scope of Work.

3) Detailed implementation plan of coal sampling work in FY 1985 was slightly modified in detail. Both sides agreed and confirmed technical and budgetary undertaking on the same division described in Scope of Work.

4) Preliminary site survey for methanol cost estimation was carried out and conceptual plan for transportation of equipment, raw materials and product was examined.

(2) 2nd Mission

The 2nd mission was organized by the experts of the study team A (coal gasification test facilities).

1) Both sides discussed the detailed engineering of the test facilities and agreed on the design phylosophy and conditions.

2) Both sides confirmed each undertaking of equipment supply on the basis of Scope of Work. The technical specifications of utility supply system were discussed and agreed upon by both sides.

3) The counterpart promised to provide core drilling data of deep boring which the DOC of Indonesia was carrying out at N.W. Banko.

4) The counterpart also promised to provide the maps of Banko area, having the scale of 1/10,000.

(3) 3rd mission

The 3rd mission was organized by the experts of the study team B and carried out the coal sampling work at N.W. Banko and West Banko.

(4) 4th Mission

The 4th mission was organized by the experts of the study team A and C.

1) Final Engineering Report of the coal gasification test facilities was discussed and agreed upon.

2) Method of equipment transportation from PALEMBANG to a plant site was studied and barge towing system through the Musi and Lematang rivers was idealized as the most economical method.

3) Conception for introduction of fuel alcohol in Indonesia was discussed with the counterpart and relevant organizations.

(5) 5th Mission

1) The study team D has discussed with the counterpart regarding coal sampling and analysis work.

2) Core drilling data in N.W. Banko and West Banko (partially) were provided by the counterpart.

(6) 6th Mission

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

1) The draft Interim Report (FY 1985) was discussed and agreed upon.

2) The results of detailed engineering were discussed in detail and the necessary preparation work for the construction of the coal gasification test facilities was confirmed by both sides.

3) The implementation plan of the Study in FY 1986, including the study on market for fuel alcohol and its supply system, was discussed and confirmed mutually that both sides shall continue necessary preparation work for the Study in FY 1986

4) Technology transfer on coal analysis method and its related equipment was carried out.

4. RESULTS OF DETAILED DESIGN ON COAL GASIFICATION TEST FACILITIES

PART SUMMARY

The basic design on the coal gasification test facilities has successfully finished in FY 1984 and the results are reported on the Interim Report on May, 1985.

In this FY 1985, the detailed design was carried out on the basis of the basic design, and completed in September, 1985.

JICA has started the procurement of the equipment and materials of the test facilities in accordance with the undertaking of the Scope of Work.

BPPT has continued the construction of the pilot plant building in PUSPIPTEK, including utility facilities, and almost completed the work.

4-1 INTRODUCTION

Coal reserved in Banko area has a wide variety of qualities depending on area and coal stream. Therefore before working out the Feasibility Study on Effective Utilization of Banko Coal in the Republic of Indonesia, it is necessary to have a information of properties of each coal reserved in Banko area from the view point of gasification. Therefore different kinds of brown coal sampled in Banko area are gasified in a molten iron coal gasification test facilities.

The basic design on the facilities has successfully finished in FY 1984 and prepared the Interim Report on May, 1985.

In this FY 1985, the followings were mainly studied:

1) The detailed design on the coal gasification test facilities
2) The detailed planning on the installation, trial run, commissioning of the facilities and test of coal gasification.
3) The detailed job assignment with counterpart.
4) The planning on erection work of the facilities.

The results of the detailed design and the detailed job assignment with counterpart has been discussed to Indonesia for the site survey on July and August, 1985 respectively.

This chapter is concerned with the studies in FY 1985.

4-2 DETAILED DESIGN ON COAL GASIFICATION TEST FACILITIES

4-2-1 Design Condition

The design conditions such as location, capacity, seismic design and applied cords of the facilities are as follows:

(1) Location

The facilities are constructed in the Pilot-Plant Building in PUSPIPTEX, Serpong, Jakarta, the Republic of Indonesia.

(2) Capacity

The facilities must have a capacity to generate minimum 40 Nm^3/h of produced gas, corresponding to minimum 20 kg/h feeding rate of pulverized coal, in order to make an accurate analysis of product gas component by minimizing the external disturbance.

Therefore the capacity of the test facilities is designed as follows:

1) maximum feeding rate of coal is 40 kg/h
2) normal feeding rate of coal is 30 kg/h
3) minimum feeding rate of coal is 20 kg/h

(3) Seismic Design

$Fe = kw$

where, Fe : horizontal shear force
k : seismic coefficients
w : weight of the components

The "k" value is 0.2, as all the equipments are smaller than 16 m and their specific period are shorter than 0.4 second.

(4) Applied Cords and Standards

All construction shall conform to or refer to the following Japanese cords and standards:

1) Building standard act
2) Design standard for steel structure
3) Japan petroleum institute standard
4) Design specifications for pressure gas cylinders
5) Regulations for security of gas cylinders
6) Regulations for security of liquefied petroleum gas
7) Regulations for security of other pressured gas
8) Japanese industrial standard
9) The Japanese electrotechnical committee
10) The Japan electrical manufacture's association
11) Technical standard for electric equipments
12) The other cords and standards considered necessary by the engineers

Moreover the other design conditions such as climate data, materials, wastes and utilities are shown in Table 4-2-1.

4-2-2 Main Components of Coal Gasification Test Facilities

The principal coal gasification test facilities are composed of a coal drying unit, a coal pulverize and injection system, a gasifier, a gas filtration system and equipments for utilities as shown in Fig. 4-2-1.

Moreover the incidental equipments are a melting furnace, a runner for the metling iron, burners for the gasifier and the runner, a slag treatment system, a partial dust collector and analyzers for produced gas, pig iron and slag.

4-2-3 General Layout

The major test facilities are installed the inside of the Pilot-Plant Building in PUSPIPTEX as shown in Fig. 4-2-2, Fig. 4-2-3 and Fig. 4-2-4.
On the other hand, the some utility equipments such as water cooling tower and a flare stack are constructed the outside of the building.

A coal stock yard, the coal dryer and the slag treatment system are installed at the ground floor in the building. The gasifier, the coal injector and the runner for the melting furnace are installed at the first floor in the building. Moreover the melting furnace, the coal pulverizer are installed at the second and third floor in the building respectively.

4-2-4 Description and Specification of the Coal Gasification Test Facilities

(1) Coal Drying System

100 kg of Raw coal having 35 % moisture is dried in a chassis-typed dryer until its moisture content is reduced down to 5% in approximately one hour.
After that, the dried coal is transported to a coal pulverizer by a over-head crane and charged to a hopper of the coal pulverizer.

The assemble drawing of the coal drying system is shown in Fig. 4-2-5.

(2) Coal Pulverize and Coal Injection System

A coal pulverize and coal injection system is composed of a coal pulverizer and a coal injector.
After charging to the hopper, the dried coal is pulverized into 0.074 mm particle in a hammer-typed pulverizer and the pulverized coal is gathered in a blow tank.

And then it is fed out in a predetermined amount, approximately 30 kg/h of coal, by a rotary feeder and transported pneumatically to a coal blowing lance, main lance by mean of a carrier gas, nitrogen gas.

The assemble drawing of the coal pulverize and coal injection system is shown in Fig. 4-2-6.

(3) Melting Furnace

The molten iron required for coal gasification test is produced in a medium-frequency induction furnace from scrapped iron in approximately two hours.
The molten iron produced is transported to a gasifier through a runner after being adjusted for its chemical composition, mainly carbon content, and for temperature.

The assemble drawings of the melting furnace and the runner are shown in Fig. 4-2-7 and Fig. 4-2-8.

Further main chemical compositions of pig iron and slag are measured by a iron analyzer and a slag analyzer.

(4) Gasifier

The gasifier is lined with magnesia refractory bricks on internal wall and equipped with a lance, through which both coal and oxygen are blown and a induction coil to maintain temperature of molten iron constant.

30 kg/h of pulverized coal, blown at a high speed with oxygen onto the surface of molten iron bath in the gasifier, is instantaneously gasified and 64.5 Nm^3/h of gas is produced.

The assemble drawings of the gasifier and the main lance are shown in Fig. 4-2-9 and Fig. 4-2-10.

During gasification, temperature and carbon content of molten iron in the gasifier are measured by a sub-lance.

(5) Produced Gas Filtration System

A produced gas Filtration system is composed of a water-cooled duct, a cyclone and a bug filter.

The produced gas in the gasifier is recovered through a hood directly connected to the gasifier.
The recovered gas is cooled and dedusted by the water-cooled duct, the cyclone and the bug filter.
Finally, it is burned at a flare stack and released to atmosphere.
The assemble drawings of the gas filtration system and the flare stack are shown in Fig. 4-2-11 to Fig. 4-2-14.

Moreover the recovered gas is sampled by a gas sampling equipment and chemical compositions of it are measured by some types of gas analyzers.

(6) Slag Treatment System

A slag treatment system is composed of a slag pot and a slag pot car.

After coal gasification test, the molten iron is discharged to the slag pot and transported by the slag pot car and then the molten iron is cooled naturally.

The assemble drawing of the slag treatment system is shown in Fig. 4-2-15.

(7) Partial Dust Collector

Fume generated during molten iron transportation and coal gasification test is recovered by a partial dust collector.

The assemble drawing of it is shown in Fig. 4-2-16.

(8) Operation Room

A mimic panel, a operation console, a instrument panel and an air conditioner are installed in an operation room. The operation states for each equipment are indicated at the mimic panel.

And the coal injector, the gasifier, the main lance, the hood for the gasifier and a induced draft fan are operated at the operation console.

Further the other equipments such as the coal dryer, the coal pulverizer, the melting furnace, the sub-lance and the dust filtration system are operated at local.

Moreover indicators, announciators and recorders are set at the instrument panel.

The descriptions of other equipments are abbreviated in this chapter and only the drawings are shown in Fig. 4-2-17 to Fig. 4-2-23.

The principal specifications and the lists of motor and instrument are shown in Table 4-2-2 to Table 4-2-4.

4-2-5 Material Balance

Material balance at standard test is shown in Table 4-2-24.

When 30 kg/h of pulverized coal with 18.0 Nm^3/h of oxygen and 10.6 Nm^3/h of nitrogen are injected onto 300 kg of molten iron, 64.5 Nm^3/h of gas are produced.

CO and H_2 contents in the produced gas are 51% and 24% respectively.

4-2-6 Utility Balance

The consumption for material, sub-materials and utilities in one-test run are shown in Table 4-2-5.

Before operation, nitrogen gas is purged the coal injection line and the dust filtration system and LPG are consumed for preheating the gasifier and the runner.

In two-hour operation, approximately 300 kg of iron scrap, 120 kg of raw coal, 145.2 Nm^3 of nitrogen gas and 36.0 Nm^3 of oxygen are consumed.

Moreover after some gasification tests, the refractory bricks for the melting furnace and the gasifier are relined.

Therefore after relining work, LPG for drying the bricks is consumed.

4-3 PLAN ON CONSTRUCTION AND COAL GASIFICATION TEST

4-3-1 Overall Schedule

The overall schedule for Banko coal gasification test is shown in Table 4-3-1.
It is scheduled that erection, trial run and commissioning of the test facilities are to be completed at or before the end of March, 1987.
The coal gasification tests including data analysis are to be conducted for about ten months, from June in 1987 to March in 1988.

4-3-2 Plan on Trial Run and Commissioning

The main contents for trial run and commissioning are shwon in Table 4-3-2.

The checks of motors and valves are mainly carried out in non-load test period. After then, drying, pulverizing and feeding tests using Banko coal are carried out in load test period to check capacity for coal drying system and coal pulverize and injection system. Moreover trial run are carried out to check the performance of gasifier and melting furnace.

4-3-3 Plan on Coal Gasification Test

The coal gasification test is divided into three steps of Campaign 1 to Campaign 3 as shown in Table 4-3-2.

First, preparatory tests are conducted to understand the characteristics of the test facilities such as heat loss of gasifier during Campaign 1.
After that, essential tests are conducted to investigate the characteristics in Banko coal gasification during Campaign 2. Finally, tests are conducted to supplement the test results of Campaign 1 and 2 during Campaign 3.

Moreover it is noted that test results such as material balance, heat balance and produced gas contents, obtained in a small-scale tests facilities, generally tend to show a distinctive characteristics caused by the scale.
Therefore the results obtained in this test will be corrected, referring the results obtained in pilot plant and also theoretical values to prepare a fundamental information for execution of Feasible Study.

4-3-4 Time and Procedure of Coal Gasification Test

Two-hour test is needed to obtain accurate data for the coal gasification characteristics because it is predicted to take 20 to 30 minutes for stabilization of gasification reaction and one more hour for normalization of the process.

Table 4-3-3 shows the standard time schedule for one run. In the morning of test day, a 300 kg molten of scrapped iron is melted in the melting furnace. And raw coal is dried and pulverized in a coal dryer and coal pulverizer.
In the afternoon, after the molten iron is transported into the gasifier, a two-hours gasification test is conducted at a prescribed temperature.

Considering the necessary jobs to be done before and after a test including the data analysis, two runs in a week will be suitable.

4-3-5 Organization

JICA will sent the teams to the Republic of Indonesia for the erection, the trial run and commissioning of the facilities and the tests.

The team for the erection, the trial run and commissioning is organized by experts of mechanical engineer and electrical engineer.

The team for test is organized by experts of process engineer, chief operator, operators for gasifier and analyzer and maintenance men.

It is recommended that the team is organized as shown in Fig. 4-3-1 in the Republic of Indonesia to master the technology for the erection, trial run, commissioning and coal gasification tests.

4-4 JOB ASSIGNMENT PROGRAM WITH COUNTERPART

The followings are supplied to JICA by Counterpart during these period:

(1) Mateirals and sub-materials
(2) Utilities
(3) Equipments, tools and consumables for chemical analysis
(4) Office furniture
(5) Working tools for gasification test