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KALIMANTAN COAL TRANSPORT TO DOMESTIC DESTINATIONS

EVALUATION OF SEA AND LAND TRANSPORT REQUIREMENTS

Prepared by
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FOREWORD

This report on domestic land and sea transport requirements for Kalimantan coal is the third in a series of energy-related studies conducted by Badan Pengkajian dan Penerapan Teknologi (BPPT). The first study was published in December 1980 and analyzed alternative energy supply strategies for all of Indonesia. Because of the importance of the coal sector, BPPT published a second study (in June 1982), which provided a comprehensive assessment of all requirements associated with further development of the coal industry. In this study, the transportation of Kalimantan coal was recognized as one of the key problems facing the industry and was subsequently chosen as the focus of the present study.

BPPT's intent with this report is to furnish a systems analysis of specific technical problems in developing an efficient coal transportation system that links future mine sites in Kalimantan with all potential uses on Java and other locations. The actual development of the system is the responsibility of various ministries and state companies. In conducting this study, BPPT views its role as one of assisting those ministries and companies in addressing technical and technology-oriented issues. It is believed that a coordinated approach to resolve such issues may emerge as a result.

Similar to BPPT's previous energy studies, a key reason for this study is BPPT's desire to assist in the development of domestic industries that will support future expansion of the energy sector. Plans for these industries first and foremost depend on an evaluation of manpower, technologies, equipment, materials, and other resource requirements associated with plans for increasing energy supplies.

Increased development and production of coal resources will require, for example, mining and material handling equipment, coal preparation plants, transport equipment, and a host of other support elements. This study is

a needed addition to the process of improving and expanding the rolling stock, shipping, shipbuilding, and other industries that supply services and equipment for coal transport.

As a matter of policy, BPPT has intentionally disseminated the results of this study widely in the expectation that a discussion of the study's results may lead to new ways of solving our country's problems. BPPT invites the reader to critically examine this report and greatly appreciates any constructive comments.

Signed,

Wardiman

Wardiman Djojonegoro

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ABBREVIATIONS, CONVERSION FACTORS, AND ENERGY EQUIVALENTS

Abbreviations and Conversion Factors

bbl	U.S. barrel (1 bbl = 42 U.S. gallons = 0.159 kl)
Btu	British thermal unit; the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit
BOE	Barrel of oil equivalent
BRT	Bruto registed tonne
cal	calorie
cd	calendar day
cu ft	cubic feet (1 cu ft = 0.02832 cu meter)
cu meter	cubic meter (1 m^3 = 35.31 cu ft)
DWT	deadweight tonne
ft	foot (1 ft = 0.3048 m)
gal	U.S. Gallon (1 gal = 1.785 l = 0.003785 m^3
Gwh	gigawatthour (1 Gwh thermal = 123 TCE)
in.	inch (1 in. = 0.0254 m)
kcal	kilocalorie (1 kcal = 1,000 cal)
kce	kilogram of coal equivalent
kg	kilogram (1 kg = 1,000 gr = 2.205 lb)
kl	kiloliter (1 kl = 1,000 l = 6.29 bbl)
km	kilometer (1 km = 1,000 m = 0.621 miles)
kw	kilowatt (1 kw = 1,000 watt)
kWh	kilowatt-hour (1 kWh thermal = 3,413 Btu = 0.000123 TCE)
l	liter (1 liter = 0.2642 U.S. gallons = 0.001 m^3)
lb	pound (1 lb = 0.4536 kilograms)

m	1 meter (1 m = 3.28 ft)
mi	mile (1 mile = 1.609 kilometers)
mt	metric ton (1 mt = 1,000 kg = 2.205 lb)
MW	megawatt (1 MW = 1,000 kW = 1,000,000 watt)
MWe	megawatt electric output
MWth	megawatt thermal output
SCF	one cubic foot of natural gas, measured at 60°F and 1 atm.
SD	stream day or operating day for a production process
ST	short ton (1 ST = 907 kg)
tonne	metric ton (1 tonne = 1,000 kg = 2,205 lbs)
TCE	tonne of coal equivalent
TOE	tonne of oil equivalent
US$	1984 U.S. dollars

Multiples:

M - 10^3, thousand

MM - 10^6, million

G - 10^9, billion

T - 10^{12}, trillion

Energy Equivalents of Fuels

Fuels	Quantities: Approximately Equivalent to 1 TCE in U.S. Units	Quantities: Approximately Equivalent to 1 TCE in Metric Units
Liquid		
Crude Oil	4.79 bbls	0.76 kl
All Refined Products	4.96 bbls	0.79 kl
Kerosene	4.91 bbls	0.78 kl
Ethanol	8.08 bbls	1.28 kl
Methanol	11.87 bbls	1.89 kl
Natural Gas Liquids	6.01 bbls	0.96 kl
Syncrude	4.96 bbls	0.79 kl
Liquefied Natural Gas (LNG)	8.08 bbls	1.28 kl
Liquefied Petroleum Gas (LPG)	6.67 bbls	1.06 kl
Gaseous		
Natural Gas	27,780 SCF	787 cu meter
City Gas	27,780 SCF	787 cu meter
Solid		
Coal (Bukit Asam - Air Laya)	1.23 ST	1.12 tonne
Coal Briquets	1.23 ST	1.12 tonne
Charcoal	1.08 ST	0.98 tonne
Wood and Agricultural Wastes	2.21 ST	2.00 tonne

GENERAL ENERGY EQUIVALENTS

To Convert:	Multiplication Factors											
From \ To	KCE	TCE	Million TCE	BOE	TOE	Joule	Kilo Joule	Terra Joule	Cal	K Cal	Btu	MM Btu
1. KCE	1	10^{-3}	10^{-9}	4.79×10^{-3}	0.684×10^{-3}	0.029×10^{9}	0.029×10^{6}	0.029×10^{-3}	7×10^{6}	7.0×10^{3}	27.78×10^{3}	27.78×10^{-3}
2. TCE	10^{3}	1	10^{-6}	4.79	0.684	0.029×10^{12}	0.029×10^{9}	0.029	7×10^{9}	7.0×10^{6}	27.78×10^{6}	27.78
3. Million TCE	10^{9}	10^{6}	1	4.79×10^{6}	0.684×10^{6}	0.029×10^{18}	0.029×10^{15}	0.029×10^{6}	7×10^{15}	7.0×10^{12}	27.78×10^{12}	27.78×10^{6}
4. BOE	209	0.21	0.21×10^{-6}	1	0.143	0.61×10^{10}	0.61×10^{7}	0.61×10^{-2}	1.46×10^{9}	1.46×10^{6}	5.8×10^{6}	5.8*
5. TOE	1,461	1.46	1.46×10^{-6}	6.99	1	4.28×10^{10}	4.28×10^{7}	4.28×10^{-2}	10.23×10^{9}	10.23×10^{6}	40.59×10^{6}	40.59**
6. Joule	34.5×10^{-9}	34.5×10^{-12}	34.5×10^{-18}	1.64×10^{-10}	0.23×10^{-10}	1	10^{-3}	10^{-12}	0.239	$.239\times10^{-3}$	9.478×10^{-4}	9.478×10^{-10}
7. Kilo Joule	34.5×10^{-6}	34.5×10^{-9}	34.5×10^{-15}	1.64×10^{-7}	0.23×10^{-7}	10^{3}	1	10^{-9}	0.239×10^{3}	0.239	0.9478	9.478×10^{-7}
8. Terra "	34.5×10^{3}	34.5	34.5×10^{-6}	1.64×10^{2}	0.23×10^{2}	10^{12}	10^{9}	1	0.239×10^{12}	0.239×10^{9}	$9.4.3\times10^{8}$	947.8
9. Cal	0.142×10^{-6}	0.142×10^{-9}	0.142×10^{-15}	0.68×10^{-9}	0.1×10^{-9}	4.18	4.18×10^{-3}	4.18×10^{-12}	1	10^{-3}	3.968×10^{-3}	3.968×10^{-9}
10. K Cal	0.142×10^{-3}	0.142×10^{-6}	0.142×10^{-12}	0.68×10^{-6}	0.1×10^{-6}	4.18×10^{3}	4.18	4.18×10^{-9}	10^{3}	1	3.968	3.968×10^{-6}
11. Btu	0.036×10^{-3}	0.036×10^{-6}	0.036×10^{-12}	0.17×10^{-6}	0.025×10^{-6}	0.105×10^{4}	1.055	0.105×10^{-8}	0.25×10^{3}	0.25	1	10^{-6}
12. MM Btu	36	0.036	0.036×10^{-6}	0.17	0.025	0.105×10^{10}	0.105×10^{7}	0.105×10^{-2}	0.25×10^{9}	0.25×10^{6}	10^{6}	1

* As adopted by the U.S. Bureau of Mines

** Assuming a specific gravity of 6.99 bbl/mt

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Section 1

INTRODUCTION

This section consists of the following subsections:

- o 1.1 Background
- o 1.2 Development and Domestic Transport of Kalimantan Coal
- o 1.3 Study Objectives
- o 1.4 Project Organization
- o 1.5 Acknowledgments
- o 1.6 Organization of the Report
- o 1.7 References

1.1 BACKGROUND

1.1.1 Recent Energy Planning

Badan Pengkajian dan Penerapan Teknologi (BPPT), or the Agency for Assessment and Application of Technology, has, since 1980, been conducting a comprehensive planning program related to the energy sector. The program started with an assessment of the requirements for the capital, manpower, and material resources associated with the future expansion of the entire energy sector, including all subsectors such as oil and natural gas, coal, and biomass (Reference 1-1). Because of the great importance of domestic coal in satisfying future energy needs, BPPT focused its attention on the activities, projects, and programs that should be undertaken by the government to ensure that coal production and use proceeds as planned (Reference 1-2).

As stated in Presidential Decree No. 31 of 1982, the basic responsibilities of BPPT are:

- "To formulate general policies for consideration by the President regarding programs for the assessment and application of technology requisite for national development
- To provide overall and integrated coordination of the execution of programs for the assessment and application of technology
- To provide services to both government and private organizations in the assessment and application of technology for national development
- To conduct activities in technology assessment and application which support government policy on the application of technology for development"

BPPT's investigations revealed the vast range and scope of activities that will have to be initiated. It was clearly recognized that coal transportation will be the critical link in ensuring domestic consumers a secure supply at competitive prices. For this reason, BPPT placed special emphasis on coal transport and, in particular, coal transport from Kalimantan.

The continuation of BPPT's energy program in 1983 was made possible by including it as part of the development of the Puspiptek Energy Research Laboratory (PERL). PERL will be one of the 11 laboratories of the government's National Center for Research, Science and Technology (Puspiptek) located in Serpong near Jakarta. Staffed and managed by BPPT, PERL receives the financial support of the U.S. Agency for International Development (USAID). PERL's general function is to "conduct research, develop, test, demonstrate, and promote cost-effective equipment, processes, and products that make maximum long-term use of Indonesia's energy resources." To make a complete assessment of technologies for coal transport and use, a specific project was funded through the USAID loan for development of PERL and by BPPT. This project has the following components:

- Development of a coal production, use, and transport data base
- Identification of industrial requirements for supporting coal industry development
- Study of coal transport issues, including:
  - Analysis of coal transport from Kalimantan to Java and Sulawesi
  - Analysis of coal transport from South Sumatra to Java
  - Analysis of transport and use of coal on Java

1.1.2 Current Study

The current report addresses the analysis of coal transport from Kalimantan to Java and Sulawesi, and as such is only part of the complete project documentation. These five additional reports were prepared in Bahasa, Indonesia by the BPPT energy planning team with Bechtel's assistance.

- Trihono, Data - Pokok Batubara, BPP Teknologi, 31 Agustus, 1984, Jakarta
- Malik, Cecilia L., Penggunaan dan Pengangkutan Batubara Kalimantan, BPP Teknologi, 31 Agustus, 1984, Jakarta

- Boedoyo, M. S., Pengangkutan dan Pemakaian Batubara Untuk Industri Kecil dan Rumahtangga, BPP Teknologi, 31 Agustus, 1984, Jakarta

- Nurdyastuti, I., Prihiastoto, D., Pengangkutan Batubara di Sumatera Selatan, BPP Teknologi, 31 Agustus, 1984, Jakarta

- Suharyono, H., Masalah Industri Penunjang Dalam Pengembangan Batubara, BPP Teknologi, 31 Agustus, 1984, Jakarta

1.1.3 USAID Support and Funding

The project was started in September 1983 as a joint effort by the BPPT energy planning team (see Subsection 1.4) and Bechtel National, Inc. of San Francisco. To provide technology transfer to BPPT and work with the energy planning team on a daily basis, Bechtel's project manager was stationed in Jakarta at the BPPT offices.

Under the contract between USAID and Bechtel National, Inc., DAN 5724-C-00-1085-00, "Technical Assistance in Conventional Energy," funds were made available for a portion of this study. The costs associated with residence in Jakarta were provided by BPPT.

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1.2 DEVELOPMENT AND DOMESTIC TRANSPORT OF KALIMANTAN COAL

Since the increase in the price of crude oil in the middle and late seventies, coal has become a very important domestic energy source and the development of the country's extensive coal resources has been established as a major national policy. Increased use of coal is one of the key elements of the government's energy diversification program. Coal is to be used to generate electricity and as fuel in the cement industry. It is also under consideration, in briquet form, as a substitute for kerosene and wood for rural household cooking, and as a source of synthetic gas to augment natural gas supplies.

Coal is found throughout most of the country, with major deposits located mainly on the islands of Sumatra and Kalimantan. On Sumatra, coal is developed by the two state coal companies: PN Tambang Batubara in west Sumatra, and P.T. Bukit Asam in south Sumatra. To start coal development in Kalimantan, the government invited foreign investors to participate in the developmental process. The terms of participation are stated in Reference 1-3:

> Aware of its limited funds availability, the constraints faced by the state coal companies to fully expand their production potentials, which at current estimates will not exceed 5 to 6 million tonnes/year by 1990, and the huge demand required by newly built coal-fired power and new cement plants, during the second half of the eighties, the government had to resort to unconventional ways - the so-called special cooperation on coal - to embark on coal development programs, particularly in east and south Kalimantan. This opened the way for foreign investors, with due respect of Article 33 of the 1945 Constitution, to carry out survey work, exploration, and eventual development of coal mines as contractors to PN Tambang Batubara. Contractors bear all the risk of the investment and the state, once the mines start production, will enjoy a 13.5 percent share of the mine's annual coal output.

With the exception of four private companies operating relatively small concessions along the Mahakam River, coal production in east and south Kalimantan has not started yet. However, as of mid-1984, seven contractors to PN Tambang Batubara were in various stages of

exploration. Some companies were close to initiating production, pending completion of sales contracts for the coal to be produced. The government has projected that these seven producers, possibly augmented by additional companies in unexplored areas, will provide the majority of domestic coal production. PN Tambang Batubara projects that by 1994 Kalimantan producers will supply 17 million tonnes or 67 percent of total domestic production (Reference 1-3). The majority of this production is destined for consumers on Java, including power plants, cement plants, and other potential users.

Currently, most attention is focused on development of Kalimantan coal (resource assessment, exploration, preliminary mine feasibility studies, etc.). The government has also projected which power and cement plants may become users of Kalimantan coal. Little attention has been given to the transport system needed to transport coal from Kalimantan to consumers on Java and Sulawesi. Such a system, which would be similar in scope to Pertamina's domestic transport and distribution system for refined products, is a critical link between producers and consumers. Development of the system must take into account all system elements, including:

- Locations and characteristics of loading ports in Kalimantan
- Locations and characteristics of unloading ports on Java
- Type and size of vessels used
- Land transport options on Java

Figure 1.2-1 illustrates the typical elements of the domestic coal transport system and indicates key parameters and basic options in developing the system.

So far, the issue of coal transport has been addressed primarily by the various contractors in their own preliminary investigations, and has focused on providing coal to loading ports in Kalimantan close to their concessions. Consideration of the entire coal chain between producers

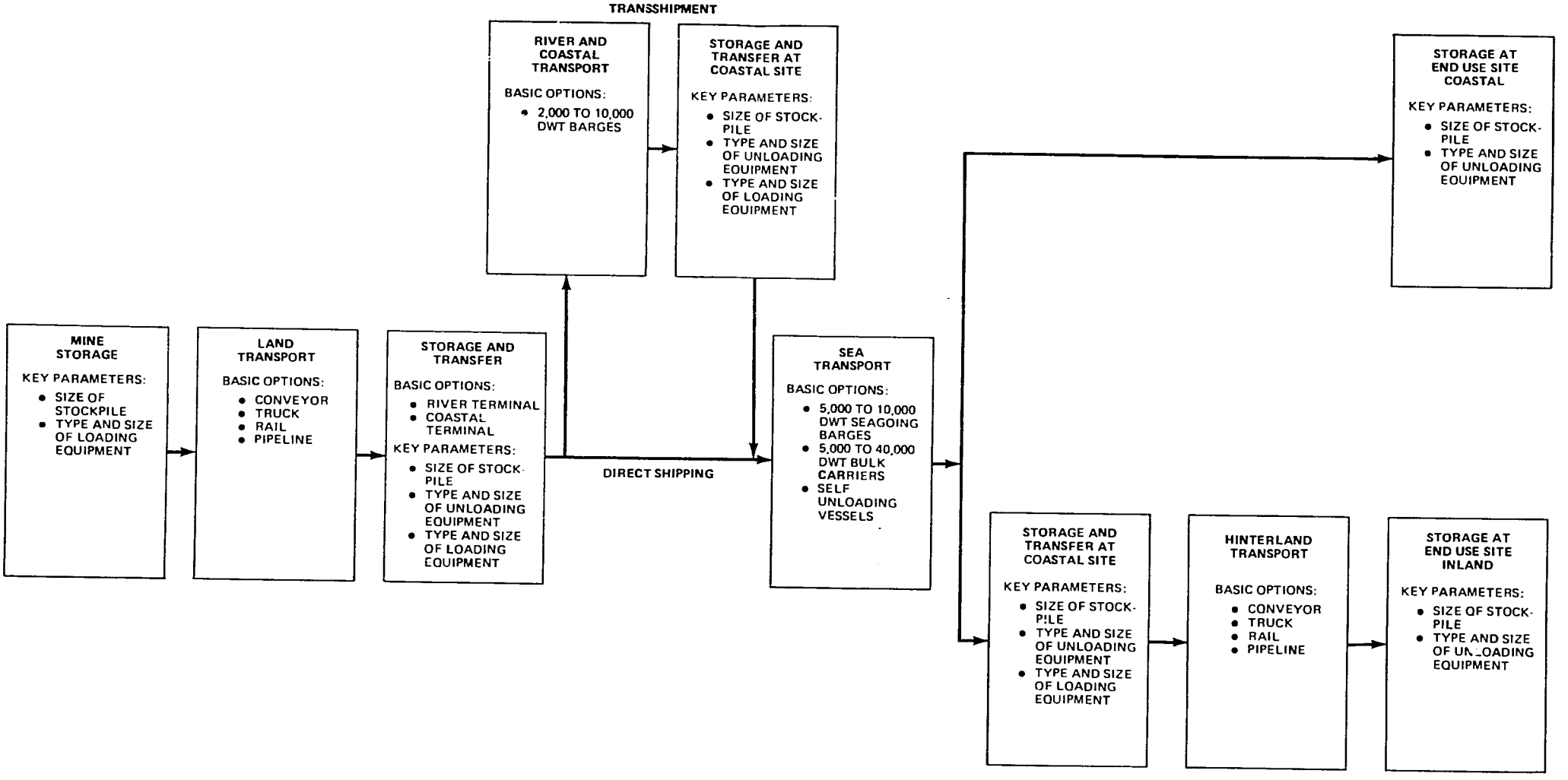

Figure 1.2-1 TYPICAL SYSTEM ELEMENTS OF THE DOMESTIC COAL TRANSPORT SYSTEM

and domestic consumers, however, is critical to being able to guarantee consumers the security of Kalimantan coal supply at a cost that is at least competitive, and preferably cheaper, than other supply sources (including imports). Since transport and handling costs could be as high as 40 percent of the price of coal delivered to an inland consumer on Java, every possible savings in the transport and handling of the coal is vital to promoting the domestic development and use of Kalimantan coal.

Coal transport generally uses proven technologies. Complexities in coal transport come primarily from the interdependence of various links or system elements within a coal chain. Improper design or operation of any link in the chain (e.g., inappropriate vessels, inadequate ports, etc.), affects the operation and cost of the entire chain. Whereas coal transport is normally a complex logistical operation, Indonesian conditions increase this complexity (see Reference 1-4):

- Inter-island transport
- Topography
- Coastal conditions
- Lack of infrastructure

In addition to these physical complexities, additional development issues will play an important role in the transport of Kalimantan coal to Java:

- Divided Responsibilities. Responsibility for successfully implementing a coal supply chain will be shared by a variety of institutions. Private coal producers on Kalimantan will be responsible for transport from the mine to loading in a vessel. Approval of loading ports, vessels, routes and licenses, unloading ports, etc., falls within the jurisdiction of the Directorate General of Sea Communications. Transport on Java falls within the jurisdiction of the Directorate General of Land Communications. Rail transport on Java will depend on the capabilities of the National Railroad Company (PJKA). Sea transport will depend on the capabilities of either special state-run companies such as P.T. Angkutan Pertambangan (PTAP) or state-owned shipping companies such as P.T. Bahtera Adiguna.

- Existing Policies and Directives. Implementation of a particular coal transport system must take into account existing policies and directives governing the transport of bulk materials. For example, to supply the cement plants at Narogong and Citeurup, the Ministry of Communications has identified Cigading in west Java as the unloading port, followed by about 200 km of rail and truck transport to the cement plants. This plan raises two questions:

  - Will it be feasible to transport 1 to 2 million tonnes per year in 25 to 30 tonne containers over the existing railroad to Bekasi, and by truck from Bekasi to the central plants?

  - Is this the lowest cost system for both the government and private industry?

- Availability of Capital. To implement a coal transport system, where previously there was none, requires new facilities for loading and unloading, new vessels, new handling equipment, etc. All of these facilities would need to compete for scarce resources if the government were to provide them. Private industry may be reluctant to invest in transport facilities, desiring instead that coal be delivered at their plants. Financing arrangements thus becomes a critical issue.

The development of any domestic supply system will have to deal with these complexities. However, to aid in the development of such a system, a simplified perspective has been taken in this report. The following question displays the perspective which has given direction to this effort: If one entity (private or public) were to have the responsibility for transporting coal from various producers in Kalimantan to various consumers on Java and Sulawesi, what types of transport systems would best be employed? Admittedly this question does not coincide with reality of multiple transport entities. Nonetheless, the systems envisioned from this perspective could provide the point of departure for the development of the actual domestic transport system, since it takes into account the interests of everybody involved in the coal transport chain, including private companies and government entities. The study objectives formulated in the next subsection have been defined from this perspective.

1.3 STUDY OBJECTIVES

The overall objective of the current study is to analyze alternative generic shipping and coal handling technologies for transport of Kalimantan coal to Java and identify the steps needed for the development of a technically and economically feasible domestic transport system. To meet this objective, the work plan for this study identified these major tasks:

- Postulate major coal flows between Kalimantan and Java expected between 1983 and 1994, working in conjunction with PN Tambang Batubara and private coal companies operating in Kalimantan. The objective is to approximate as closely as currently possible coal transport requirements and provide the basis for a comparison of generic alternative shipping systems.

- Formulate alternative systems for transporting coal from Kalimantan to Java. Identify the range of systems and technologies that may have to be considered for coal handling (e.g., loading and unloading), shipping (e.g., type and number of vessels), and related infrastructure (e.g., ports).

- Evaluate and analyze transport alternatives and identify implementation requirements with respect to domestic manufacturing of transport components (e.g., handling equipment, barges, etc.)

- Based on the results of the above task, identify steps and actions to be taken by agencies of the Government of Indonesia (GOI) to formulate and design an economically and technically feasible transport system. Where appropriate, develop Terms of Reference for additional studies.

Figure 1.3-1 graphically displays the approach taken toward the tasks listed above. In most cases, it is premature to conduct detailed evaluations of individual transportation options, and such evaluations are outside the scope of this report. At the same time, it is recognized that a realistic assessment of transportation requirements requires more than an examination of overall supply and demand. The detailed physical characteristics of Kalimantan coal areas and the points of use in Java introduce unique limitations and opportunities for coal transportation. Figure 1.3-1 reflects this view.

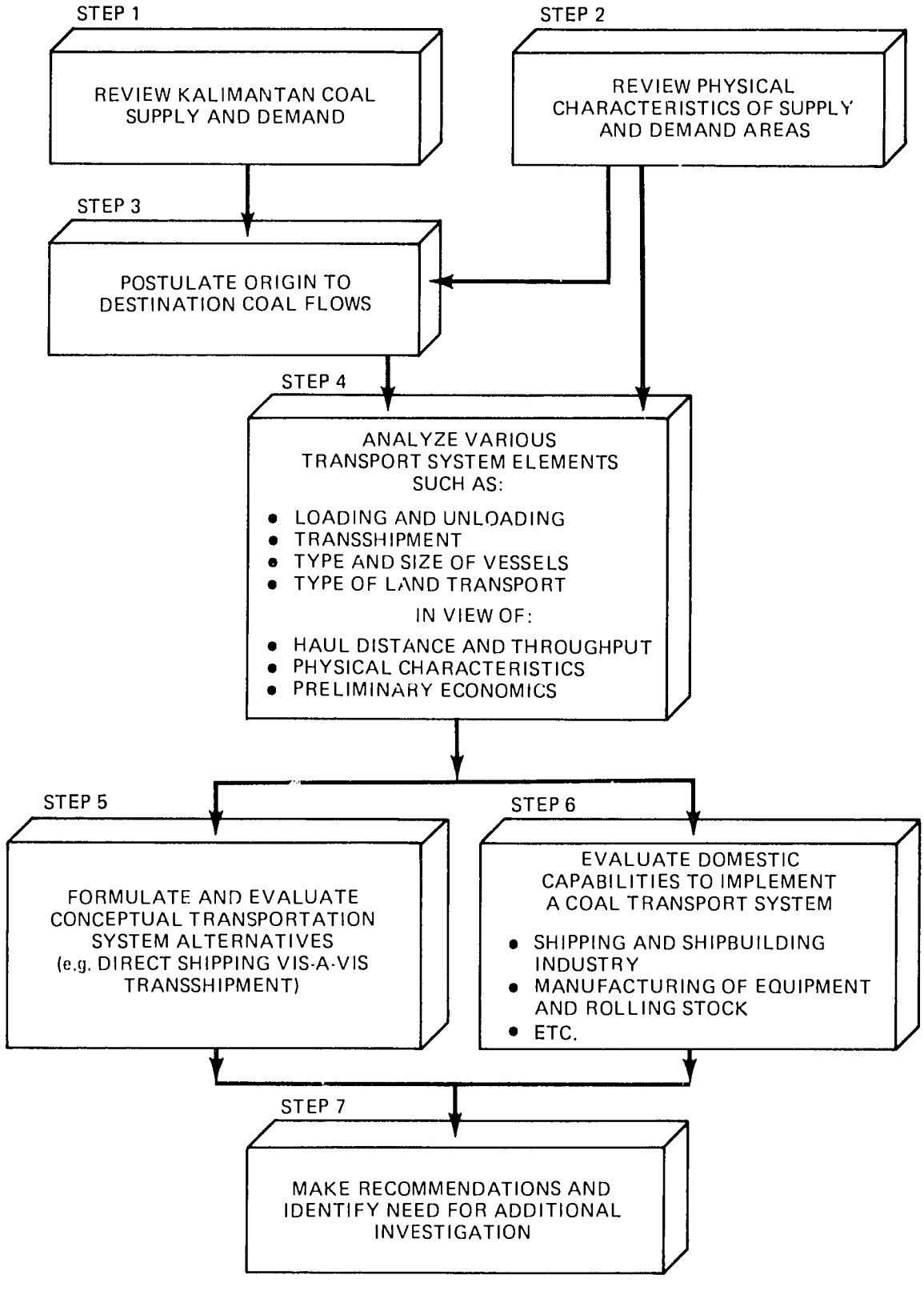

Figure 1.3-1 KALIMANTAN COAL TRANSPORTATION STUDY APPROACH

First, the Kalimantan coal supply and demand situation was reviewed for the coming 10 years (1985-1994) (Step 1). Stated government coal production goals and a review of both current exploration programs and government plans for expansion in the power and cement industry were assessed. In parallel with these efforts, the actual physical characteristics of supply and demand areas were reviewed (Step 2). Information available from various government sources was supplemented by site visits to coal areas in Kalimantan, and potential coal unloading ports in Java such as Cigading and Gresik.

The overall supply and demand picture was then translated into actual requirements for the movement of coal (Step 3). The postulated allocations of coal from particular supply areas to consumers are intended to represent a reasonable pattern of development on which to base a transportation system.

The formulation of alternative transport systems consisted of three steps (Steps 4, 5, and 6). First, various system elements were analyzed in an attempt to focus on the type of options that are most likely to be part of a domestic transport system (Step 4). For example, the type and size of vessel to be used in a domestic (inter-island) coal transport system was determined in large part by distance and throughput of the routes considered. Based on these results, the entire system was developed and basic directions that may be adopted were analyzed, such as direct shipping between producers and consumers or transshipment in Kalimantan prior to shipment to consumers. Finally, the systems resulting from this step were analyzed in view of the country's capability to implement any given system (Step 6).

At this point, it was recognized that the actual transport system most likely will be a mixture of what is theoretically desirable (Step 5) and what is practically possible (Step 6). For example, although currently available 6,500 deadweight tonne (DWT) log carriers were not designed to haul coal, they may provide an acceptable interim solution for transporting Kalimantan coal.

Finally, and without intending to be apologetic, this report has been prepared in a planning environment characterized by constant changes in the planned timing and quantity of future coal uses, resulting from delays in power plant startups, changing coal supply source preferences by private companies because of prevailing prices, etc. Since change of this sort is inevitable, few reports can be regarded as definitive statements of future action. The function of this report, therefore, is simply to narrow the scope of issues to be addressed in developing the system and to specifically identify the next steps to be taken by the government (Step 7) as they relate, for example, to required feasibility studies. In this regard, the current study is a planning study, as contrasted to a feasibility study of a particular technical system.

1.4 PROJECT ORGANIZATION

This study was carried out by BPPT, using the services of Bechtel International, Inc. as consultants on coal, energy and transport technology, and technology transfer. The following individuals are active participants in BPPT's energy program:

Project Leader:	Ir. Wardiman Djojonegoro
Scientific Advisor:	Ir. Nengah Sudja
Energy Planning Team for BPPT:	Ir. Cecilya Malik Ir. Fathor Rahman Ir. Hari Suharyono Dra. Ina Miryanti Ir. Sidik Budoyo Ir. Trihono Ir. Mohammad Rasyid Ir. Endang Suarna Dra. Sri Susanti Ir. Bambang Suwondo Dra. Netty Sigit Ir. Joko Prihiastoto Ir. M. Muchlis Ir. A. Yusak Lubis

The Bechtel International, Inc. planning team was made up of:

Project Manager	Dirk P. Lijesen	Jakarta
Manager of Projects	James F. Houle	San Francisco
Project Engineer	Floyd E. Davis	San Francisco
Transportation Specialist	Peter Van Gorp	San Francisco
Transportation Specialist	James A. Slater	San Francisco
Operations Research Specialist	Bizhan Binesh	San Francisco
Economist	Frank B. Lucarelli	San Francisco
Project Administrator	Nuala Murphy	San Francisco
Technical Editor	Patrick W. Ellis	San Francisco

1.5 ACKNOWLEDGMENTS

The broad assessment carried out in this study is based on review of a great number of studies, papers, reports, and statistical data, as well as site visits and many interviews with government officials and private company representatives. Specifically, we wish to acknowledge our gratitude to the following companies and government organizations for their help:

- Directorate General for Mining and Directorate for Coal
- Directorate General for Land Communications
- Directorate General for Sea Communications
- PN Tambang Batubara
- National Electricity Company, PLN
- National Railway Company, PJKA
- P.T. Arutmin
- P.T. Utah
- Consol
- P.T. Kaltim Prima
- P.T. Kideco
- P.T. Berau
- P.T. Bukit Baiduri Enterprise
- P.T. PAL
- P.T. Boma Stork
- P.T. INKA
- P.T. Barata
- P.T. Natra Raya
- P.T. Krakatau Steel
- INDOCEMENT
- P.T. Johs Larsen & Co.

1.6 ORGANIZATION OF THE REPORT

This report is organized to accommodate two types of readers. Those wishing a brief summary should refer to Section 2, which presents an executive summary of the entire study; and those wishing a more detailed review should refer to the rest of the report. Sections 3 through 7 contain the following detailed information:

- Section 3. A review of coal development efforts conducted by private contractors in Kalimantan up to mid-1984, focusing on planning issues to be resolved based on findings to date and postulating a preliminary coal production schedule

- Section 4. An assessment of the potential use of Kalimantan coal by domestic consumers, including official government projections

- Section 5. A discussion of sea transport of Kalimantan coal to domestic consumers, including the advantages and disadvantages of two systems: a direct shipping system, and a system involving transshipment at Kalimantan

- Section 6. A general evaluation of land transport technologies, land transport options in Kalimantan and Java, with an emphasis on Java, since land transport in Kalimantan is the responsibility of the various contractors

- Section 7. An evaluation of the capabilities of local industries to participate in the development of a domestic transport system, including conclusions and recommendations regarding the actual system that may emerge in the future

Finally, and similar to other BPPT reports related to energy, this report provides a system-wide comprehensive assessment and survey of many issues related to Kalimantan coal transport. As such, this report is not aligned with the perspective of any one particular entity involved in implementing a specific transport system. It is hoped that the report's broad discussion of issues, problems, conclusions, and recommendations will facilitate further cooperation among these various entities, which is considered the real benefit of BPPT's efforts.

1.7 REFERENCES

1-1 Alternative Strategies for Energy Supply in Indonesia 1979-2003, Analysis of Impacts upon Capital, Manpower and Material Resources, BPPT in association with Bechtel National, Inc., December 1980.

1-2 Energy Development and Transport in Indonesia, Assessment of Requirements for Coal Industry Development: 1982 - 2003, BPPT in association with Bechtel Group, Inc., June 1982.

1-3 Prijono, Ir. A., Long Range Development Plan of Indonesia to Meet Projected Demands, P.N. Tambang Batubara, Paper presented at the Coal/Lignite Development Symposium, Jakarta, October 18-22, 1983.

1-4 Djojonegoro, Ir. Wardiman, Technical Issues in Coal Transportation, BPPT, Paper presented at the Coal/Lignite Development Symposium, Jakarta, October 18-22, 1983.

Section 2

EXECUTIVE SUMMARY

This section consists of the following subsections:

- o 2.1 Introduction
- o 2.2 Development and Use of Kalimantan Coal
- o 2.3 Sea Transport
- o 2.4 Land Transport
- o 2.5 Institutions: Conclusions and Recommendations
- o 2.6 Action Plan

2.1 INTRODUCTION

2.1 INTRODUCTION

Without the rapid development of domestic coal, Indonesian energy demands will absorb practically all available refined products during the next decade. Coal could substitute for refined products and natural gas, thus reducing the rate of growth of domestic consumption of these fuels. As a result more crude oil and natural gas would be available for export which, in turn, means that more foreign exchange would be available to finance future development of the country. The government's Repelita IV plan (1984/85 - 1988/89) projects that the percentage of refined products and natural gas in domestic consumption of commercial energy will decrease from 94.1 to 81.3 percent over the duration of the plan. Coal use will increase from 0.5 to 9.7 percent over the same period, particularly as fuel for existing cement plants, and for future power and cement plants. Geothermal energy and hydropower will make up the balance.

2.1.1 Study Basis

Kalimantan is expected to provide the majority of coal needs. PN Tambang Batubara projects that by 1994 Kalimantan will produce 17 million tonnes per year (MMTPY) of coal, or 67 percent of total domestic coal production. To bring this coal to market will require systems for both sea transport and land transport of coal. It is the exclusive aim of this report to address the requirements associated with sea and land transport of Kalimantan coal. Thus the type of questions addressed are:

- What type and size of coal transport vessels are to be used?
- What order of magnitude sea transport costs can be expected?
- Are there existing vessels in the country that can transport coal, or should new vessels be constructed?
- If vessels are to be constructed, can they be fabricated in domestic shipyards?
- What land transport modes (e.g., truck, conveyor, rail, or slurry pipeline) are most suitable in Kalimantan, Java, and Sulawesi?

- How many trucks and/or railroad cars will be needed for future coal transport?

- Are the existing land transport systems adequate or will it be necessary to upgrade them, or construct new ones?

- What studies will the government have to undertake to ensure smooth, efficient and, most importantly, least cost transport of coal?

Major premises for the current study are:

- Schedules for coal production and projections for future use of Kalimantan coal are for the most part the same as formulated in 1984 by PN Tambang Batubara and the PTE (Sections 3 and 4 review these schedules).

- As a result of the above, no consideration was given to an analysis of coal versus other fuels, such as natural gas.

- Only sea and land transport of Kalimantan coal to domestic consumers are considered. Neither the likelihood nor the requirements associated with export of Kalimantan coal are addressed.

- The system's analysis of Kalimantan coal transport provided is intended to serve as a model. If, for example, changes in projections occur (which undoubtedly will be the case), the study can be updated to reflect such changes.

2.1.2 Conclusions

- Kalimantan coal of good quality is available in sufficient quantity to have a significant impact upon Indonesia's energy needs during the next decade

- Without rapid development of coal for power generation and cement plant use, continued increasing consumption of refined products could practically eliminate oil as an export commodity during the next 10 years

- We project 12 million tons per year of Kalimantan coal consumption in 1994 - equivalent to roughly 160,000 barrels per day of fuel oil, or 10 percent of total Indonesian oil production

- Costs of sea transport from Kalimantan to Java will not be competitive with Australian coal transport costs unless an efficient shipping system is designed and operated

- Small bulk carriers (20,000 to 40,000 DWT) are preferred over barges for inter-island transport of coal, although 10,000 DWT barges could be useful at low throughputs

- Transshipment terminals on Kalimantan will become economically attractive in the 1990s when coal volume becomes sufficient to justify the capital investment

- Log carriers (6,500 DWT) could be converted to coal colliers at low cost for use during the early years of Kalimantan production

- Domestic shipyards should have the capability to fabricate bulk carriers up to 30,000 DWT by 1990

- Studies need to be undertaken now to verify the feasibility of converting log carriers to coal transport

- Dredging studies are necessary on a number of harbors before a selection of ship size and type can be made

- Coal should not be barged to west Java (Cigading) or south Java (Cilacap) since costs will be far in excess of international bulk carrier rates

- Land transport of coal on Kalimantan will likely be by truck since rail or slurry pipelines are economically unfeasible. Conveyors should be considered in several locations

- On Java, trucking coal to island cement plants is not a viable long term solution and slurry pipelines cannot be justified for the relatively low throughputs involved. Thus, rail system expansion and upgrading appears to be the most attractive option

- Current plans to combine rail and truck transport for cement plants south of Jakarta should be re-evaluated in view of the high capital and operating costs expected. Alternative ports and a new dedicated rail line could prove more attractive over the long term

- The demand for trucks and rail cars can be met by existing Indonesian industry

- The West Java Coal Transportation study sponsored by the U.S. Trade Development Program will be of value in ensuring that an efficient and dependable land transport system is established. Unless such a system is in place during the 1980s, we cannot expect a major shift from fuel oil to coal use

2.1.3 Action Plan

An action plan is proposed (see Subsection 2.6) which integrates the efforts of the more than 20 ministries, government agencies, and state and privately held companies. A inter-ministerial committee is recommended to ensure high priority be given to this project and to maintain the level of coordination necessary to its implementation.

2.2 DEVELOPMENT AND USE OF KALIMANTAN COAL

2.2 DEVELOPMENT AND USE OF KALIMANTAN COAL

2.2.1 Resources and Limitations

Conservatively estimated, total Kalimantan coal deposits suitable for surface mining in all contractor areas could be on the order of 1 billion tonnes. By and large this coal is of a good quality for power and cement production. At a recovery rate of 50%, this resource base alone could support an annual production level of about 17 MMTPY. Figure 2.2-1 shows the various areas in Kalimantan which were under development as of mid-1984 by seven private coal companies under contract to PN Tambang Batubara. Names of the most promising deposits are indicated. Whether this production level is achievable or will be surpassed will depend on the outcome of continued exploration efforts and continuing investment decisions by the various contractors. All current indications point to a number of relatively small (about 2 MMTPY) mines scattered along the coast of south and east Kalimantan, with a 4 to 5 MMTPY operation on the Senakin Peninsula being the exception rather than the rule. Most mines will be located in close proximity (less then 50 km) to tidal waters (a river, a bay, or the sea).

As most exploration areas are in sparsely populated and remote regions, mine development will require construction of all infrastructure, (housing, camps, utilities, etc). Limited production levels, proximity to loading points, and limited conflicts in land uses indicate that, in general, provision of infrastructure will not pose a serious development constraint. The mine development plans prepared by the various contractors will have to include provisions for this needed infrastructure.

Practically all Kalimantan coal will have to be "exported" out of Kalimantan, since there will be very limited use of coal on the island itself. Resolution of how coal will be transported out of Kalimantan is the most important development issue. Table 2.2-1 summarizes transport characteristics for future mining areas in Kalimantan. For six out of

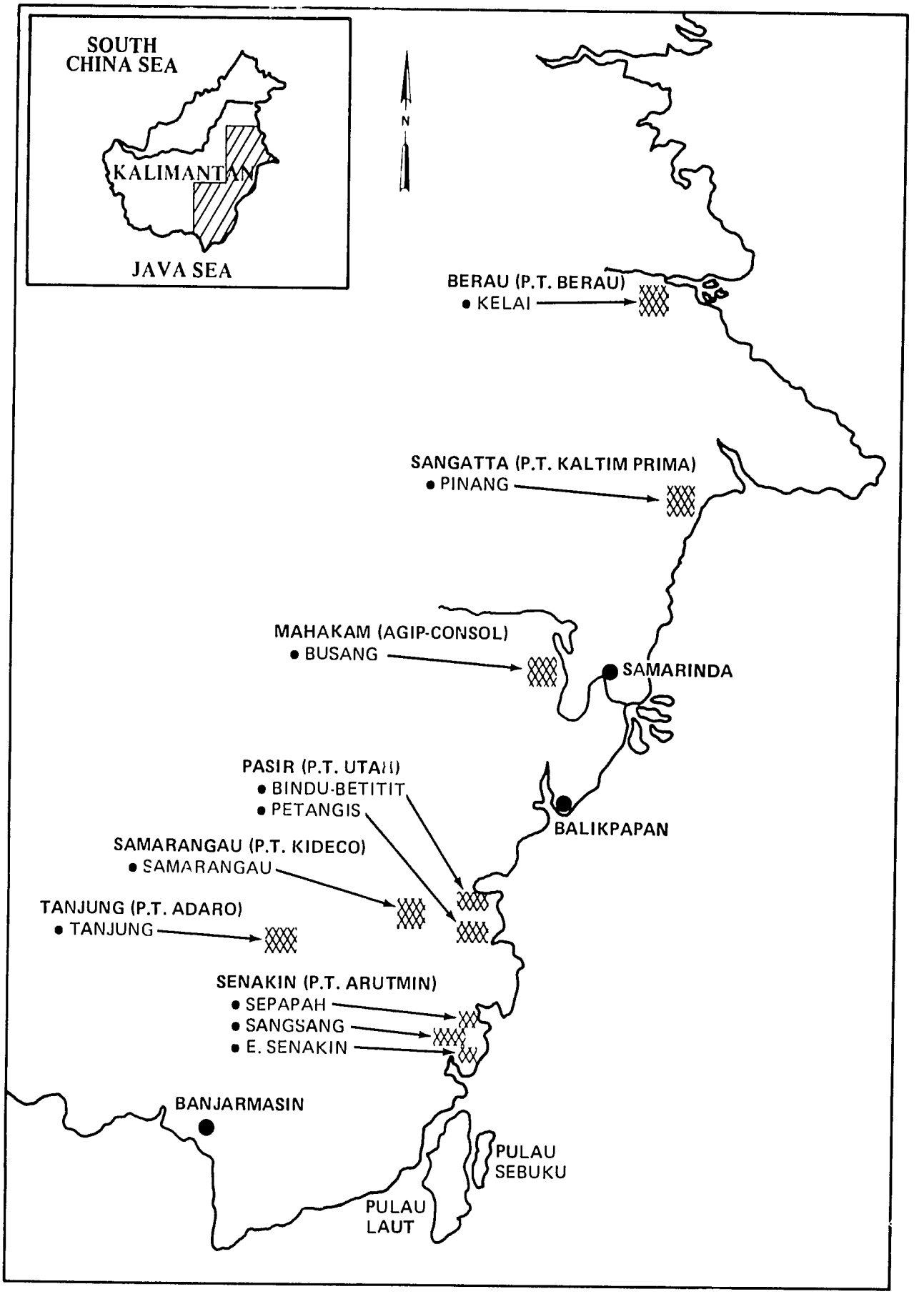

Figure 2.2-1 COAL DEVELOPMENT AREAS AND PROMISING DEPOSITS IN KALIMANTAN

Table 2.2-1

SUMMARY OF TRANSPORT CHARACTERISTICS FOR FUTURE MINING AREAS IN KALIMANTAN

Item	Area									
	Senakin			Pasir		Samarangau	Mahakam	Sangatta	Berau	Tanjung
Contractor	P.T. Arutmin			P.T. Utah		P.T. Kideco	Consol	P.T. Kaltim Prima	P.T. Berau	P.T. Adaro
Deposit	Sangsang	Sepapah	East Senakin	Bindu-Betitit	Petangis	Samarangau	Busang	W. Pinang	Kelai	Tanjung
River transport	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Likely
River	-	-	-	Apar	Kuaro	Kuaro	Mahakam	-	Segah and Berau	Negara and Barito
Coastal water/bay	Teluk Klumpang	Teluk Klumpang	Teluk Klumpang	Teluk Apar	Teluk Adang	Teluk Adang	Mahakam Delta	Makassar Straits	Berau Delta	-
Limiting draft without major dredging (meters)	8	8	8	6	6.5	6.5	7	13	4 - 5 (Berau) 8 (Delta)	?
Possible loading point	Tanjung Batu	Tanjung Batu	Tanjung Batu	Linding (near)	Tanah Merah (near)	Tanah Merah (near)	Tenggarong Bunglaun (near)	Tanjung	Lebanan/ Lunsurannaga	?
Approximate land distance loading point (km)	25	30	30	14	15	45	10	20	31 to Lebanan	If Banjarmasin: 200 If Balikpapan: 220
Approximate loading port distance to open water/sea (nautical miles)	5 - 10	5 - 10	5 - 10	24	32	32	66	-	44 from Lebanan to Lunsurannaga	150+
Approximate river transport distance (nautical miles)	-	-	-	16	7	7	66	-	44	150+
Approximate bay/coastal transport distance (nautical miles)	5 - 10	5 - 10	5 - 10	8	25	25	-	-	-	-

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ten future mining sites the loading point will be on a river. Limiting drafts, navigational considerations, physical obstructions (such as the new bridge over the Mahakam, limiting vessel height to 12 meters) present a serious constraint to the type and size of vessel that can carry coal out of Kalimantan. This in turn seriously affects the viability of Kalimantan coal development.

2.2.2 Projected Production and Consumption

Figure 2.2-2 shows schedules for both total production and total consumption of Kalimantan coal, indicating when various areas in Kalimantan are expected to start production. Since total domestic demand will be less then total production, there will be coal available for export; some several hundred thousand tonnes in 1985, increasing to almost 5 MMTPY by 1994.

Kalimantan coal is projected to be used domestically by PLN (beginning in the late 1980s when the first unit at Paiton starts operation), by two state owned cement plants at Gresik in east Java and Tonasa on Sulawesi, and by privately owned cement plants (four in 1985 increasing to ten by 1994). Total Kalimantan coal demand for power production will start in 1988 at 690,000 tonnes and will increase to 6.51 MMTPY by 1994. State owned cement plants are projected to start consumption in 1986 at 260,000, increasing to 1 MMTPY by 1994. Finally, privately owned cement plants, accounting for the majority of Kalimantan coal demand for cement production, will consume 200,000 tonnes in 1985, increasing to 4.55 MMTPY by 1999. Total Kalimantan coal demand will increase from 200,000 tonnes in 1985 to 12.06 MMTPY by 1994.

2.2.3 Market and Transport Development

Figure 2.2-2 divides development of the market for Kalimantan coal into three phases. During startup (Phase I -- until 1988), coal will be used by the cement industry in relatively small amounts. From 1988 until 1991 (Phase II), startup of major coal-fired power plants will entail rather large sales contracts, adding to the certainty of Kalimantan coal development. After 1991 (Phase III), a stable market will emerge.

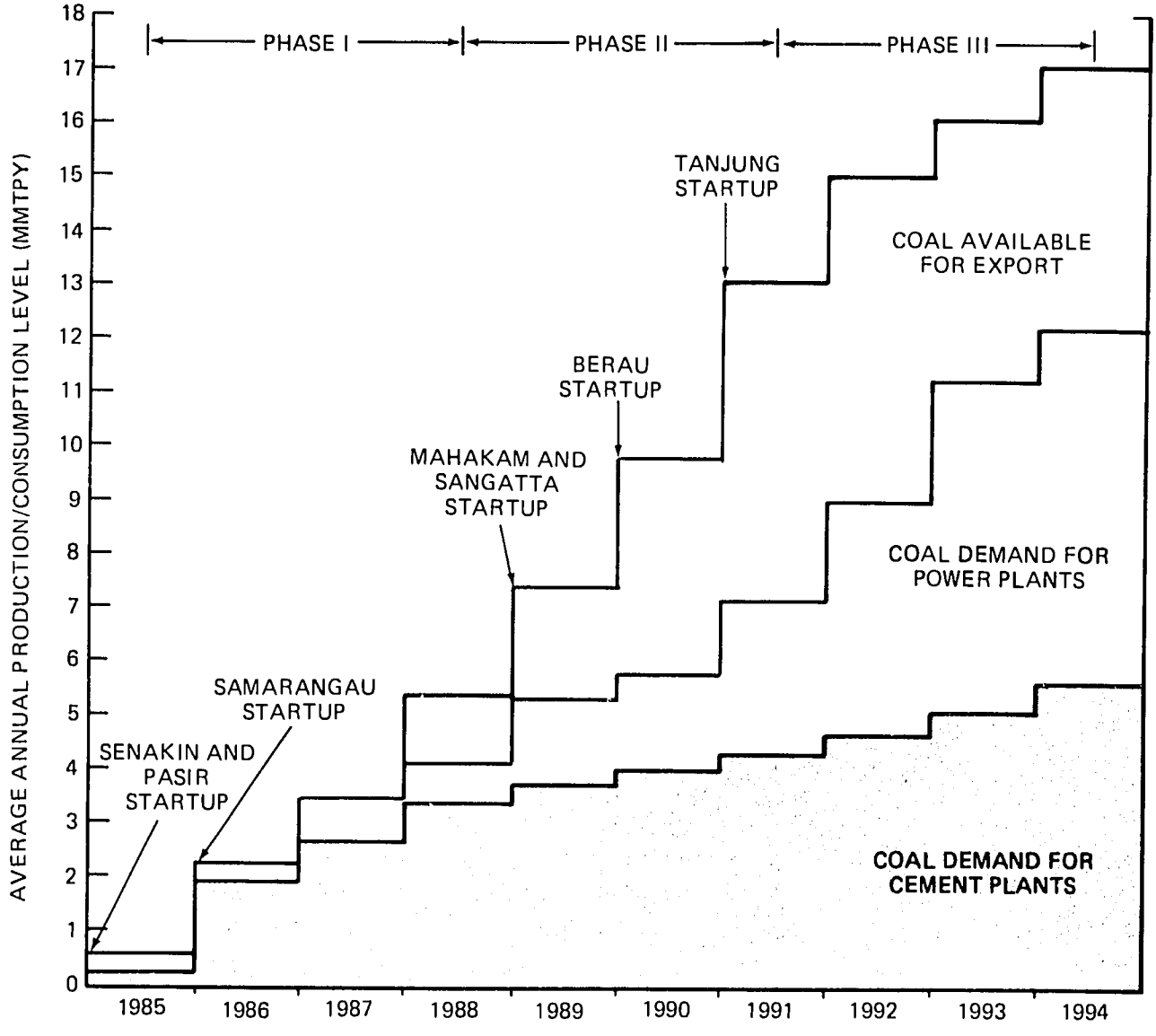

Figure 2.2-2 PRODUCTION AND DEMAND SCHEDULES FOR KALIMANTAN COAL

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Development of both the sea transport and land transport systems is expected to exhibit a similar phased development, reflecting basic uncertainties in the emerging market. Thus, during Phase I, when uncertainties are greatest, emphasis will be on initiating coal transport at the lowest possible cost and with minimal capital investments, until larger capital outlays can be justified by existing sales contracts (in Phases II and III).

To analyze sea transport and land transport requirements for this report, reasonable allocation rules were applied to determine which potential consumers of Kalimantan coal were to be supplied by specific areas in Kalimantan. The supply strategy used in this study for 1988 and 1994 is shown in Table 2.2-2. Table 2.2-3 identifies the designated unloading ports on Java and Sulawesi to serve the customers listed in Table 2.2-2.

Table 2.2-2

KALIMANTAN COAL SUPPLY STRATEGY FOR 1988 AND 1994
(MMTPY)

User	Coal Demand		Coal Supply Source													
			Tanjung Area		Senakin Area		Pasir Area		Samarangau Area		Mahakam Area		Sangatta Area		Berau Area	
	1984	1994	1988	1994	1988	1994	1988	1994	1988	1994	1988	1994	1988	1994	1988	1994
Cement plants																
Java	3.17	4.85	-	-	-	-	1.67	1.95	1.50	1.93	-	-	-	0.97	-	-
Sulawesi	0.19	0.70	-	-	-	-	-	-	0.19	-	-	-	-	0.36	-	0.34
TOTAL	3.36	5.55	-	-	-	-	1.67	1.95	1.50	1.93	-	-	-	1.33	-	0.34
Power plants																
Java	0.69	5.93	-	-	0.69	4.56	-	-	-	-	-	1.37	-	-	-	-
Kalimantan	-	0.58	-	0.14	-	-	-	-	-	-	-	0.44	-	-	-	-
TOTAL	0.69	7.09	-	0.14	0.69	4.56	-	-	-	-	-	1.81	-	-	-	-
TOTAL USE	4.05	12.06	-	0.14	0.69	4.56	1.67	1.95	1.69	1.93	-	1.81	-	1.33	-	0.34
Estimated production	5.37	17.00	-	1.50	2.00	5.50	1.67	2.00	1.70	2.00	-	2.00	-	2.00	-	2.00
Surplus production	1.32	4.94	-	1.36	1.31	0.94	-	0.05	0.01	0.07	-	0.19	-	0.67	-	1.66

Refer to Table 5.3-1 for further details on coal production allocations

Table 2.2-3

COAL UNLOADING PORTS ON JAVA AND SULAWESI

Region	Unloading Ports	Existing and Future Customers to be Served
West Java	Cigading	P.T. Semen Cibinong, Narogong Indocement, Citeurup P.T. Tridaya M. Perkasa, Palimanan
South-central Java	Cilacap	P.T. Perkasa S. Karya, Cilacap P.T. Semen Nusantara, Karang Talun P.T. Semen Gombong, Gombong New power plant, near Cilacap
North-central Java	Semarang	P.T. Semen Sugih Harapan, Tanggung P.T. Semen Purwodadi, Purwodadi
East Java	Gresik Madura Cement Harbor Paiton	P.T. Semen Gresik, Gresik P.T. Perkasa K. Hasta, Karang Pandan New power plant, Paiton
Sulawesi	Biringkassi Bitung	P.T. Semen Tonasa, Tonasa P.T. Semen Menado, Menado

2.3 SEA TRANSPORT

2.3 SEA TRANSPORT

The sea transport problem addressed in this report consists of determining how the amount of coal shown in Table 2.2-2 can be transported from loading ports in Kalimantan to unloading ports on Java and Sulawesi (see Figure 2.3-1).

2.3.1 Conclusions

Importance of Kalimantan Coal Transport. In 1983, total inter-island cargo carried by ships amounted to about 30 million tonnes, half of which consisted of crude oil and refined products. Coal flows from Kalimantan alone will reach 4.05 MMTPY in 1988, increasing to 11.48 MMTPY by 1994. Thus, Kalimantan coal will add a very significant volume to the inter-island cargo flows, most likely becoming the second commodity in terms of volume.

Competitive Advantage of Kalimantan Coal. Coal from Australia can be shipped to deep draft ports on Java for as low as approximately US$8 per tonne. Although it is possible to transport Kalimantan coal for less than that, the competitive advantage is relatively small. As a result, a premium is placed on planning a low cost, efficient system.

Loading and Unloading Facilities. In inter-island shipping with low throughputs on individual routes and relatively small distances, loading and unloading costs are as large or larger an issue as sea transport costs. Based on projected throughputs at Bitung, Biringkassi, Madura Cement Harbor, Gresik, and Semarang, it is preliminarily concluded that these ports do not warrant shore-based unloading facilities. As a result, these ports should be serviced by geared vessels (or self-unloading vessels).

Draft Restrictions. Without a major dredging effort, draft restrictions and navigational considerations for all future Kalimantan loading ports are a major impediment to a low-cost sea transport system (except for Tanjung Bungalun). Fully loaded vessels will be restricted to at most

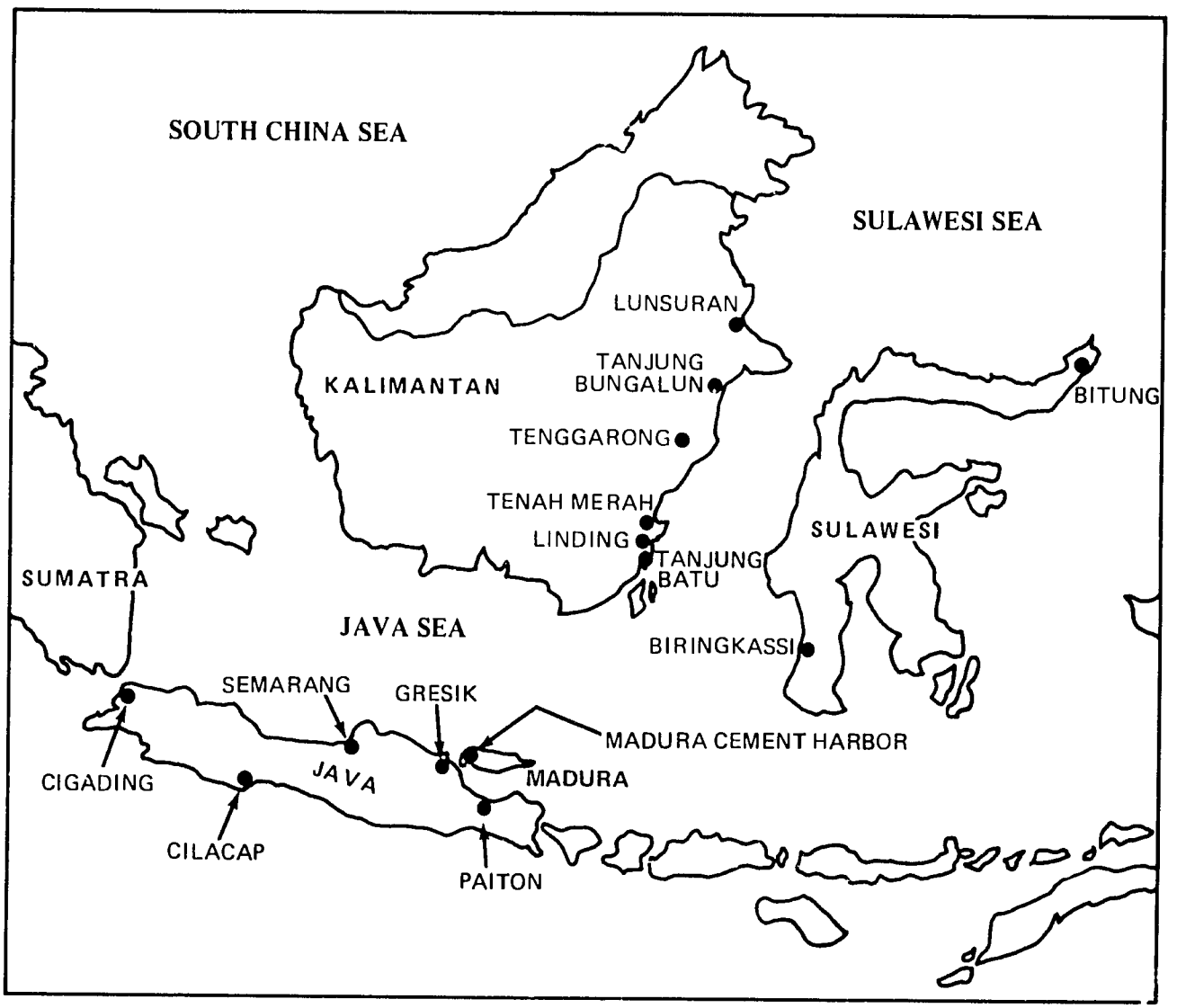


Figure 2.3-1 COAL LOADING PORTS IN KALIMANTAN AND UNLOADING PORTS ON JAVA AND SULAWESI

10,000 DWT, and in most cases only barges will be able to service the loading ports. Tanjung Bungalun is the only future port located on the coast with access to deep water. In general, draft restrictions are less for unloading ports on Java and Sulawesi, with the exception of Semarang. Unloading ports can accommodate bulk carriers of 20,000 DWT while at Cigading, Cilacap, and Paiton, vessel size may be as large as 40,000 to 60,000 DWT.

Vessel Selection.

- On inter-island routes (400 - 1,100 miles), bulk carriers are preferred over barges. On short coastal routes (25 - 150 miles), barges are preferred.

- If barges are selected for inter-island transport because of draft restrictions, the largest possible size is preferred regardless of throughput or annual transport requirements per route.

- The size of barges for coastal transport depends on annual throughput per route. At low levels of 0.5 MMTPY per route, smaller barges are preferred (i.e., 5,000 DWT).

- "Handy-sized" bulk carriers (vessels of 20,000 to 30,000 DWT) are preferred for inter-island transport at relatively low throughput levels (0.5 MMTPY). When throughput increases, the preference is for larger vessels of 40,000 DWT. Beyond 40,000 DWT, savings in annual transport cost per tonne would be minor and a 40,000 DWT bulk carrier could be considered the maximum size vessel to be used in domestic coal transport. Mini-bulk carriers (less than 10,000 DWT) would be attractive for short distances at low throughput levels.

Shipping Systems. Domestic transport of coal could be done either with a direct shipping system (Option 1), or with transshipment of coal in Kalimantan to large bulk carriers (Option 2). Figures 2.3-2 and 2.3-3 illustrate these systems for 1994 (Phase III), when the domestic market for Kalimantan coal is fully developed and a regular sea transport system should be in place. Because annual throughputs in the beginning will be low and construction of transshipment terminals will require time, coal would most likely be transported by a direct shipping system. In Phases II and III transshipment would become an option.

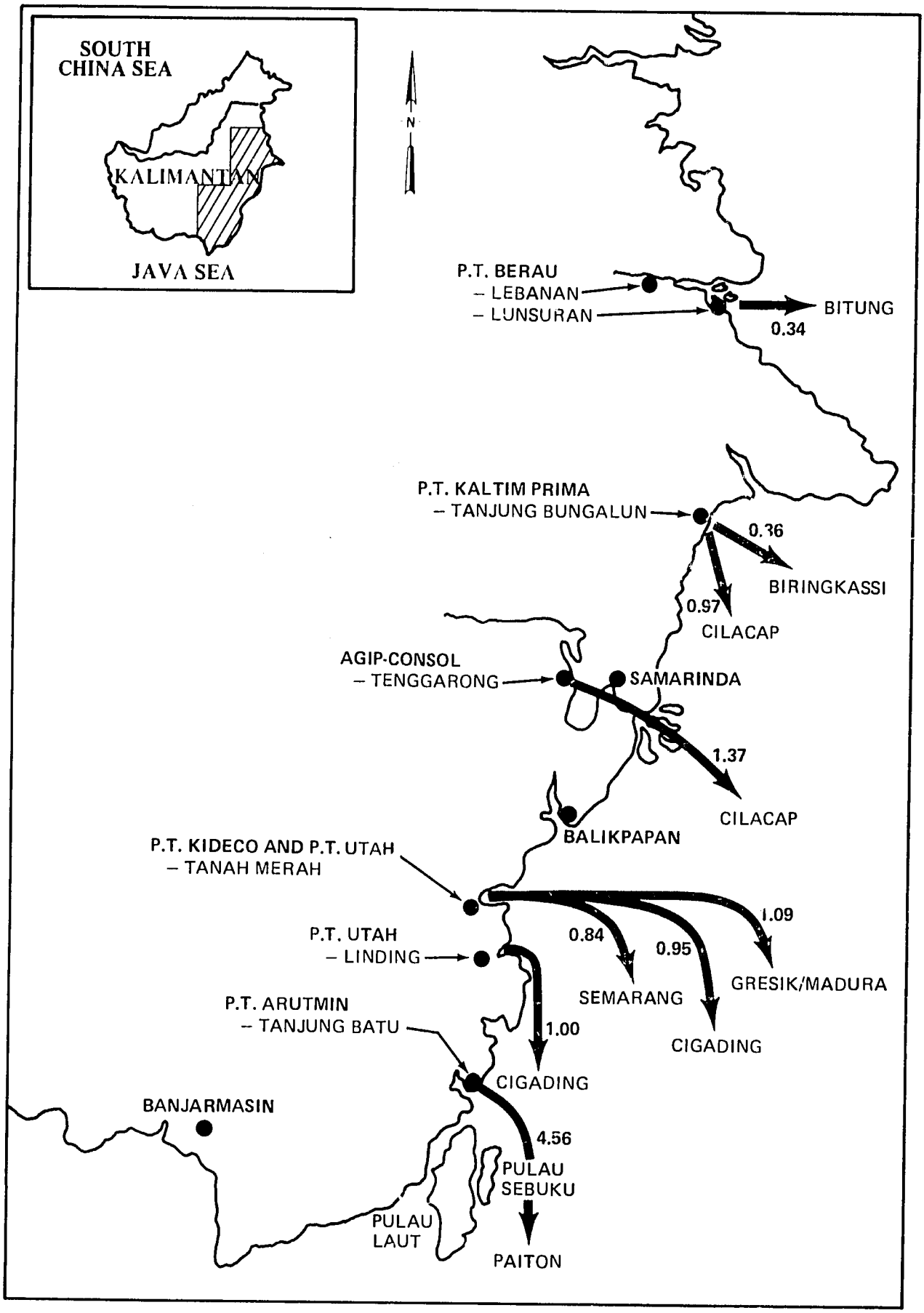


Figure 2.3-2 OPTION 1: DIRECT SHIPPING IN 1994 (TOTAL TRANSPORTED: 11.48 MMT)

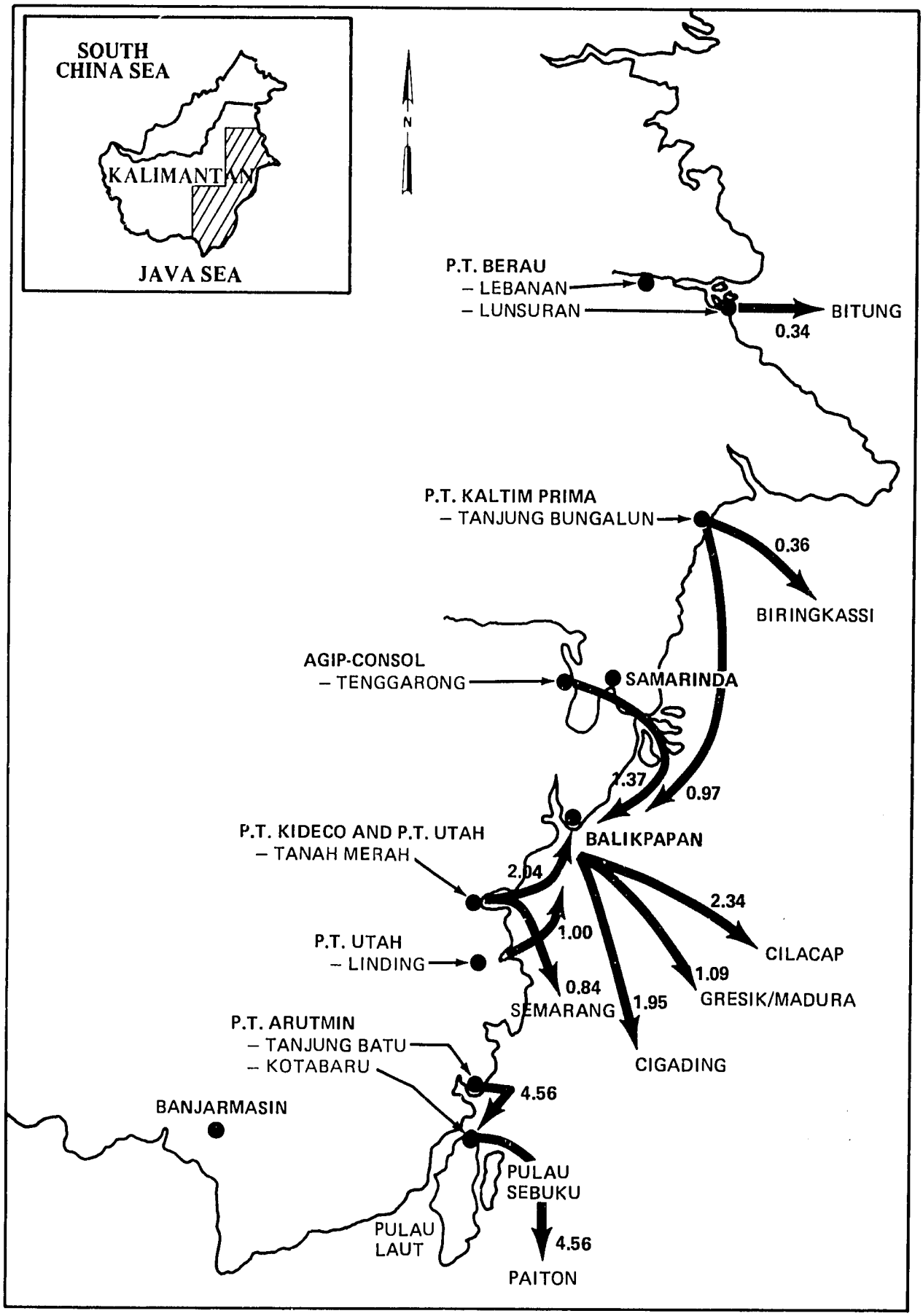


Figure 2.3-3 OPTION 2: TRANSSHIPMENT IN 1994 (TOTAL TRANSPORTED: 11.48 MMT/ THROUGH BALIKPAPAN: 5.38 MMT/THROUGH KOTABARU: 4.56 MMT/ DIRECT: 1.54 MMT)

Both options represent relatively simple shipping systems consisting of a limited number of ports and routes. At the end of Phase I, the total system would carry approximately 4.05 MMTPY increasing to 11.48 MMTPY by 1994. Table 2.3-1 shows fleet composition for each of the options based on the aforementioned vessel criteria and without dredging of loading ports on Kalimantan. Under Option 1, the fleet would consist mostly of 10,000 DWT barges, augmented by 10,000 to 20,000 DWT bulk carriers on routes where draft restrictions would allow their use. Option 2 provides for coastal barging from certain areas to the transshipment terminal, but retains direct shipping where such is clearly less costly (see Figure 2.3-3).

Table 2.3-1

FLEET COMPOSITION AT THE END OF PHASES I, II, AND III
FOR OPTIONS 1 AND 2

Vessel Type	Number of Vessels		
	1988	1991	1994
Option 1: Direct Shipping			
10,000 DWT barges	10	16	17
Tugs	10	16	17
10,000 DWT bulk carriers	1	3	8
20,000 DWT bulk carriers	-	1	2
Option 2: Transshipment			
10,000 DWT barges	10	7	12
Tugs	10	4	5
10,000 DWT bulk carriers	1	3	1
40,000 DWT bulk carriers	-	3	6

Transport Costs and Savings. Figure 2.3-4 compares round-trip transport cost for all routes considered for 1994 under both Options 1 and 2. Figure 2.3-5 shows annual system transport cost in 1994 for both options. The following is concluded:

- The roundtrip transport cost between Kalimantan and these locations in a direct shipping system in which dredging was not considered was estimated as follows:

  - Sulawesi: US$4/tonne
  - East Java: US$4.50 to US$6/tonne
  - North-central Java (Semarang): US$7.50/tonne
  - West Java: US$8 to US$9.50/tonne
  - South-central Java: US$8 to US$13/tonne

  By and large, the higher numbers reflect direct shipping in 10,000 DWT barges.

- Based on the above estimates and using US$8 per tonne as the cut-off point, barge transport to west Java and south-central Java is a potential deterrent to the use of Kalimantan coal in those areas.

- Exclusive of the cost of transshipment itself, transshipment to large vessels for domestic transport reduces round-trip transport cost per tonne.

- Transshipment into 40,000 DWT bulk carriers, when compared to direct shipping in 10,000 DWT barges, results in transport cost reductions averaging 37 to 45 percent. Compared to direct shipping in 10,000 DWT and 20,000 DWT bulk carriers, these reductions are, on average, 13 to 14 percent and 7 to 8 percent, respectively.

- Exclusive of the cost of transshipment itself, the total annual cost for all system transport requirements can be reduced by approximately US$15 to US$20 million during Phases II and III with transshipment. This reduction reflects the reduction in cost to the country as a whole.

Economic Feasibility of Onshore Transshipment Terminals. Economic feasibility of transshipment is a direct function of annual cost to operate the terminal versus annual transport savings to be obtained. The cost analysis for Options 1 and 2 provides insight into this issue. Figure 2.3-6 provides a comparison of transshipment cost and savings in 1994. The following is concluded:

- Assuming a transshipment charge of US$3 to US$4 per tonne, a terminal at Balikpapan could be attractive from a national perspective. Annual savings would at least be sufficient to recover the cost of constructing the terminal.

- Assuming a transshipment charge of US$5 to US$6 per tonne (the charge needed to ensure a commercially acceptable rate of return on investment by a private company), a terminal at Balikpapan will probably not be economically attractive.

- Establishing a terminal at Kotabaru for domestic coal transport would not be an attractive solution because the transshipment cost would far outweigh the potential savings, regardless of who owns or operates the terminal.

- To capture the potential national economic benefits of a transshipment terminal at Balikpapan, one government company must not only be responsible for transport, but also for establishing and operating the terminal.

- While national economic benefits associated with a terminal at Balikpapan may be marginal, additional benefits exist that could be significant. The government company operating the terminal could:

  - Function as a central marketing and distribution agent, coordinating and promoting the marketing and use of Kalimantan coal for domestic use

  - Engage in imports and/or exports

  - Engage in blending and coal preparation

  - Provide a service to private coal companies

  - Secure a supply of Kalimantan coal for domestic consumers

  - Contribute to regional development of Kalimantan

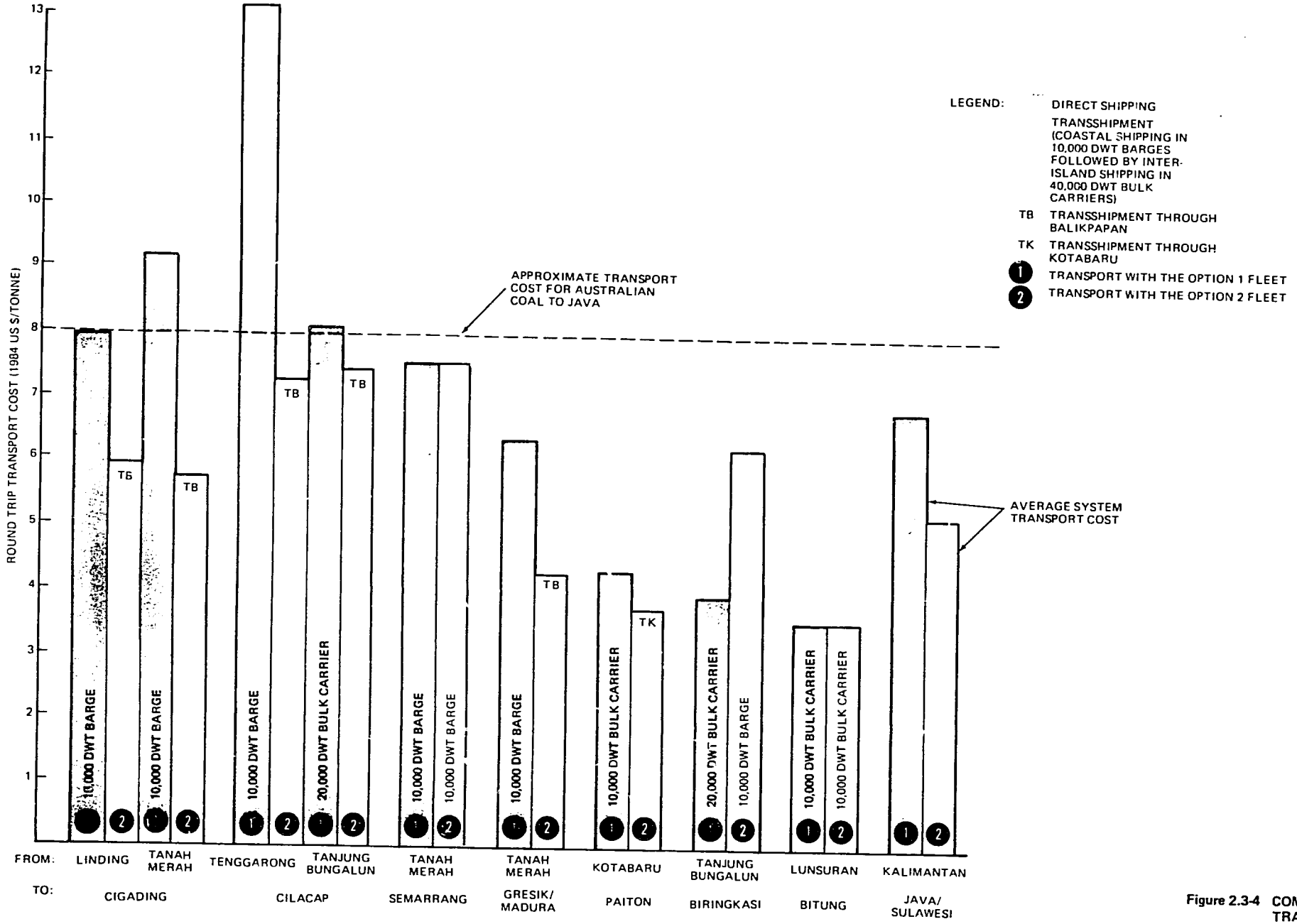


Figure 2.3-4 COMPARISON OF ROUNDTRIP TRANSPORT COST

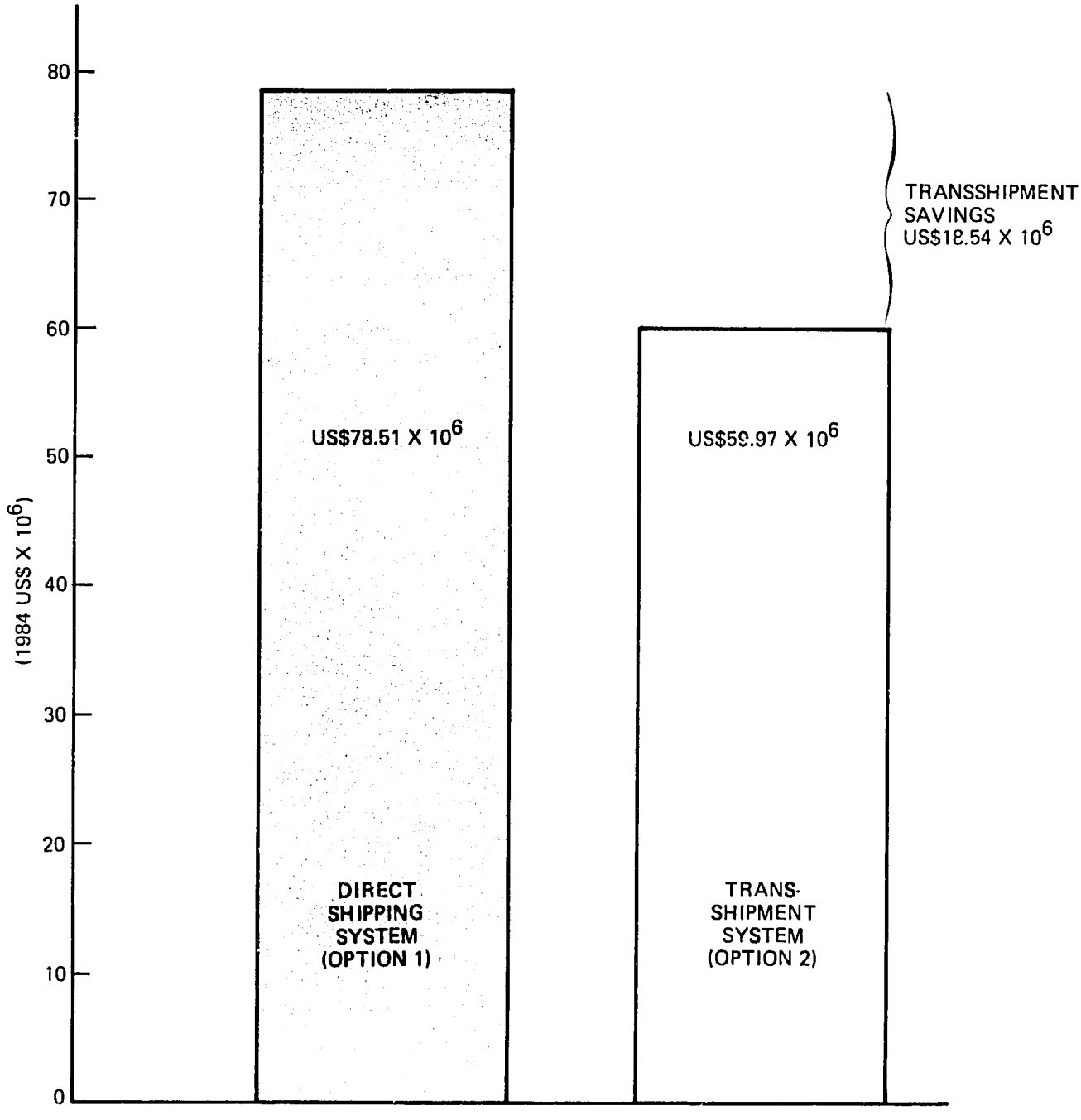
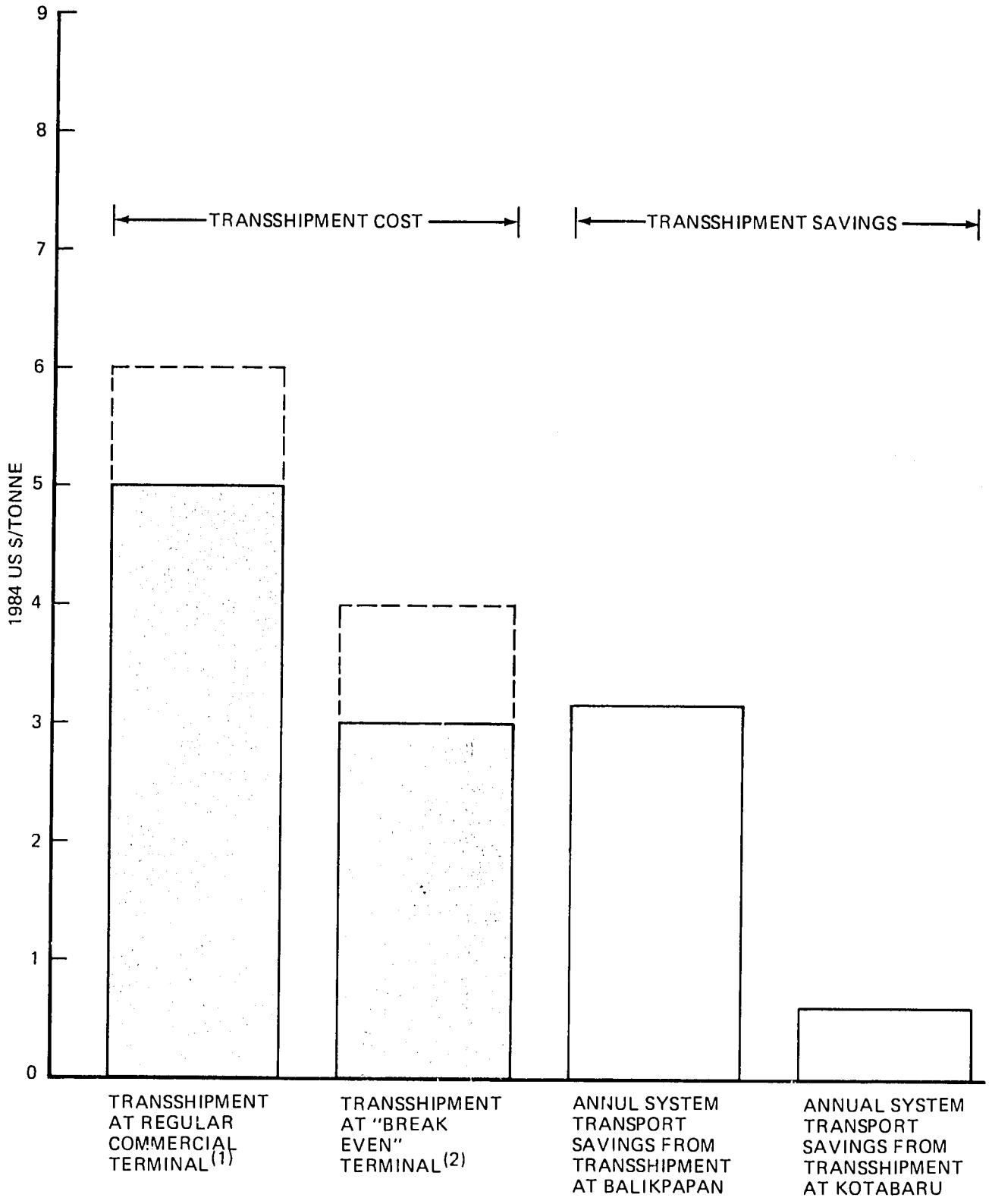


Figure 2.3-5 ANNUAL SYSTEM TRANSPORT COST IN 1994



(1) TERMINAL OPERATED TO ACHIEVE REGULAR COMMERCIAL RATES OF RETURN ON INVESTMENT; 5 MMTPY THROUGHPUT

(2) TERMINAL OPERATED ONLY TO BREAKEVEN REVENUES WITH COSTS; 5 MMTPY THROUGHPUT

Figure 2.3-6 COMPARISON OF TRANSSHIPMENT COST AND SAVINGS IN 1994

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- Establishing a terminal at Balikpapan could be a deciding factor in development of Kalimantan coal resources, especially in view of projected low production levels in individual areas. Future production levels not only influence decisions by contractors to proceed with the development of concessions, but also the amount of capital investment allocated to harbor and transport facilities to ship coal to domestic destinations. The competitive advantage of Kalimantan coal is lessened if such facilities would not allow for the lowest cost sea transport.

Suitability of the Domestic Fleet to Transport Coal. The country's total fleet is quite large in number and total carrying capacity (8,500 vessels and 6.5 million DWT). However, most of the fleet is inadequate for coal transport because type and size of vessels are inappropriate, vessels are generally old, and those that could be used are already committed to specific trades. Based on a brief review of the domestic fleet, it appears that there are two exceptions: transport vessels owned and operated by P.T. Angkutan Pertambangan (P.T. AP) could be used, or coal could be transported with converted log carriers. The following is concluded:

- Log carriers provide an option for Kalimantan coal transport and possibly could be used during Phase I as a means of starting system development. In such case, 12 vessels would be required to transport 4.05 MMTPY in 1988. Three vessels would operate out of Linding, seven out of Tanah Merah, and two out of Tanjung Batu.

- In addition to their availability, log carriers also have the advantage that conversion to coal colliers would be relatively easy. It has been estimated that the simplest conversion procedure would cost about US$0.5 million per vessel.

- Eighty to ninety log carriers owned and operated by 20 companies have available capacity due to the export ban on logs, effective January 1, 1985. Log carriers average 6,500 DWT. Since the majority of the vessels have been acquired quite recently, it is possible to select vessels that are less than five years old.

- P.T. AP's eight small vessels are less likely to be used in the Kalimantan coal trade because their size is too small (3,453 DWT), they are old (almost 20 years), and may not be available because of other transport commitments.

Capability of Domestic Yards to Fabricate Bulk Transport Vessels. The domestic capability to fabricate bulk transport vessels is a key factor in the ultimate configuration of a Kalimantan coal transport fleet. The following is concluded:

- Four domestic yards have the technical capability to build vessels up to 10,000 DWT for Options 1 and 2. These yards are owned and operated by:

  - P.T. PAL (Surabaya)
  - P.T. Dok dan Perkapalan (Tanjung Priok)
  - P.T. Pelita Bahari (Jakarta)
  - P.T. Intan Sengkunyit (Palembang)

  By the late eighties, P.T. PAL will have the capability to build vessels up to 30,000 DWT. No company currently has the capability nor plans to build 40,000 DWT vessels. Because of the minimum requirement for shipyard facilities, log carriers can be converted at some 19 yards (owned and operated by 11 companies), including the above four.

- Since conversion of log carriers imposes minimum demands on required yard capacity, it is the option that has the least impact on the shipbuilding and repair industry, adding to the attractiveness of using log carriers.

2.3.2 Recommendations Concerning Sea Transport

Coal Transport Fleet. Decisions regarding the specific configuration of the future Kalimantan coal transport fleet are influenced by four major issues:

- Short-term Requirements versus Long-term Needs. How to get started during Phase I versus the type of system ultimately to be adopted

- Influence of Dredging. Economic and technical feasibility of dredging Kalimantan coal loading ports greatly influences fleet configuration

- Availability of Log Carriers. If log carriers provide a fast but not necessarily least cost solution, they still may have to be used for the sake of expedience

- Economic and Technical Feasibility of Transshipment. As shown before, transshipment greatly alters the configuration of the transport fleet to be used

At present, it is too early to fully prescribe a future transport fleet. Instead, a decision-making framework is recommended that takes into account the above issues and will result in a specific fleet configuration (see Figure 2.3-7). Key to making any decisions regarding the future fleet are a number of essential feasibility studies, the results of which will allow choosing a specific path through the decision tree shown in Figure 2.3-7.

To respond to the short-term concerns of getting coal transport underway, it is recommended that the following interrelated studies be immediately undertaken:

- Study No. 1: Log Carrier Feasibility Study. As log carriers provide a potentially attractive starting option, their actual use should be further investigated in a two-part study. Part 1 should address total costs, schedule, and other logistical requirements to convert 12 log carriers for use during Phase I. Part 2 should address the economic and financial implications of using log carriers, based on actual transport charges to be incurred, and should compare resulting transport cost with the use of newly constructed or acquired vessels.

- Study No. 2: Dredging Feasibility Study. A pre-feasibility study should be conducted for all potential loading ports to determine the approximate cost of initial and annual dredging (as a function of vessel size). The study should focus on a comparison of dredging cost and potential savings in transport cost per tonne for domestic routes between 400 and 1,100 nautical miles, in vessels up to 40,000 DWT, and with throughput levels not exceeding 0.5 to several MMTPY.

Pending the results of the above studies and prior to making full-fledged commitments to acquire and/or construct a Phase I fleet, it is recommended that the following studies be undertaken as soon as possible:

- o Study No. 3: Feasibility Study for Kalimantan Transshipment Terminal. This study, aimed at investigating economic and technical feasibility of transshipment during Phases II and III, should have the following scope:
  - Verification of projected coal production
  - Analysis of domestic and export markets
  - Site selection
  - Formulation of shipping networks
  - Formulation of terminal functions
  - Preliminary design and cost estimate
  - Institutional arrangements
  - Financial and economic analysis
  - Transport system evaluation
  - Implementation plan
- o Study No. 4: Evaluation of Continued Use of Log Carriers. As log carriers are viewed as a possible starting solution, their continued use during Phases II and III should be evaluated in view of their age as well as opportunities to be used for different domestic trades.

Towards Improved Sea Transport. The following recommendations are made in response to some of the major conclusions stated earlier:

- o Loading and Unloading. A study should be undertaken to determine appropriate unloading facilities and procedures for those ports that have relatively small throughputs (less than 850,000 tonnes per year). The study should be limited in scope to bulk carriers of up to 40,000 DWT and focus on the projected situation at Gresik, Madura Cement Harbor, Biringkassi, Semarang, and Bitung.

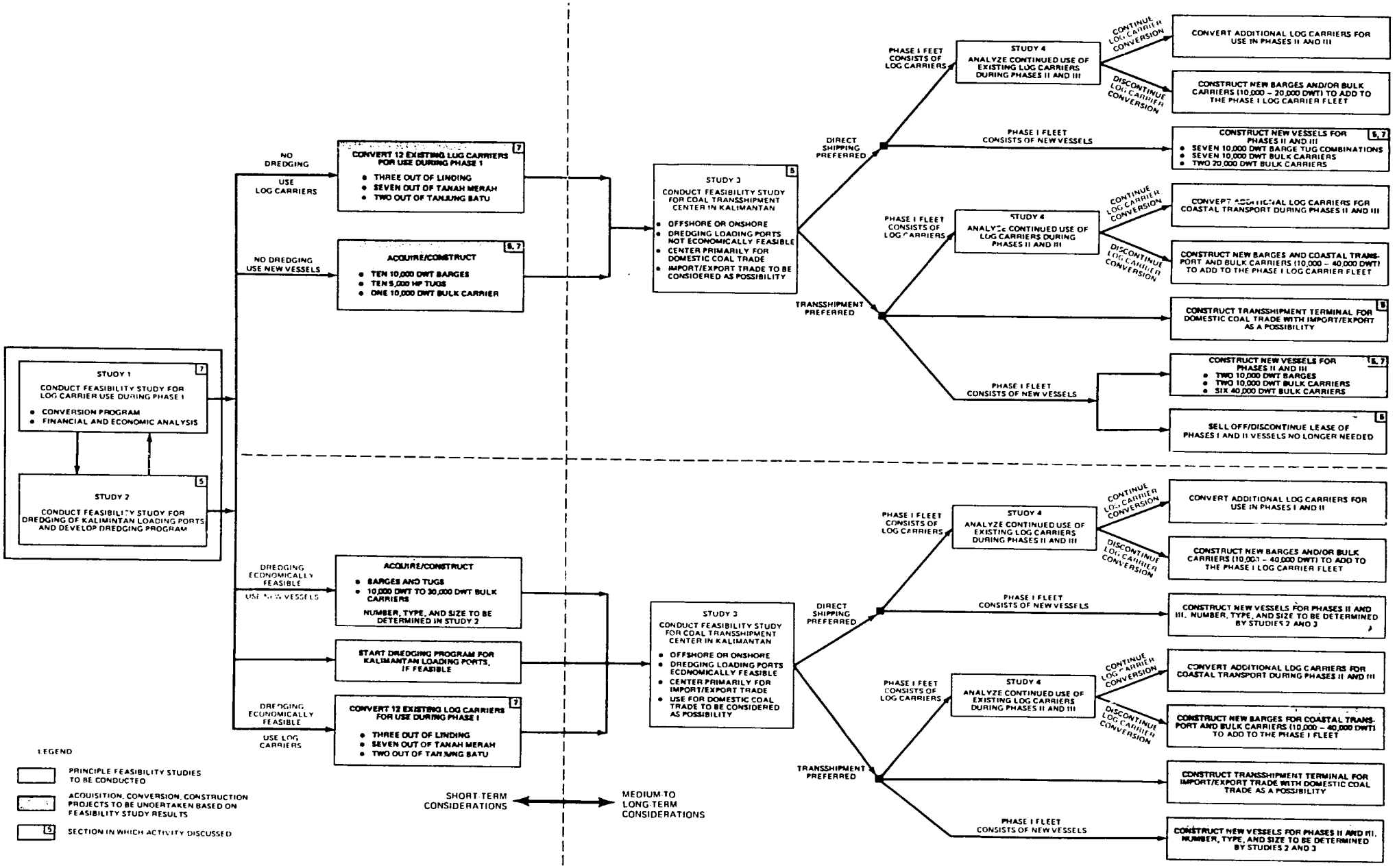

Figure 2.3-7 DECISION MAKING FRAMEWORK FOR DEVELOPMENT OF THE KALIMANTAN COAL TRANSPORT FLEET

- Draft Restrictions. Exclusively shallow draft wide-beam vessels should be used for domestic coal transport. For Indonesian draft conditions, such vessels appear to present the cheapest alternative to dredging.

- Coal Transport Through Semarang. Current port facilities at Semarang should not be used for coal unloading. Instead, a special harbor facility should be developed near Semarang. Even at such a facility, current indications are that the maximum draft would be 7 meters.

- Coal Transport to West Java and South-central Java. As indicated before, coal transport by barge to Cigading and Cilacap should be avoided if at all possible. Instead, coal for west Java and south-central Java should only be carried in bulk carriers so as to achieve the lowest possible transport cost. West Java will be a major consumer during Phase I, with 1.67 MMTPY destined for Cigading in 1988, and is of immediate concern. During this phase only three loading ports are projected to be in operation; Linding, Tanah Merah, and Tanjung Batu. As soon as possible a study should be undertaken to determine how the consumers in west Java could be supplied with coal from Kalimantan during Phase I in view of quality and other requirements, and in view of having to achieve minimum transport cost by using bulk carriers.

2.4 LAND TRANSPORT

2.4 LAND TRANSPORT

2.4.1 Introduction

Land transport of Kalimantan coal includes overland transport on Kalimantan, as well as on Java and Sulawesi. Since all PLN power plants targeted for Kalimantan coal will be located on the coast of Java, no land transport of coal is involved other than within the limits of the power plant site. Thus, land transport on Java and Sulawesi is only related to supply of cement plants. Cement plants can be differentiated in terms of those with an inland location and those with a coastal or "near-the-coast" location. Table 2.2-1 identified land transport distances on Kalimantan. Table 2.4-1 identifies land transport distances for the two types of cement plants on Java and Sulawesi, and is based on the designated unloading ports shown in Table 2.2-3.

2.4.2 Conclusions

Overall Land Transport Requirements. Figure 2.4-1 shows requirements for land transport of coal on Kalimantan, Java, and Sulawesi, based on the coal supply strategy shown in Table 2.4-1, potential loading ports in Kalimantan, and designated unloading ports. Of all areas, by far the largest requirements for land transport are in west Java to supply two cement plants south of Jakarta and one near Cirebon. The principal reason is the great distance between Cigading and the cement plant locations. Land transport requirements from the Senakin and Samarangau area in Kalimantan follow. Most other areas have moderate to low land transport requirements.

Land Transport Mode in Kalimantan. (see also Figure 2.4-1)

- Trucking is the most likely transport option for all areas. Low production levels and short distance combine to favor this option.

- Conveyors may have to be considered under conditions where new haul roads would otherwise have to be built or where production levels exceed the range of economic operation for a trucking system. The Sangatta area is an example of the first condition, while the East Senakin area is an example of the second condition.

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Table 2.4-1

LAND TRANSPORT DISTANCES ON JAVA AND SULAWESI
TO SUPPLY CEMENT PLANTS

Area	Location	Approximate Transport Distance (km)
Inland Cement Plants		
West Java	Narogong	201
	Citeurup	211
	Palimanan	382
South-central Java	Gombong	68
North-central Java	Tanggung	74
	Purwodadi	68
Coastal Cement Plants		
South-central Java	Cilacap	10
	Karang Talun	10
East Java	Gresik	1.5
	Karang Pandan (Madura)	30
Sulawesi	Tonasa	15
	Bitung (Menado)	15

- It is very unlikely that rail would be a viable land transport option in Kalimantan.
- For all practical purposes, the use of slurry pipelines for land transport of Kalimantan coal can be eliminated.

Land Transport Mode on Java to Supply Inland Cement Plants. Very high population density, current road congestion, lack of available land and

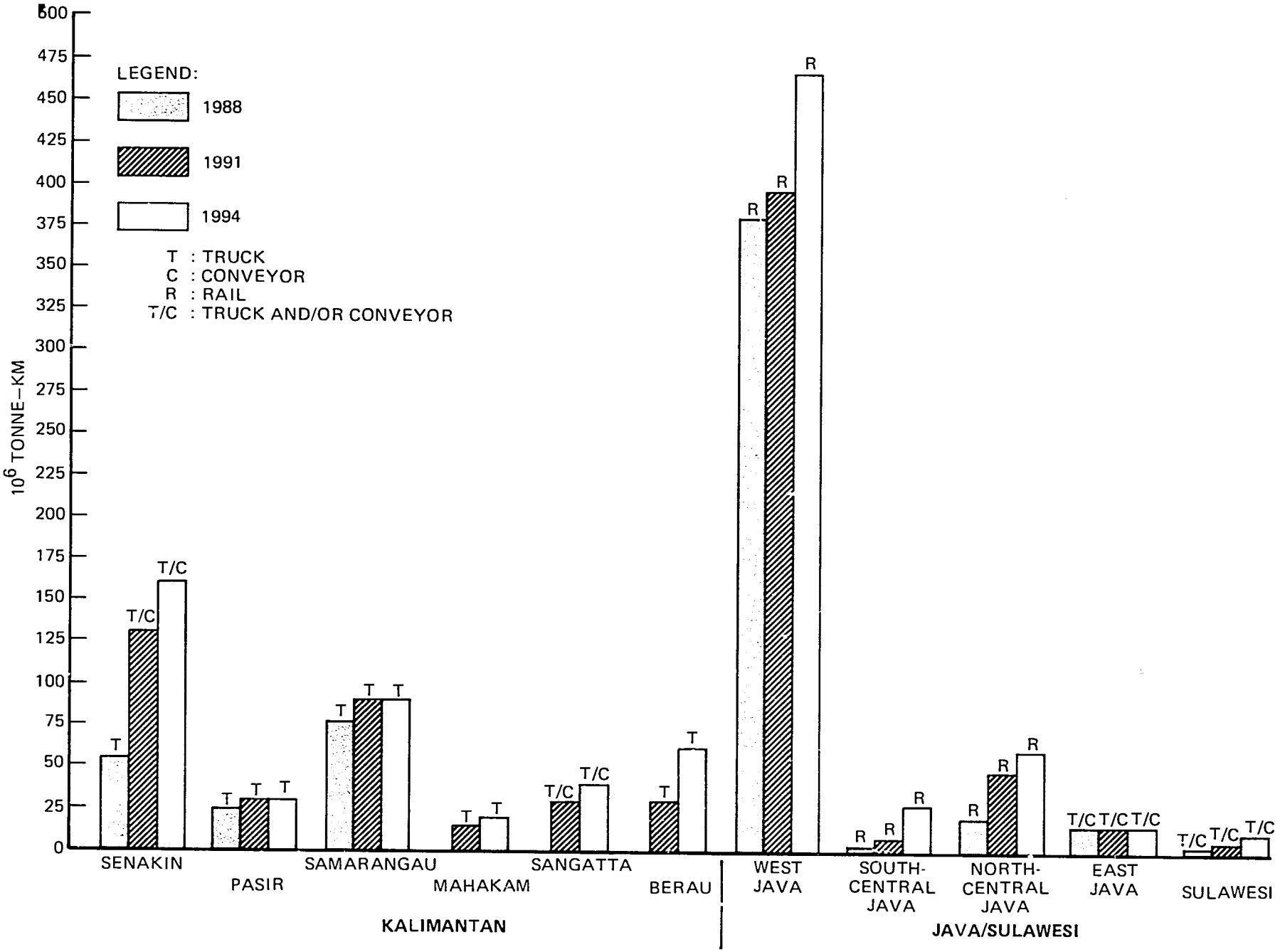


Figure 2.4-1 PROBABLE LAND TRANSPORT MODES AND REQUIREMENTS FOR TRANSPORT OF KALIMANTAN COAL

high cost of new road construction virtually rule out the use of trucks to supply cement plants with an inland location. Although the existing rail system is severely deteriorated and needs upgrading, it provides the only viable solution. Slurry pipelines can be eliminated as an option because of the existing rail system, and throughputs that are too small to justify the extra costs. Coal transport in west Java, south-central Java, and north-central Java will have to be by rail.

Land Transport Mode on Java and Sulawesi to Supply Coastal Cement Plants. Generally, the only options are trucks and/or conveyors. In certain cases, where there is an existing rail system (such as in Cilacap), rail could be preferred, even for short distances. Land transport to all coastal cement plants is not considered a major problem, with the exception of the plant near Cirebon.

Land Transport to Inland Cement Plants South of Jakarta. The following is concluded regarding coal supply to the cement plants south of Jakarta, particularly as it relates to current activities to develop a land transport system (see Figure 2.4-2):

- Cigading has been officially designated as the unloading port to supply cement plants south of Jakarta. Using Cigading and the existing rail system, Indocement has developed a plan to supply 4,000 tonnes per day to their facilities at Citeurup. This plan provides an expensive solution to coal transport in west Java because:

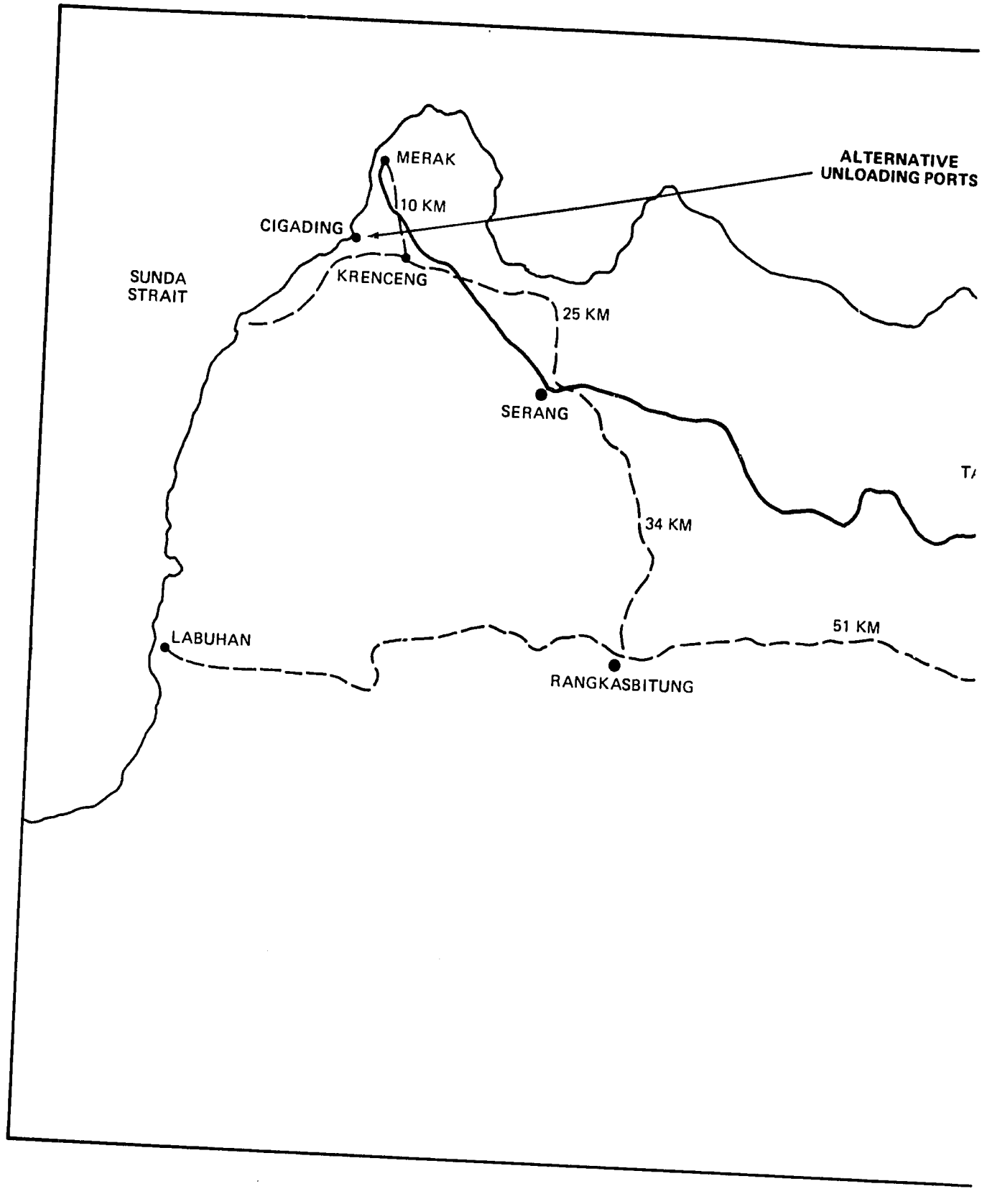
  - Transport distance is long (211 km)

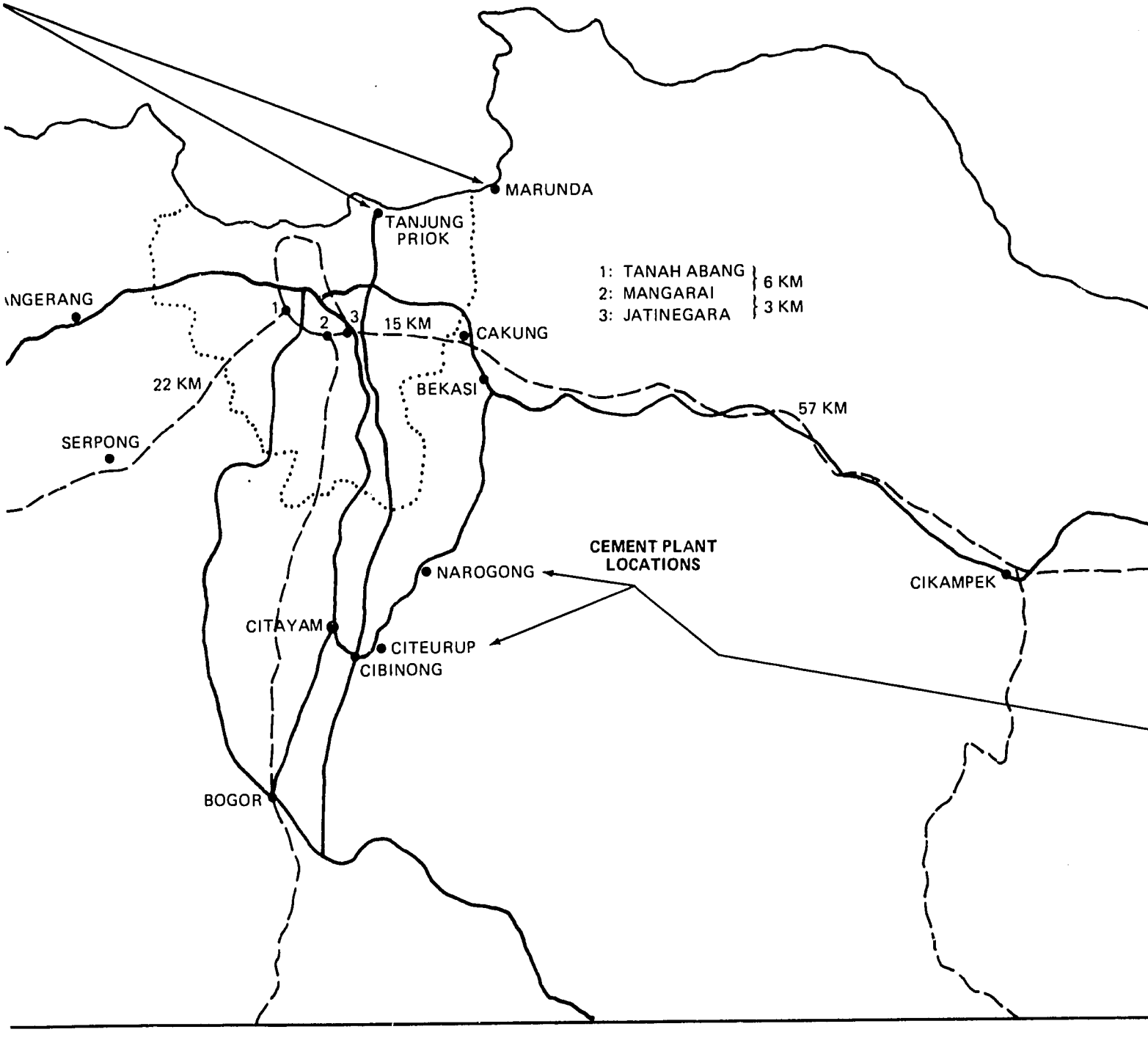
  - Amount transported per rail car is small (23 to 25 tonnes)

  - Amount transported per train is small (400 tonnes)

  - Transloading from rail to truck and multiple handling is involved

  - Additional investment is required for containers to carry the coal and for a fleet of trucks to carry the containers over the road on the last 45 km to the cement plant at Citeurup


MERAK
ALTERNATIVE
UNLOADING PORTS
10 KM
CIGADING
KRENCENG
SUNDA
STRAIT
25 KM
SERANG
34 KM
LABUHAN
51 KM
RANGKASBITUNG


MARUNDA
TANJUNG PRIOK
1: TANAH ABANG
2: MANGARAI
3: JATINEGARA
6 KM
3 KM
NGERANG
1
2
3
15 KM
CAKUNG
22 KM
BEKASI
57 KM
SERPONG
CEMENT PLANT LOCATIONS
NAROGONG
CIKAMPEK
CITAYAM
CITEURUP
CIBINONG
BOGOR

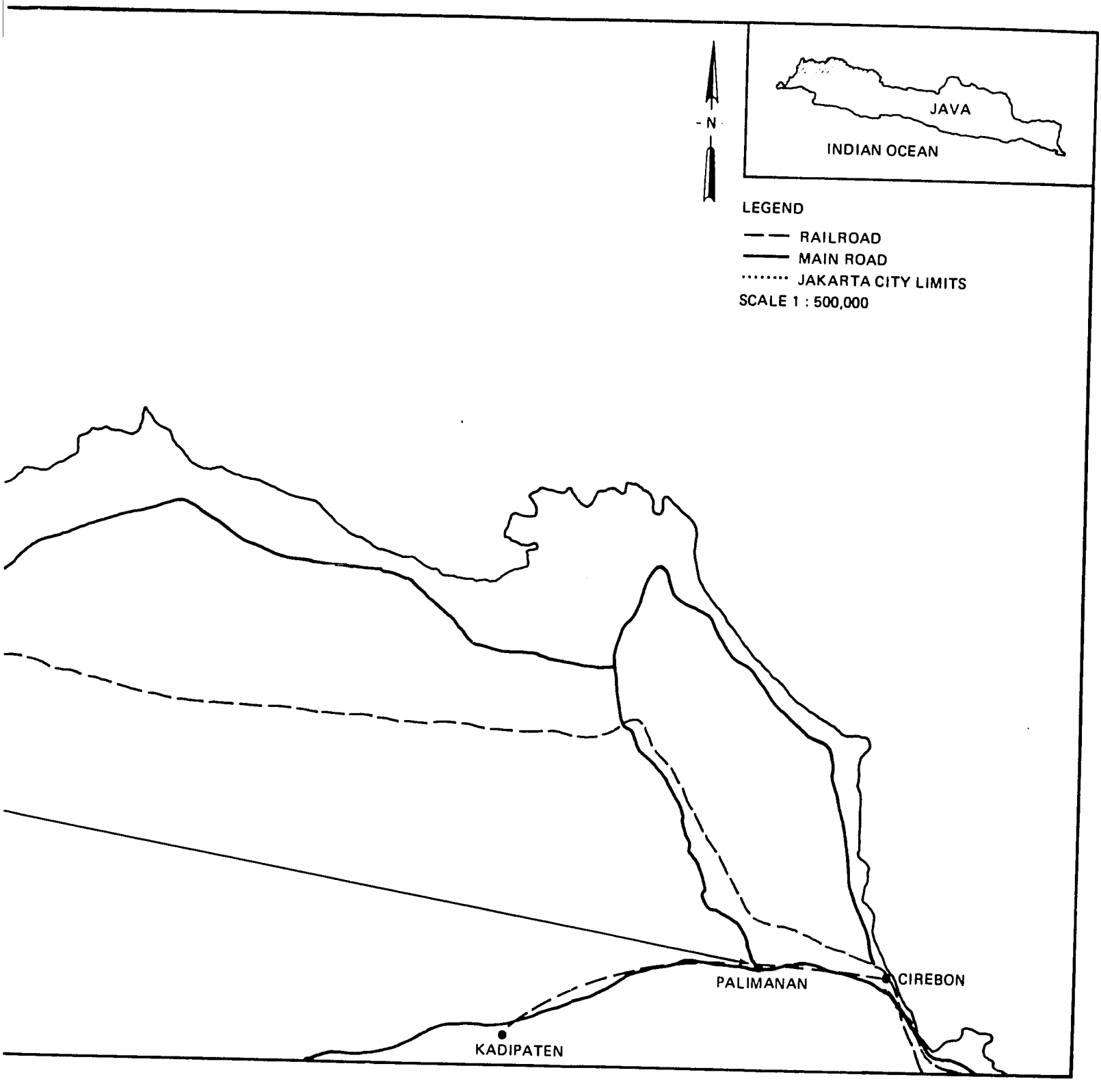


Figure 2.4-2 LAND TRANSPORT IN WEST JAVA

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- Although it is possible that the type of transport plan developed by INDOCEMENT is the only practical scheme available in west Java, it appears that there are other alternatives that could provide a more economical land transport solution.

- For the purpose of preliminary screening, a new coal unloading facility near Tanjung Priok and one near Marunda on the north coast of west Java were postulated as alternatives to Cigading. With these three alternative unloading ports, seven alternative land transport systems were formulated using various different rail routings (see Figure 2.4-3). Subsequently these alternatives were compared on the basis of construction cost required to provide a transport system that would result in rail service of similar quality.

- On the basis of the above preliminary screening, it is concluded that Cigading is not necessarily the most economical unloading port on west Java, and ports such as Tanjung Priok and Marunda could well provide a better solution. If Cigading has to be selected as the unloading port for other reasons, the current routing used in the INDOCEMENT plan could be improved by constructing a new railroad line directly to the plant facility at Citeurup, avoiding transport through the Jakarta area and coal transport by truck from Bekasi to Citeurup.

Land Transport to the Remaining Inland Cement Plants.

- Although the plant at Palimanan is near the coast, the fact that Cigading has been designated as the unloading port makes this cement plant the one with the longest transport distance. Low cost and efficient coal transport using a system that covers the entire width of west Java is highly unlikely.

- Rail transport out of Semarang and Cilacap to supply future cement plants at Purwodadi, Tanggung, and Gombong will require upgrading of the existing rail system. In and by itself, rail transport should not present any problems and will be the only viable land transport alternative.

Requirements for Rolling Stock for Land Transport.

- To transport the total coal production by truck from the mines in Kalimantan to respective loading ports will require a total of 76 30-tonne truck-trailer

combinations in 1988, increasing to 162 in 1991 and 201 in 1997.

- The total number of trucks required to sustain projected Kalimantan coal production levels requires a vehicle acquisition program averaging 50 to 100 truck-trailer combinations per year.

- Currently there is more than enough domestic capacity to build trucks up to about 15 tonnes of payload for coal transport. There are no companies currently licensed to build larger trucks, particularly off-highway coal transport trucks. The latter may be required pending detailed economic analysis conducted by Kalimantan coal contractors.

- Using unit trains of 25 cars carrying a total of 1,000 tonnes per train, the total land transport requirements over the next 10 years to supply inland cement plants on Java can be met by six unit trains; three to supply cement plants south of Jakarta, one to supply the cement plant near Palimanan, one in south-central Java, and one in north-central Java.

- With six unit trains, total demand for rail cars is 150 cars with a maximum demand of 20 locomotives. With these unit trains all destinations can be easily served, leaving a considerable amount of capacity that could be used to carry more coal for other uses.

- Requirements for railroad cars can be met by P.T. INKA in Maduin, east Java, which has both the technical capability as well as the facilities to meet the railroad car demand in Java.

2.4.3 Recommendations Concerning Land Transport

Based on the above conclusions the following is recommended to improve land transport of coal.

West Java Coal Transport Study. Industry will not favor coal as an alternative to fuel oil unless an efficient and dependable land transport system on Java is established. A feasibility study should be undertaken as soon as possible to determine the optimal land transport system to supply the cement plants south of Jakarta (at Narogong and Citeurup). In

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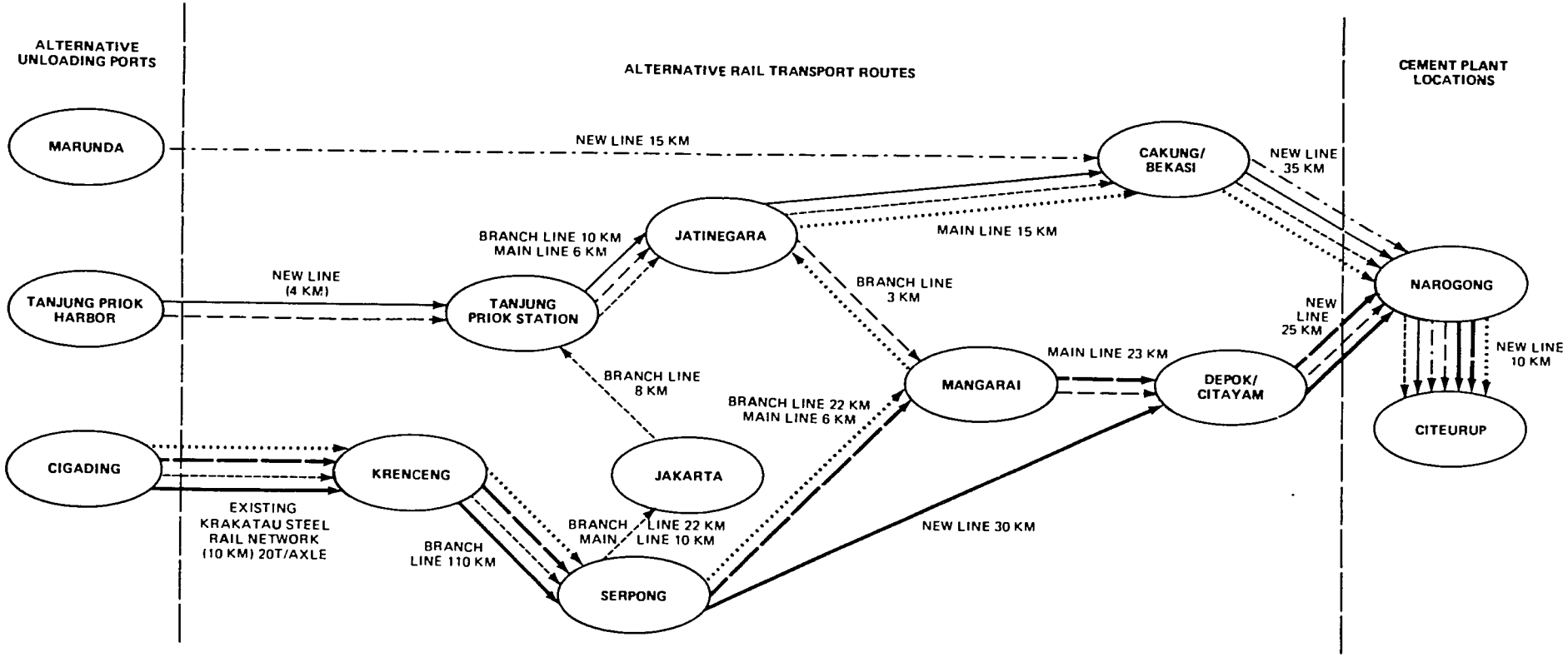


	TOTAL DISTANCE
ALT. 1: 60 KM OF NEW LINE	60 KM
ALT. 2. 49 KM OF NEW LINE, 21 KM OF MAIN LINE, 10 KM OF BRANCH LINE	80 KM
ALT. 3: 39 KM OF NEW LINE, 29 KM OF MAIN LINE, 13 KM OF BRANCH LINE	81 KM
ALT. 4: 45 KM OF NEW LINE, 21 KM OF MAIN LINE, 135 KM OF BRANCH LINE, 10 KM KRAKATAU STEEL LINE	211 KM
ALT. 5: 35 KM OF NEW LINE, 29 KM OF MAIN LINE, 132 KM OF BRANCH LINE, 10 KM KRAKATAU STEEL LINE	206 KM
ALT. 6: 45 KM OF NEW LINE, 31 KM OF MAIN LINE, 150 KM OF BRANCH LINE, 10 KM KRAKATAU STEEL LINE	236 KM
ALT. 7: 65 KM OF NEW LINE, – KM OF MAIN LINE, 110 KM OF BRANCH LINE, 10 KM KRAKATAU STEEL LINE	185 KM

Figure 2.4-3 RAIL TRANSPORT ALTERNATIVES FOR CEMENT PLANTS SOUTH OF JAKARTA

addition, this study should address the entire coal transport chain to bring Kalimantan coal to these plants. This is very important because it would, for the first time, demonstrate how and at what cost Kalimantan coal can be made available to domestic consumers, taking into account all the logistical requirements involved. Major work elements of the study relate to:

- Loading ports and terminals in Kalimantan
- Type and size of vessel for sea transport
- Unloading ports and receiving terminals in west Java
- Formulation of entire coal chain alternatives
- Evaluation of coal chain alternatives in terms of coal price to the consumer
- Specification of construction projects to implement the preferred alternative

The study sponsored by the U.S. Trade Development Program, scheduled to begin in 1985, will address these issues.

Additional Feasibility Studies. Although of lower priority than the above study, additional feasibility studies are recommended:

- Supply Cement Plant at Palimanan. A study should be conducted to analyze supply to this plant using Cirebon as the unloading port and using a currently existing railroad between Cirebon and Palimanan
- Interface Unloading Facilities with Land Transport at Cilacap. A study should be conducted to investigate whether other than current harbor facilities could be used to supply nearby cement plants. This could decrease the land transport costs by supplying the plants by a simple conveyor system.
- Semarang Unloading Facilities and Rail Connection. A study should be conducted to analyze required systems and facilities, needed to achieve an efficient interface between the Semarang coal unloading port and the existing rail system.

Railroad Upgrading. Since rail will be the dominant land transport mode on Java and the current system cannot accommodate unit coal trains of 25 wagons and 40 tonnes payload per wagon, it is recommended that as soon as possible a major program for railroad upgrading be undertaken in west Java, north-central Java, and south-central Java. This will require upgrading and rennovation of track and roadbed, strengthening of bridges, and lengthening of selected sidings.

Large Trucks Manufacturing. It is recommended that a brief analysis be conducted to determine the economic viability of assembling trucks larger than 15 tonnes and off-highway vehicles in Indonesia. If economically viable such assembly could be beneficial to the domestic automobile industry, which currently operates far below design capacity.

Rail Car Manufacturing. To have domestically produced rail cars available when they are needed, it is recommended that a program be designed as soon as possible to have P.T. INKA initiate production and supply PJKA with 150 new 40-tonne rail cars.

2.5 INSTITUTIONS: CONCLUSIONS AND RECOMMENDATIONS

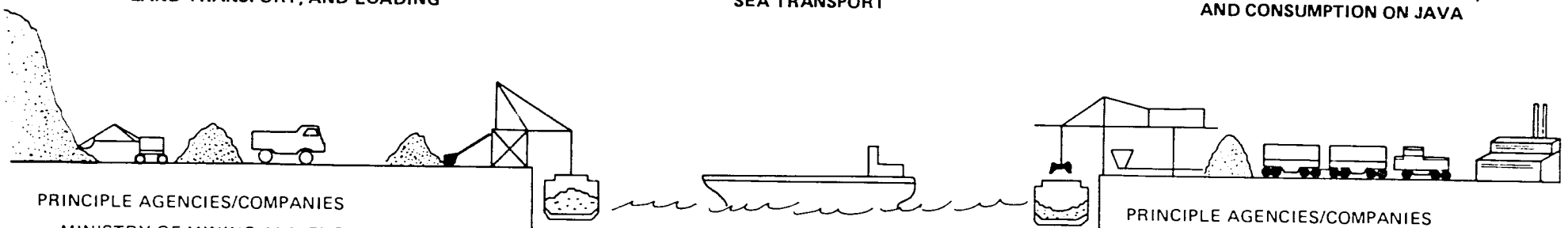
2.5 INSTITUTIONS: CONCLUSIONS AND RECOMMENDATIONS

Figure 2.5-1 shows some of the agencies and companies involved in development and transport of Kalimantan coal. Based on a brief analysis, it is concluded that implementation of projects for Kalimantan coal development, transport, and use will most likely be a slow process. This is due to:

- Large number of institutions involved
- Limited producer/consumer interaction
- No integration between coal development and coal transport and distribution
- Limited promotion/marketing of Kalimantan coal
- No analysis of complete coal supply chains
- Slow resolution of policy differences
- Limited means and incentives to facilitate implementation

In addition, accelerated implementation does not require an entirely new institutional structure, since the current arrangements are adequate. The implementation process can be accelerated by taking the following measures:

- An independent analysis group be attached to the interministerial committee for Kalimantan coal development
- Formal interaction and exchange be established between private coal companies on Kalimantan and potential domestic consumers
- A technical advisory/support group be established to advise potential customers on requirements and systems, including transport, for the most efficient use of Kalimantan coal
- A public campaign be organized to promote development and use of Kalimantan coal in particular, and development of Kalimantan in general
- Specific alternatives be investigated to further integrate coal development and transport, with particular emphasis on the type of organization for bulk transport of coal



KALIMANTAN COAL DEVELOPMENT, LAND TRANSPORT, AND LOADING

PRINCIPLE AGENCIES/COMPANIES

- MINISTRY OF MINING AND ENERGY
  - ENERGY POLICY DECISIONS
- MINISTRY OF COMMUNICATIONS
  - OVERALL TRANSPORT POLICY
- DIRECTOR GENERAL FOR MINING
  - COAL DEVELOPMENT POLICY
- DIRECTOR FOR COAL
  - COAL DEVELOPMENT
- DIRECTOR GENERAL FOR LAND COMMUNICATIONS
  - APPROVAL FOR ROAD TRANSPORT
- P.N. TAMBANG BATUBARA (PNTB)
  - RESPONSIBLE FOR COAL DEVELOPMENT
  - MAIN CONTACT WITH CUSTOMERS
- PRIVATE COAL COMPANIES
  - MINING CONTRACTORS TO PNTB

APPROVALS/PERMITS

- LOCAL GOVERNMENT
- PROVINCIAL GOVERNMENT
- OTHERS INCLUDE
  - DIRECTOR GENERAL OF FORESTRY
  - DEPARTMENT OF ENVIRONMENT
  - SEKNEG/TPP

SEA TRANSPORT

PRINCIPLE AGENCIES/COMPANIES

- MINISTRY OF COMMUNICATIONS
  - OVERALL TRANSPORT POLICY
- MINISTRY OF INDUSTRY
  - SHIPBUILDING POLICY
- DIRECTOR GENERAL FOR SEA COMMUNICATIONS
  - APPROVAL LOADING PORT
  - APPROVAL UNLOADING PORT
  - LICENSING TRANSPORT ROUTE
  - LICENSING TRANSPORT COMPANY
- SEA TRANSPORT COMPANY (PRIVATE)
  - UNDER CONTROL OF DIRECTOR GENERAL FOR SEA COMMUNICATIONS
- SEA TRANSPORT COMPANY (GOVERNMENT)
  - UNDER CONTROL OF DIRECTOR GENERAL FOR SEA COMMUNICATIONS
  - UNDER CONTROL OF GOVERNMENT MINISTRY OR MINISTRIES

UNLOADING, LAND TRANSPORT, AND CONSUMPTION ON JAVA

PRINCIPLE AGENCIES/COMPANIES

- MINISTRY OF MINING AND ENERGY
  - ENERGY POLICY DECISIONS
- MINISTRY OF COMMUNICATIONS
  - OVERALL TRANSPORT POLICY
- MINISTRY OF INDUSTRY
  - FUEL DECISIONS FOR STATE OWNED INDUSTRIAL PLANTS
- DIRECTOR GENERAL FOR POWER AND NEW ENERGY
  - FUEL DECISIONS FOR PLN
- DIRECTOR GENERAL FOR LAND COMMUNICATIONS
  - APPROVAL FOR TRANSPORT MODE
- NATIONAL RAILROAD COMPANY (PJKA)
  - RESPONSIBLE FOR RAIL TRANSPORT
- COAL CUSTOMERS
  - NATIONAL ELECTRIC COMPANY (PLN)
  - PRIVATELY OWNED CEMENT PLANTS
  - STATE OWNED CEMENT PLANTS

APPROVALS/PERMITS

- LOCAL GOVERNMENT
- PROVINCIAL GOVERNMENT
- OTHERS INCLUDE
  - DEPARTMENT OF ENVIRONMENT
  - SEKNEG/TPP

Figure 2.5-1 OVERVIEW OF SOME OF THE AGENCIES/COMPANIES INVOLVED IN DEVELOPMENT AND TRANSPORT OF KALIMANTAN COAL

2.6 ACTION PLAN

2.6 ACTION PLAN

Table 2.6-1 summarizes the various recommendations made in this study and assigns priorities. Highest priority items should be implemented without any further delay. Taken together, these recommendations establish an action plan aimed at establishing a low cost, efficient coal transport system that is vital to the success of Kalimantan coal development.

Table 2.6-1

ACTION PLAN FOR COAL TRANSPORT

Subject Area	Recommendation	Priority 1	Priority 2	Priority 3
Sea Transport	Log carrier feasibility study	X		
	Dredging feasibility study	X		
	Feasibility study for Kalimantan transshipment terminal		X	
	Evaluation of continued use of log carriers			X
	Analysis of unloading at low throughout ports			X
	Use of shallow draft wide-beam vessels	X		
	Unloading port facilities at Semarang		X	
	Phase I sea transport system to west Java	X		
Land Transport	West Java coal transport study	X		
	Supply cement plant at Palimanan		X	
	Interface unloading facilities with land transport at Cilacap		X	
	Semarang unloading facilities and rail connection		X	
	Railroad upgrading in west Java	X		
	Railroad upgrading in south-central Java		X	
	Railroad upgrading in north-central Java		X	
	Manufacturing of large trucks			X
	Rail car manufacturing			X
Institutions	Independent analysis group attached to interministerial committee on Kalimantan coal development	X		
	Formal interaction and exchange between producers and consumers	X		
	Technical advisory/support group		X	
	Public campaign on Kalimantan coal development			X
	Integration of coal development and transport	X		

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Section 3

REVIEW OF COAL EXPLORATION AND DEVELOPMENT IN KALIMANTAN

This section contains the following subsections:

- 3.1 Introduction
- 3.2 South Kalimantan Area
- 3.3 Pasir Area
- 3.4 Samarangau Area
- 3.5 Mahakam Area
- 3.6 Sangatta Area
- 3.7 Berau Area
- 3.8 Tanjung Area
- 3.9 Future Coal Production Levels in Kalimantan
- 3.10 Conclusions
- 3.11 References

3.1 INTRODUCTION

3.1 INTRODUCTION

This section is a review and summary of the efforts through mid-1984 by the production sharing contractors engaged in exploration and development of coal resources in Kalimantan. The main objective of this review is to determine reasonable production schedules for the various areas projected to come into production. Thus, the focus is on how much, when, and where coal could be produced, assuming there will be a ready market.

This section also identifies those characteristics of Kalimantan coal development with a bearing on a future domestic coal transport system. In this regard, the focus is on a discussion of the physical features of the various areas, including possible port sites, distances to open water, and other concerns.

Although officially started in only 1981, P.N. Tambang Batubara has already made considerable progress in its attempt to develop Kalimantan coal resources on a large scale. The government concluded that it would be most expedient to offer private companies the right to explore and develop major areas in Kalimantan. Acting as contractors to P.N. Tambang Batubara, these companies perform the needed exploration and development tasks in return for a share of future production. For information on the specific contractual arrangements, see References 3-1, 3-3, 3-4, and Appendix A (for highlights of Presidential Decree No. 49 of 1981, taken from Reference 3-1).

Figure 3.1-1 identifies seven coal exploration areas actively being explored as of mid-1984. Rights to an eighth area have recently been negotiated with a group of companies from Taiwan. Table 3.1-1 lists the area names, as used in this report, and the companies operating in them. Please note that these area names refer only in a general sense to the exploration areas covered by each contractor and have no other connotation. Thus, South Kalimantan is the area covered by P.T. Arutmin (some of which has already been relinquished) and does not relate to the South Kalimantan province. Similarly, and merely for convenience, the exploration area of P.T. Kideco has been named for the location of coal deposits currently considered most promising (near the Samarangau River).

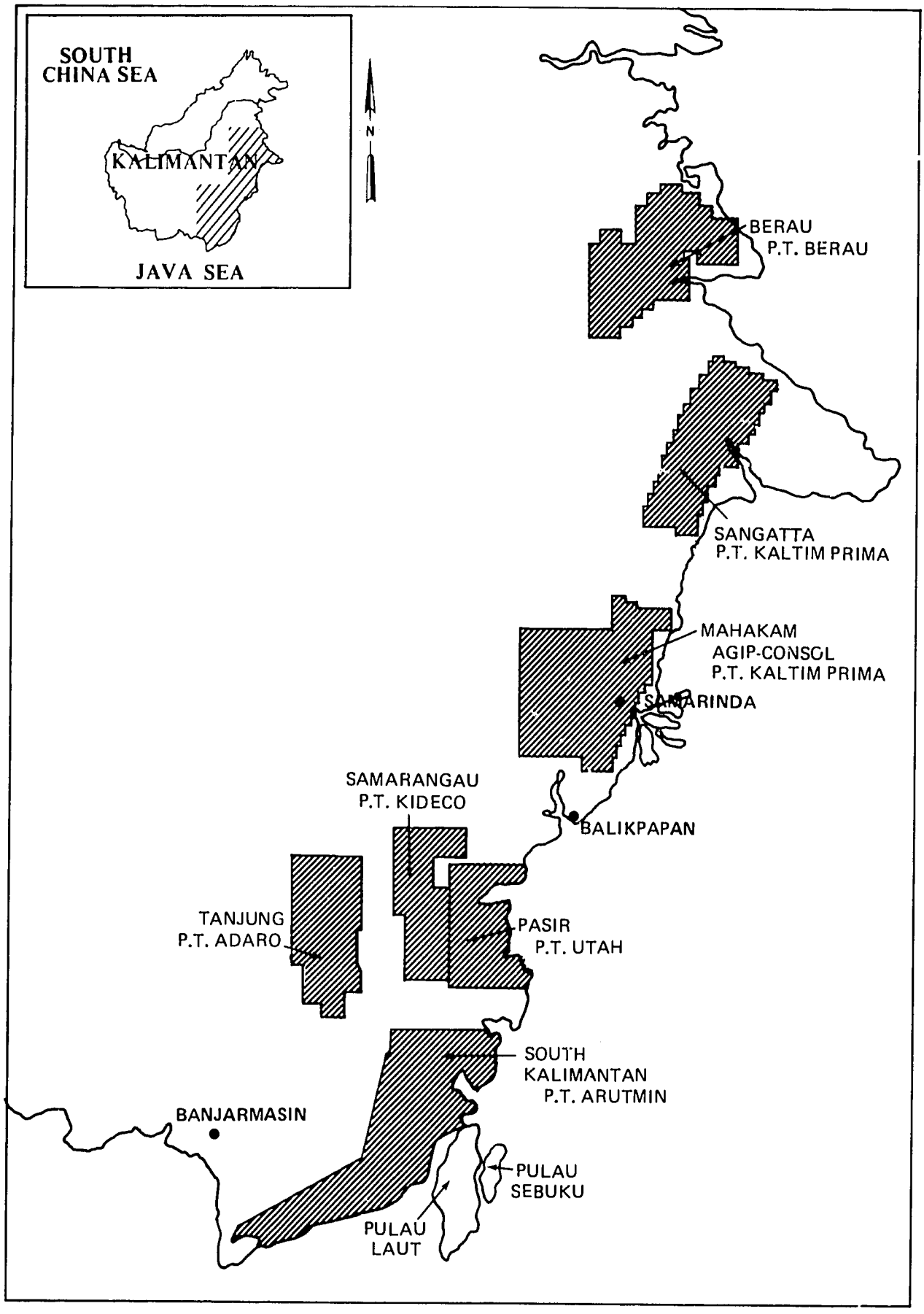

Figure 3.1-1 KALIMANTAN COAL EXPLORATION AREAS

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Table 3.1-1

KALIMANTAN COAL PRODUCTION AREAS

Area Name[a]	Production Sharing Contractor
South Kalimantan	P.T. Arutmin
Pasir	P.T. Utah
Samarangau	P.T. Kideco Jaya Agung
Mahakam	Agip-Consol Joint Venture P.T. Kaltim Prima Coal
Sangatta	P.T. Kaltim Prima Coal
Berau	P.T. Berau
Tanjung	P.T. Adaro

(a) Used in this report

PN Tambang Batubara has a long-range production schedule for all of Kalimantan, leading to a production level of 17 MMTPY by 1994 (see Reference 3-1), as well as a specific production schedule for each of the areas (see Reference 3-8). Without significantly altering these projections, this section discusses these projections in light of ongoing exploration activities and preliminary findings of the various contractors operating in Kalimantan. The production schedules, as well as the potential demand schedule developed in the next section, form the basis for the coal transport discussions in Sections 5 and 6.

Data used in developing this section is in large part based on information provided by PN Tambang Batubara and the Ministry of Mines and Energy (References 3-1, 3-2, 3-3, 3-5, 3-6, 3-8, and 3-9). Reference 3-8 is particularly important in that it documents preliminary plans and decisions regarding Kalimantan coal development resulting from a meeting on March 15, 1984 attended by the Ministers of Mines and Energy, Industry, and Communications. The data from the above references has been augmented by information obtained from field visits to the South Kalimantan, Pasir, and Mahakam areas, and from extended discussions with

P.T. Arutmin, P.T. Utah, P.T. Kideco Jaya Agung, Consol, P.T. Kaltim Prima Coal, and P.T. Berau. The data used in this section is sufficient to gain general insight into the opportunities, possibilities, and constraints of Kalimantan coal development. However, currently available data is still too sketchy and incomplete to assess the technical and economic feasibility of coal production in Kalimantan. In most areas, continued exploration and feasibility studies will be required to complete the needed data base.

Subsections 3.2 through 3.8 provide a summary for each individual area identified in Figure 3.1-1, based on information available to the authors of this report. Treatments of the South Kalimantan and Pasir areas are more extensive than the others, in part reflecting the fact that P.T. Arutmin and P.T. Utah are the furthest along in their exploration efforts. Subsection 3.9 discusses future production levels by area. Subsection 3.10 presents a set of observations and conclusions regarding Kalimantan coal development.

3.2 SOUTH KALIMANTAN AREA

3.2 SOUTH KALIMANTAN AREA (References 3-10 through 3-18)

3.2.1 Exploration Overview

P.T. Arutmin concentrated initial exploration efforts in South Kalimantan on the eocene coal deposits in the Senakin Peninsula (see Figure 3.2-1). Senakin is located north of Pulau Laut and Pulau Sebuku, two major islands off the coast of South Kalimantan. Boats run from Kotabaru on Pulau Laut to Tanjung Batu on the southern tip of the peninsula. P.T. Arutmin recently stepped up its exploration efforts on the mainland of South Kalimantan and has identified sizable miocene coal deposits close to the coast, opposite Kotabaru and across Laut Strait, between the Sarangga and Setangga Rivers.

Exploration on the Senakin Peninsula during 1982 and 1983 identified three major coal deposits (the Sangsang, Sepapah, and East Senakin deposits) with an average thickness of at least 4 meters and with dips ranging from 8 to 18 degrees (see Figure 3.2-2). They were identified from aerial photographs followed by extensive ground surveys and core drilling. At the end of 1983, analyses from 140 drillholes (70 to 100 meters deep) and numerous outcrop samples were available. All the deposits are close to navigable waters, or are no more than 30 km from a possible loading point.

The center of the Sangsang deposit is approximately 4 to 5 km from Sangsang village. The deposit covers about 3.2 square kilometers and has an average thickness of about 6 meters. The area topography ranges from rugged and dissected rain forest near the coal outcrop in the east to lower lying gently undulating grass and scrublands in the west. Dips range from 10 to 12 degrees near the surface. Farther down, the seam plunges abruptly to dips over 40 degrees. Southwest of the area there is a rubber and palm oil plantation. The Pengapitan River, which goes through the village of Sangsang and passes the deposit, drains into the Sangsang estuary near Duren Island. Abundant mangroves grow at the mouth of this river.

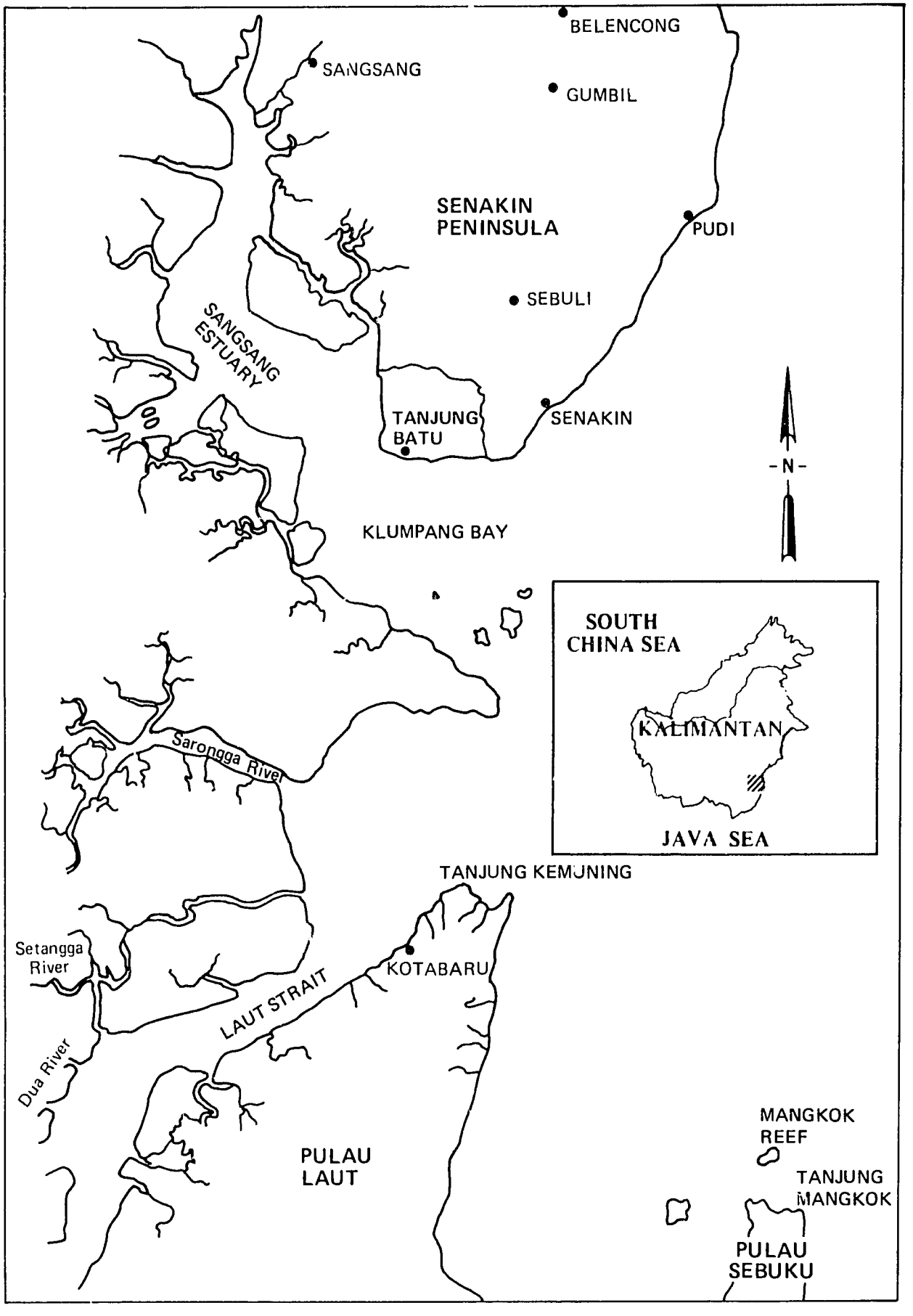

Figure 3.2-1 CENTER OF SOUTH KALIMANTAN
COAL EXPLORATION ACTIVITIES

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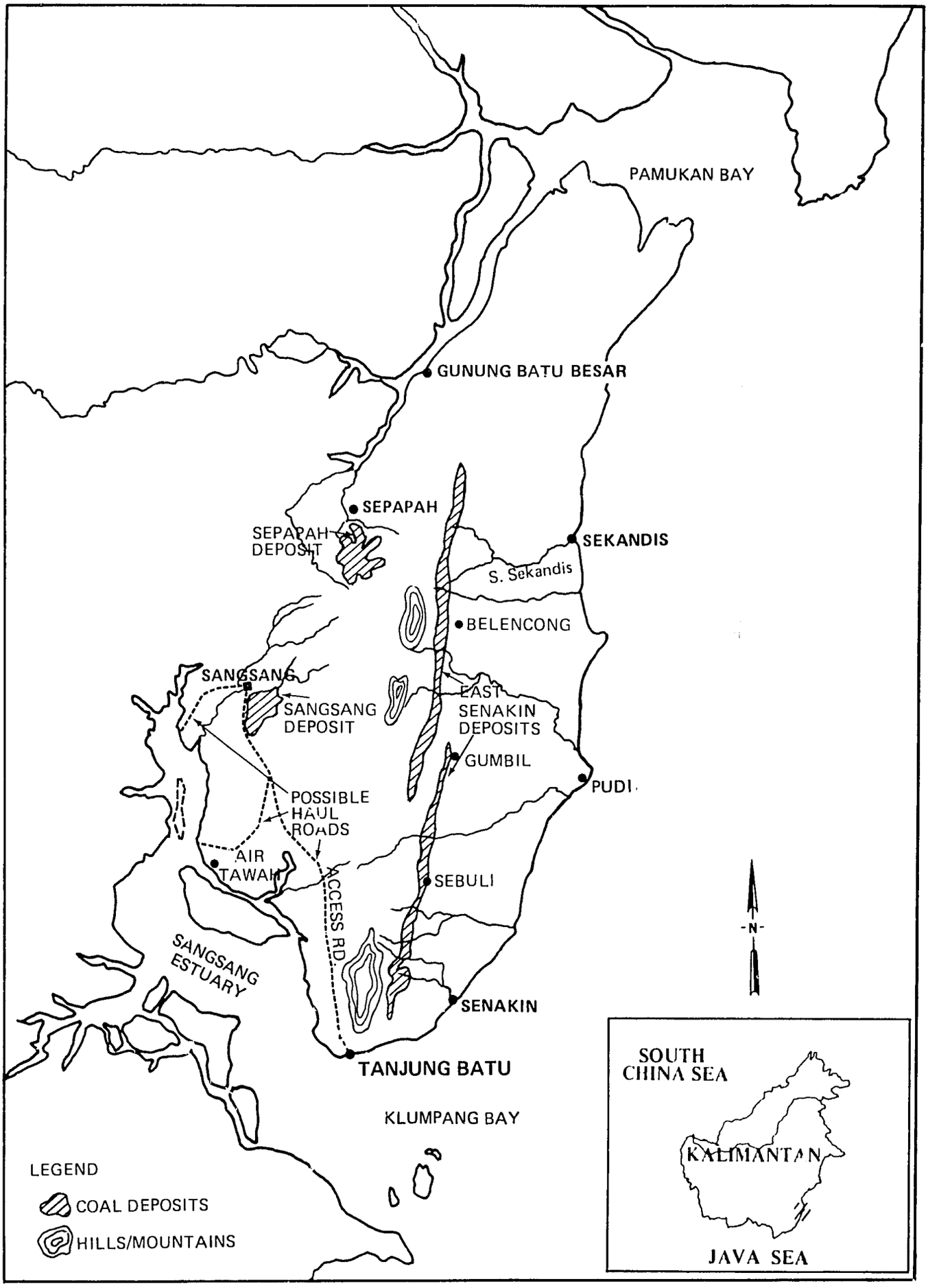


Figure 3.2-2 SENAKIN PENINSULA

The Sepapah deposit, northeast of Sangsang, is very similar to the Sangsang deposit, with seam thicknesses of over 4 meters. Primary rain forest covers the area along the western side. Not far to the north of Sepapah there is a logging operation of the P.T. Inhutani-II forest company. The Sepapah River goes through the deposit and flows into Pamukan Bay, passing Sepapah Village and the old coal mining town of Gunung Batu Besar.

The deposits on the eastern flank of the domed anticline form a long narrow strip almost 40 km long. Two separate areas can be identified; the northern area with Belencong as the approximate center, and the southern area with Sebuli as the approximate center. In the north, coal crops out in an area of high relief with eastward dips ranging from 8 to 18 degrees. However, the topography changes to gently rolling grassland toward the coast. The central section (8 km long), passes through primary rain forest that contains part of the timber resources of P.T. Inhutani-II. Several east-flowing rivers cross the narrow strip of coal, draining into the Makassar Strait. The southern part of the East Senakin deposits has generally less severe topographic relief. Several small settlements are within the coal deposits area and there are some scattered gardens for vegetable production.

3.2.2 Quantity and Quality Estimates

Based on the 1982 and 1983 exploration results, P.T. Arutmin initially estimated that the three major deposits on the Senakin Peninsula contained approximately 80 to 90 millions tonnes of high quality bituminous coal reserves. This estimate measured only coal up to a depth of 60 meters with stripping ratios of less than 5 to 1, and excluded the first 5 meters of weathered coal and areas with sulfur content of more than 1 percent. Of the three deposits, the East Senakin areas were estimated to contain two-thirds (about 50 million tonnes) of the total reserves, Sangsang about 30 percent (25 to 30 million tonnes), and Sepapah about 4 percent (5 to 10 million tonnes). During early 1984 additional drilling (a total of 3,000 meters) and additional trenching were performed in the three areas. Based on 1984 results, P.T. Arutmin

has indicated that the first estimate was overly conservative and a more realistic estimate for the economically recoverable reserves would total between 200 and 300 million tonnes. This includes coal to a depth of 100 meters, allowing for deep stripping with ratios of up to 20 to 1.

Senakin coal generally can be regarded as an excellent steaming coal. On an as-shipped basis, the coal is low in moisture (4.5 to 7 percent) and sulfur (0.2 to 1.0 percent), high in volatile matter (37.2 to 41.2 percent), and moderate in ash (14.5 to 20.5 percent). Ash chemistry and ash fusion temperatures are excellent for steaming coal applications. The latter has been borne out by actual bulk sample testing at the beginning of 1984. These tests demonstrated a heat content of 5,600 to 6,500 kcal/kg on an as-shipped basis. The only potential drawback is that the coal is hard, with a Hardgrove index of 34 to 42. Proper pulverizer design, however, should minimize grinding difficulties. Discussions between P.T. Arutmin and PLN have confirmed that this would be feasible and that problems related to grinding or abrasiveness are not to be regarded as serious.

Much less is known about the mainland coals in the South Kalimantan area. Preliminary investigations indicated that the area south of the Sarangga area has sizable quantities of lignite coal. Estimates range up to 150 million tonnes to a depth of 60 meters. This coal has a moisture content of between 23 and 30 percent, low ash, and a heat content of around 5,000 kcal/kg. The area this coal is from is generally flat or gently rolling grassland (alang-alang). Part of the area is a planned transmigration area.

3.2.3 Projected Coal Development

Because coal from the Senakin Peninsula appears to be the best coal in the South Kalimantan area, it is targeted for early development. Furthermore, since Sangsang coal is very low in sulfur and more accessible than East Senakin coal, the Sangsang deposit is the most likely candidate for early development. The long narrow shape and rugged terrain of the East Senakin deposit will make development more difficult.

P.T. Arutmin plans to mine the Senakin reserves by open cut methods, using trucks and shovels. Initially, dozers and scrapers will be used in areas of low overburden. When production levels increase, major equipment used will consist of hydraulic and electric shovels, large haul trucks for overburden removal, backhoe excavators, and bottom dump tractor-trailer coal haulers. Crawler-mounted rotary drills will be used for overburden and coal blasting. It is envisioned that minimal coal preparation will be required, limited primarily to coal sizing prior to shipment.

Production development is viewed as a phased process. During Phase I, areas with low stripping ratios in the Sangsang area would be opened, leading to a production level of around 1 MMTPY. This phase could start in 1985 at a level of 375,000 tonnes per year. Phase II, an intermediate production phase starting in 1987, would see production go up to 2 MMTPY by 1988 or 1989 and would require full development of the Sangsang and Sepapah deposits, and initial development of the East Senakin deposits. When all areas are in production in Phase III, a production level of 5 MMTPY could be reached by 1990. The above schedules reflect only what is technically feasible. Attainment of these schedules is dependent on having sales contracts for the coal because no development will take place without contracts.

3.2.4 Infrastructure and Coal Transport

Because early development of the South Kalimantan area is focused on the Senakin Peninsula, this subsection deals only with infrastructure on the Senakin Peninsula and options for transporting its coal to customers. The actual mining is viewed as a generally simple operation, meaning that infrastructure issues such as housing, schools, medical facilities, water supply, etc. are at present not considered to present major problems or constraints. Future mining plans will need to provide adequate solutions to these issues. Therefore, the main infrastructure issue relates to coal transport.

General Overview. The Senakin Peninsula is sparsely populated, with a total population of about 25,000. It has a very primitive road system that does not link with mainland roads. One district road in the southern part of the peninsula connects the towns of Tanjung Batu, Senakin and Pudi, and can handle trucks with axle loads of 3.5 to 5 tonnes. Most of the roads were built by the logging and coal companies, and the only vehicles operated on the peninsula are those associated with logging and coal operations. For the purpose of coal exploration and drilling, roads were built connecting the Sangsang area to the Sepapah area, and the Sangsang and Sepapah areas to East Senakin. A road also was built along the East Senakin deposits. This system is essentially temporary, and the roads and bridges are severely damaged in heavy rains.

In order to haul coal from the deposits to the coast, a new all-weather road system will have to be developed with due regard for the size trucks to be used for overburden removal and coal transport. In addition, for Senakin's coal resources to be fully developed, an all-weather, logistical support road linking the peninsula to the national highway system most likely will be necessary. A planned national road linking Banjarmasin with Balikpapan via Batu Licin will pass within 35 km of the Sepapah deposits, but no plans exist for connecting the Senakin Peninsula with this road. There are no topographical obstacles to building a connector road to this national road, but existing transmigration areas and rubber plantations may have to be crossed. Technically, road building presents no particular problems since most construction materials are available on the peninsula.

Transport Options. The building of a road network on the Senakin Peninsula is not considered a major problem. The type of transport system to be selected once the coal reaches the coast of the Senakin peninsula, however, is a more critical consideration. Several options have been considered:

- Option 1. Direct shipping to customers out of a deep draft port on the east coast of the peninsula near Pudi
- Option 2. Direct shipping to customers out of Tanjung Batu on the southern tip of the peninsula

- Option 3. Shipping by barge from suitable locations on the Sangsang estuary or Tanjung Batu to a transshipment terminal where the coal would be transloaded to larger vessels for direct shipping to customers

Option 1. Presently, the first option has been dismissed because generally swampy coastal conditions and shallow water off the east coast of the peninsula make it economically unfeasible to develop a port site. Near Pudi the 9 meter depth contour line is approximately 6 km offshore, and the 15 and 18 meter contour lines are 11 and 16 km offshore, respectively. To accommodate very large bulk carriers a very long jetty would be required, or possibly a combination of a jetty with a dredged channel. For smaller bulk carriers and ocean-going barges, it would be necessary to provide artificial protection with a long trestle and causeway. There is a minor estuary giving access to open waters at Pudi (a small fishing community), but the area is entirely unprotected and open to southeast monsoon winds and waves.

Option 2. Options 2 and 3 have been actively studied by P.T. Arutmin. The major issue for Option 2 is draft restrictions for vessels entering Klumpang Bay. Direct shipping out of Tanjung Batu (without dredging the approach channel) is constrained by a sandbar across the entrance to Klumpang Bay with a limiting draft of approximately 8 meters (at high tide). The approach channel from sandbar to the port is at least 9 meters. Near Tanjung Batu itself there is sufficiently deep water (15-20 meters) to establish a port. Without dredging the type and maximum size of vessels that can approach Tanjung Batu are:

- Barges up to 10,000 DWT
- Fully loaded bulk carriers up to 10,000 DWT, sailing at high tide
- Lightly loaded bulk carrier up to 20,000 DWT, sailing at high tide

Dredging an approach channel to Tanjung Batu has been preliminarily investigated and is technically feasible (see Table 5.4-7). The majority

of the material to be dredged would be soft and sandy, when compared to rock and coral.

Option 3. There are two major issues for Option 3: location of a barge terminal on the coast of the peninsula, and location and type of a transshipment terminal. Several potential sites for a barge terminal have been investigated along the Sangsang estuary up to Tanjung Batu. Generally, the further up the estuary the available draft diminishes, limiting the size of the barge to be used. On the other hand, a barge terminal close to Sangsang would limit the hauling distance between the Sangsang mine and the coast.

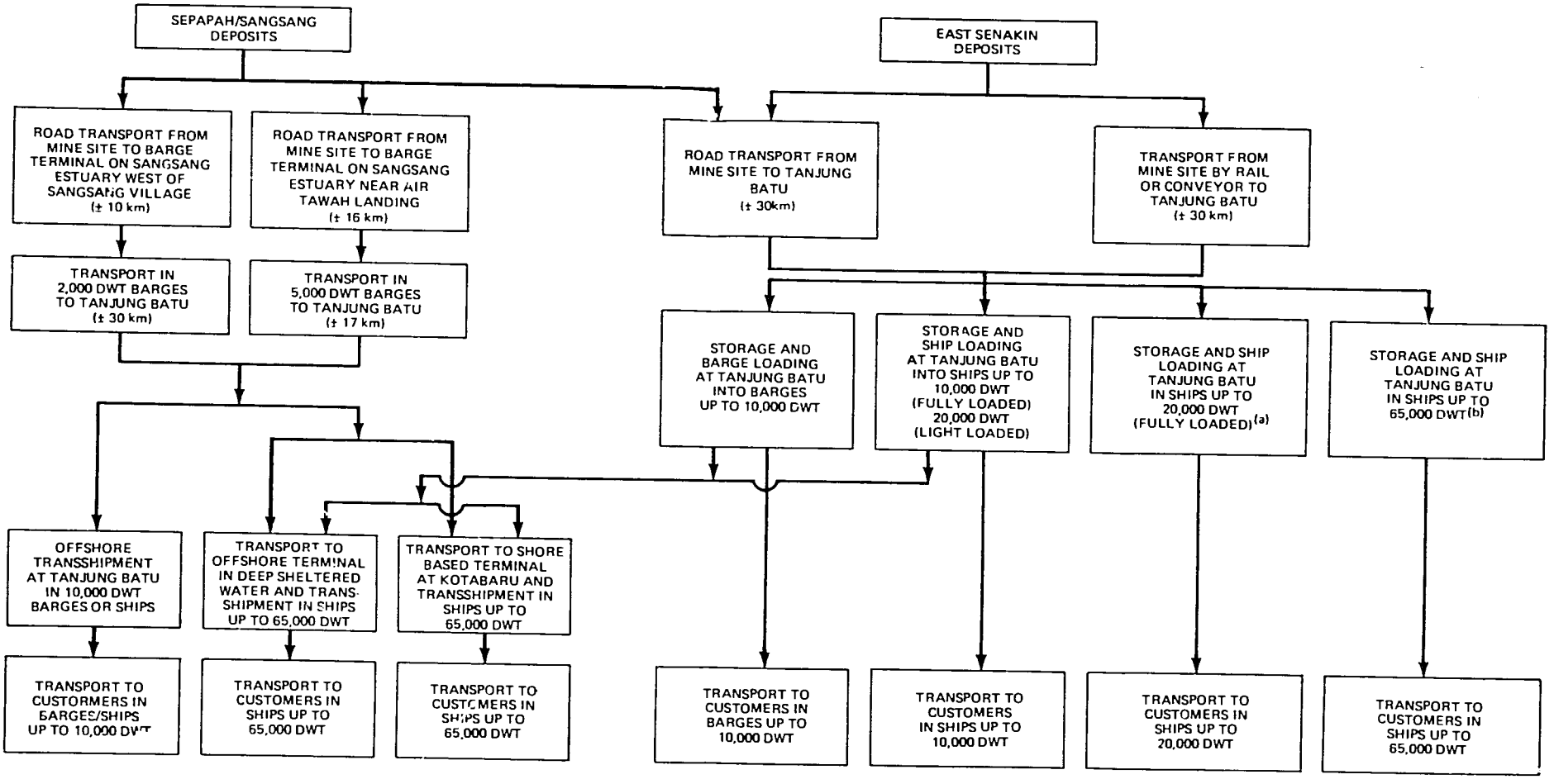
Transshipment can be performed either offshore (e.g., a ship anchored in deep sheltered water) or by shore-based terminal facilities. Two sites have been considered (see Figure 3.2-1): one near the top of Pulau Sebuku (i.e., the Mangkok Reef and Tanjung Mangkok), where there are deep waters; and at Tanjung Kemuning, about 4.5 km northeast of Kotabaru on Pulau Laut. Since the waters near the top of Pulau Sebuku are prime breeding grounds for fish and shrimp, this site has not been further investigated. The site near Kotabaru offers an excellent prospect. The current approach channel has a depth of approximately 12 meters and, with relatively minor dredging, bulk carriers as large as 160,000 DWT could be accommodated.

Alternative Shipping Systems. The above discussion of direct shipping out of Tanjung Batu vis-a-vis transshipment gives rise to a number of alternative shipping systems that potentially could be used (see Figure 3.2-3). Arbitrarily, the maximum size of vessels to be used has been set at 65,000 DWT, although larger vessels could be used if the approach channels were dredged. When the East Senakin deposits are in production (during Phase III) the throughput levels may warrant rail or conveyors to transport the coal from the mines in East Senakin to the loading point at Tanjung Batu (this is further discussed in Section 6). Finally, it should be realized that any system will be developed gradually, matching the production growth at Senakin. This in turn means

that the system may evolve over time as a combination of the alternatives shown in Figure 3.2-3. For example, during Phase I when throughput is low, coal could be shipped out of Tanjung batu in 10,000 DWT vessels without dredging. When throughput becomes large enough to warrant a terminal at Kotabaru (starting at the end of Phase II), coal could be shipped by barge to Kotabaru and transloaded into large vessels.

P.T. Arutmin has conceptually defined three alternatives. In the first alternative, Kotabaru is envisioned as the main coal terminal and Tanjung Batu would only be used initially as loading point. As production increases, coal would be barged from Tanjung Batu to Kotabaru for subsequent transshipment. In the second alternative, Kotabaru is envisioned as the main terminal, but coal would be barged from various points along the Sangsang estuary. In the third alternative, Tanjung Batu would be developed as the only loading point for Senakin coal, and the approach channel would be dredged to accommodate 30,000 DWT vessels during Phase II and 60,000 DWT vessels during Phase III.

Further analysis will be needed to identify the most attractive course of action for the development of the actual transport system. This analysis will have to take into account the types of markets served, which influence type of vessels to be used (and thus dredging costs). Finally, an important consideration is the potential for coal development in other areas of South Kalimantan. The attractiveness of the terminal at Kotabaru would be greatly enhanced if, for example, coal from the mainland could also be transshipped at the same terminal. On the other hand, if Senakin would be the only coal production area in South Kalimantan, a terminal at Tanjung Batu with a dredged approach channel may be the preferred solution.



(a) DREDGING TO 10.1 M REQUIRED FOR ENTRANCE OF KLUMPANG BAY

(b) DREDGING TO 13.9 M REQUIRED FOR APPROACH CHANNEL TO TANJUNG BATU

Figure 3.2-3 SUMMARY OF ALTERNATIVE SYSTEMS FOR COAL TRANSPORT OUT OF THE SENAKIN AREA

3.3 PASIR AREA

3.3 PASIR AREA (References 3-19 through 3-24)

3.3.1. Exploration Overview

P.T. Utah started exploration in early 1982 and has completed sufficient exploration to identify the coal production potential of their area. Major emphasis is currently on identification of possible markets and securing sales contracts. As soon as contracts are established, mine development plans can be finalized, construction can begin, and coal production will start.

Initially, exploration interest focused on two separate geographical areas: one close to the Barito River, north of the area currently being explored by P.T. Adaro (see Figure 3.1-1), and the Pasir region of east Kalimantan (see Figure 3.3-1). Early exploration results for the northern Barito area were rather disappointing, characterized by generally thin seams with little potential for surface mining. In addition, the fact that the area is relatively far inland led P.T. Utah to decide to concentrate its 1983 program on the eocene coal deposits in the Pasir area. The Pasir area can be reached by road from Balikpapan, a distance of about 100 km. The deposits are located relatively close to the existing main road connecting Balikpapan with Banjarmasin.

At the end of 1983, P.T. Utah had completed an extensive exploration program including more than 21,000 meters of mostly open hole drilling, augmented with slim line and large diameter (150 mm) coring. As a result of these exploration efforts, a number of deposits were identified in the Pasir area within a narrow, 40 km long area (see Figure 3.3-1). Although in all these deposits the same coal seam (the Kendilo seam) is of economic interest, they can be categorized as the Bindu-Betitit deposits in the area north of the Kendilo River, and the Petangis deposits south of the Kendilo River. The Kendilo seam averages in thickness between 4.4 and 6.9 meters, and dips to the east at 10 to 25 degrees. Average seam thickness in the northern area is higher than in the southern area -- 6.9 meters for Bindu and 5.7 meters for Betitit, versus 4.4 meters for Petangis.

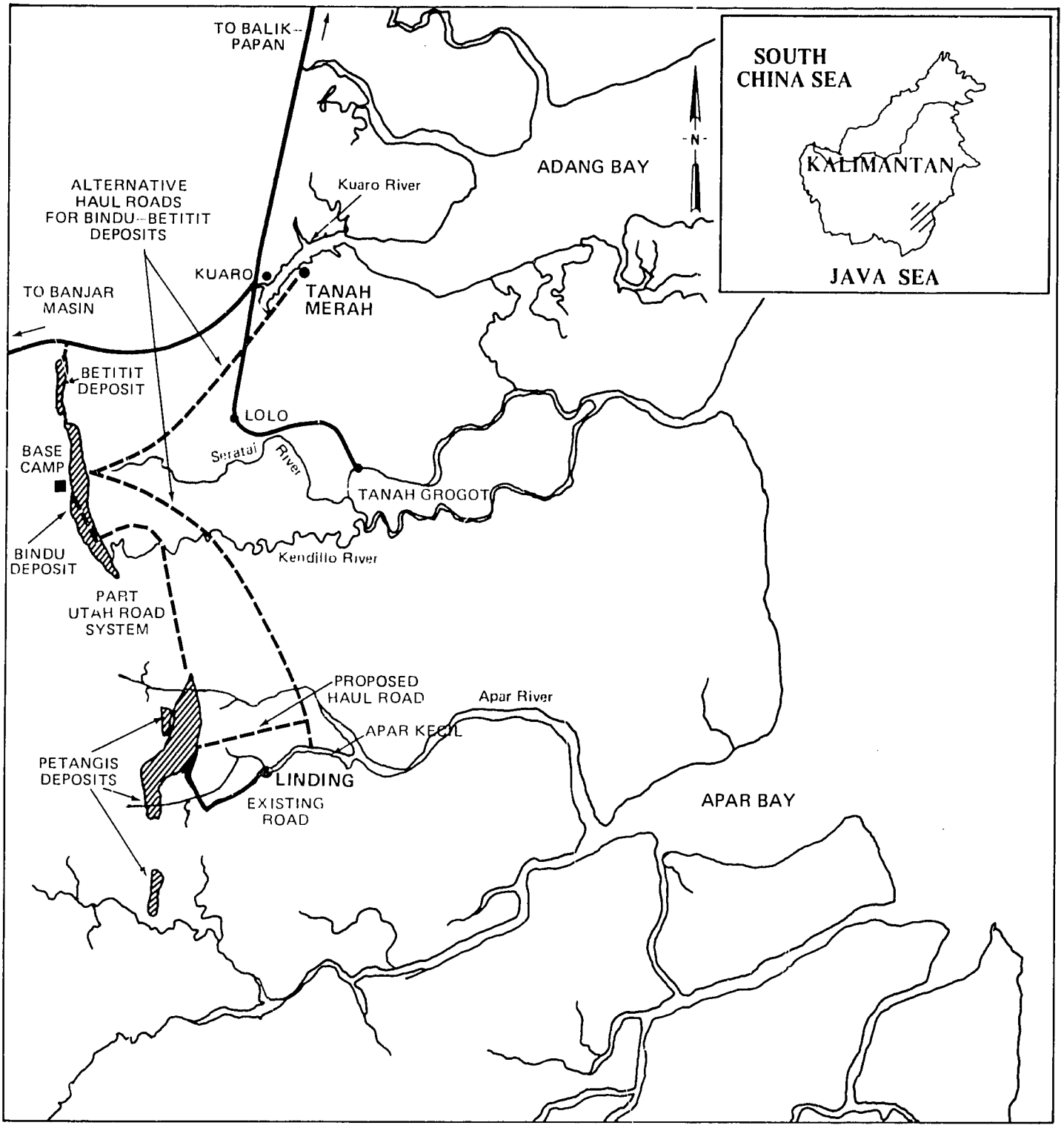


Figure 3.3-1 THE PASIR AREA

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The northern area (Bindu-Betitit) is located approximately 17 to 20 km from Tanah Grogot, the main population center in the Pasir area. The deposits generally are in rugged terrain that changes to low-lying flatlands in the direction of Tanah Grogot. The latter lands are used for agricultural purposes including rice cultivation, and rubber and palm oil plantations. Two major rivers, the Kendilo and Seratai, pass through the area.

The southern area contains several deposits, collectively called Petangis deposits, after the nearest town. The area has a gentle topography and is used for agriculture. The coal area is situated within the drainage area of the two arms of the Apar River (the Apar Besar and Apar Kecil), which drains into Apar Bay.

3.3.2. Quantity and Quality Estimates

Proven resources up to an overburden depth of 100 meters are estimated at 67 million tonnes, almost equally divided between the northern and southern areas. More specifically, the Petangis deposits in the south contain 30 million tonnes or 45 percent. The Bindu and Betitit deposits in the north contain 32 and 5 million tonnes or 48 and 7 percent, respectively.

Recoverable mining reserves for the Petangis deposit have been estimated for open pit mining as 26.5 million tonnes. This includes coal with a maximum overburden of 60 meters and stripping ratios up to 7.3 to 1.

Pasir area coal is a bituminous (high volatile B) coal with significant quality differences between the northern and southern areas. The Petangis deposits in the south are very similar in quality to Senakin coal. On an air-dried basis, the coal is low in moisture (4.6 percent) and sulfur (0.84 percent), high in volatile matter (38.1 percent), moderately high in ash (20.6 percent), and has a heat content of 5,900 kcal/kg. Similar to Senakin coal, Petangis coal is hard, with a Hardgrove index of 39.

Compared to Petangis coal, coal of the major deposit in the northern area (Bindu) is much higher in sulfur content (3.17 percent) and ash (28.2 percent), but lower in moisture (3.2 percent) and volatile matter (33.7 percent). It has a heat content of 5,470 kcal/kg. Bindu coal, with a Hardgrove index of 54.3, is much softer than Petangis coal.

In view of sulfur content, Petangis coal is a better steaming coal than Bindu coal, but if used for cement production, both coals would provide a good fuel. P.T. Utah has carried out tests to evaluate the potential for beneficiation of Pasir area coal. It has been confirmed that with a combination of a jig and water washing, ash content could be significantly reduced (33 to 41 percent) and heat content could be increased by 14 to 17 percent.

3.3.3 Projected Coal Development

Because of the lower sulfur content, P.T. Utah has preliminarily targeted the Petangis deposit for early development and feasibility-level mine planning has been conducted for this area. Coal would be produced in eight separate mining areas. An open pit haulback operation is proposed using hydraulic excavators and rear dump trucks for both overburden removal and coal mining. Overburden and coal would be drilled and blasted.

Although P.T. Utah has targeted the Petangis area for early development, there is no reason that coal from the northern area could not be developed. Thus, if sales agreements for Bindu and Betitit coal were obtained, a similar development scheme can be envisioned. Assuming recoverable reserves of around 30 million tonnes in each area, a coal production capacity of 1 MMTPY in each area is a reasonable development target.

Coal production could start in both areas within a period of 9 to 12 months after a sales agreement is obtained. About 3 months would be required for final engineering and 6 to 9 months for construction of the mine, haulage routes, and coal transport facilities. A preliminary

P.T. Utah schedule for the Pasir area indicates that it would be possible to produce 200,000 tonnes in 1985, 800,000 tonnes in 1986, 1 million tonnes in 1987, 1.5 million tonnes in 1988, and 2.0 MMTPY tonnes thereafter.

3.3.4 Infrastructure and Coal Transport

General Overview. Compared to the Senakin area, the Pasir area is much less isolated and is more developed. Total area population is approximately 70,000, with Tanah Grogot serving as the administrative center. Several transmigration settlements are located within the Pasir area. Some close to Tanah Grogot and others near the coal deposits.

The Pasir area has a well developed road system, consisting of approximately 150 km of national roadway and some 900 km of logging roads. There is a main road from Tanah Grogot to Kuaro through the village of Lolo, connecting with the national road between Banjarmasin and Balikpapan at Kuaro (see Figure 3.3-1). To reach Balikpapan, Balikpapan Bay has to be crossed by boat at Penajam. Lolo is about 8 to 10 km from the Bindu-Betitit deposits. The road from Tanah Grogot to Kuaro is in reasonably good condition and suitable for vehicles with maximum axle loading of 5 tonnes. The main national road from Kuaro to Penajam can serve road traffic with axle loading of up to 8 tonnes. Existing bridges on this stretch of road, however, are only sufficient for axle loads of up to 5 tonnes, which therefore can be considered the maximum axle load for Pasir area roads.

As part of its exploration program, P.T. Utah has made a considerable effort to initiate the development of infrastructure, which after expansion can also be used when coal production starts. A well-constructed base camp is available in the northern area and several other camps have been built. A semi-permanent road network has been built, covering and linking the northern and southern areas and providing access to the Petangis deposits. In addition, an extension of the national road to Tanah Grogot has been planned that will pass close to the Petangis deposits. Generally, road construction is not considered a major

problem, as the area outside the deposits is primarily flat. The main obstacles to new road construction are the rivers that need to be crossed.

River Transport. As can be seen from Figure 3.3-1, one of the most prominent physical features of the Pasir area is the extensive river system that cuts deep into the area. The rivers have traditionally been used to transport goods such as agricultural products. Logging companies have transported their products downstream from river loading points. In the northern part of the area, rivers flow into Teluk Adang (Adang Bay), while in the southern area rivers flow into Teluk Apar (Apar Bay). Both bays are vast expanses of water, several kilometers wide and connect the rivers with the Makassar Strait.

Because of the combination of relatively low expected production levels in both areas (i.e., not exceeding 1 MMTPY), long distances from the minesites to the Kalimantan coast (i.e., more than 60 km), shallow waters along the coast, and swampy lands near the coast covered with mangroves, a deep water coastal port for coal transport is clearly unfeasible for the Pasir area. Therefore, P.T. Utah has from the beginning concentrated on identifying suitable river locations that could be used as loading ports. The general plan for coal transport in both areas is as follows:

- Loading at the minesites in trucks of approximately 15 tonnes
- Transport to the river loading points via special haulage routes
- Simple coal preparation and storage at the loading point
- Vessel loading using a stationary loading system with a fixed point conveyor (i.e., moving the vessel while it is being loaded)

The single major constraint in using river loading points is that the type and size of vessels to be used are constrained by the limiting depth and width of the channel. Similar to the situation in the Senakin area, the presence of shallow bars at the entrance to both Adang and Apar bays precludes the use of conventional bulk carriers larger than 5,000 DWT, unless extensive dredging is done. Generally, however, water depths are

adequate for ocean-going barges of 5,000 to 10,000 DWT. If the need arises to transport Pasir area coal in larger vessels, P.T. Utah has identified two alternatives; river loading in barges followed by transshipment at either an existing deepwater port such as Balikpapan or offshore into geared bulk carriers anchored in deep water.

Northern Area Loading Sites. Various potential loading sites were investigated for both the northern and southern areas. In the northern area (see Figure 3.3-2) several sites on Adang Bay and the Kuaro River were investigated. The key problem in selecting a site was to minimize overall transport cost, including land transport cost (determined primarily by haulage distance) and sea transport cost (determined primarily by type and size of vessel used). Initially, P.T. Utah considered Pondong on Adang Bay as a possible site. The distance from Pondong to deep open water (more than 20 meters deep) is approximately 25 nautical miles and the distance to the Petangis deposits is approximately 50 to 55 km. The draft in the channel to Pondong would still limit vessels to less than 10,000 DWT, however, and construction of a haul road would be a significant undertaking. Deepening the channel to Pondong to allow access by Panamax-size vessels would require significant dredging; on the order of 30 to 60 million cubic meters. As a result, Pondong was rejected as a possible site.

The next site actively considered was Tanah Merah on the south bank of the Kuaro River. Tanah Merah is located 32 miles from open water, 15 to 20 km by road from the Bindu-Betitit deposits and 25 and 30 km from the Petangis deposits. This site provides good access to the river from elevated land, eliminating the need to cross mangrove swamps to get near the river. This site has been chosen as a loading point for a palm oil and rubber estate to be located between Tanah Grogot and Tanah Merah. As part of the transport study for the estate, a hydrographic survey was carried out for 10 nautical miles downstream of Tanah Merah. At low tide, channel depth between Tanah Merah and Pasir Mayang exceeds 12 meters. Beyond Pasir Mayang, and in Adang Bay, channel depth decreases to 6.5 to 7 meters over at least 5 to 6 miles. Channel width ranges from approximately 200 meters at Tanah Merah to 700 meters near

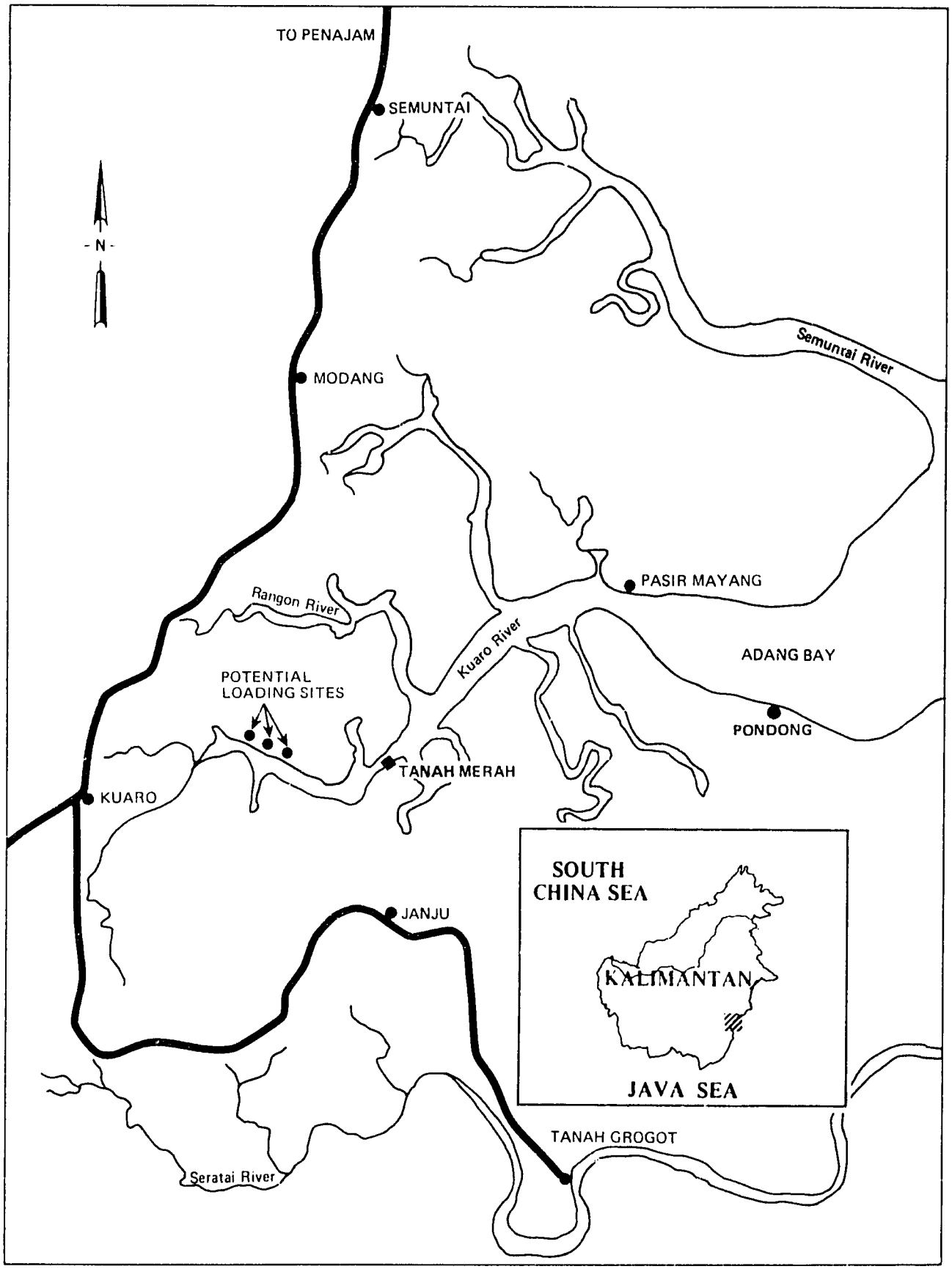

Figure 3.3-2 NORTHERN PASIR AREA

Pasir Mayang and from Pasir Mayang seawards, the width increases to well over 2,000 meters. Based on the above, Tanah Merah is potentially a suitable location for loading ocean-going barges of 5,000 to 10,000 DWT. However, special care would have to be taken in turning vessels of at least 100 meters in length at Tanah Merah. A haulage road to Tanah Merah would have to be constructed partially traversing the existing oil palm plantations.

More recently, P.T. Utah has identified a number of alternative sites further up the Kuaro River (see Figure 3.3-2). These sites are generally preferable to Tanah Merah for the purpose of coal loading. The distances by road from Bindu-Betitit could be slightly reduced, and in contrast to Tanah Merah, these sites would be exclusively used for coal loading. In terms of navigational considerations, these sites are not significantly different from Tanah Merah. For the purpose of this report, it was assumed that a loading point will be selected that is similar to and near Tanah Merah. Therefore, the name Tanah Merah will be used in the next report to identify this selected loading point.

Southern Area Loading Sites. In the southern area, a total of 11 sites on the Apar River system have been investigated. A site has been selected located on the Apar Kecil River, downstream of Linding and 14 km by road from the mining areas of the Petangis deposits (see Figure 3.3-1). There is currently an access road to Linding that was used for hauling logs and equipment, with Linding as the loading point. A new coal haulage road will be constructed to the new coal loading port. River depth at the port is approximately 12 meters and channel width is 130 to 150 meters. Further upstream towards Linding, the river becomes narrower, making it more difficult for barges to turn. The distance from the loading site, which for convenience is also called Linding, to open and deep water is approximately 24 nautical miles. The channel through Apar Bay and the Apar River contains long stretches where the depth is 8 meters or more. However, at the entrance of Apar Bay, the limiting draft is 6 to 6.5 meters. In addition, there are parts of the channel where depth decreases from 8 to 6 and 5.5 meters. Prior to initiating coal transport out of Linding, the entire channel will have to

be surveyed and most likely some dredging would have to be done to ensure that the draft would be at least 6 to 6.5 meters.

As mentioned earlier, coal transport out of the Pasir area can be accomplished by direct shipping out of Tanah Merah and Linding, or by transshipment. If Balikpapan is the transshipment point, coal would first be shipped approximately 60 miles from Tanah Merah to Balikpapan and around 80 miles from Linding to Balikpapan. Considering offshore transshipment, the distance from the river loading point to an offshore deep water location would be about 25 miles from Linding and approximately 30 miles for Tanah Merah.

3.4 SAMARANGAU AREA

3.4 SAMARANGAU AREA (Reference 3-25)

3.4.1 Exploration Overview

Samarangau is the name given to the coal concession area operated by P.T. Kideco Jaya Agung. The concession area is located in east Kalimantan west of the Pasir area (see Figure 3.4-1). The concession contains several, primarily miocene, coal deposits: Oku, Susubung, Terik, Samarangau, Biu, and Samu.

P.T. Kideco started general survey work in September 1982 on an initial area of 2,550 square kilometers. In August 1983, the general survey was finished and 40 percent of the area was relinquished. The exploration phase started in September 1983 focused on the remaining 1,550 square kilometers and was expected to be finished by the end of 1984. When the results of this phase are known, an additional 20 percent is expected to be relinquished so that the concession area for production may be as large as 30 percent of the initial area, or 750 square kilometers.

From the very start of the program, P.T. Kideco has pursued an extensive core drilling program. During 1982, 40 holes for a total of 6,000 meters were drilled, mainly focused on the Susubung, Oku, and Terik deposits. During 1983, 68 holes for a total of 7,500 meters were drilled in the Samarangau deposits. In 1984, drilling of the Samarangau deposit continued. Thirty additional holes for a total of 3,000 meters with an approximate spacing of 500 meters were programmed.

Initially, coal quality was expected to be best in the northern part of the concession, around the Susubung deposit. However, early exploration results showed very difficult geological structures with dips going as high as 70 degrees for the Susubung deposit. Therefore, P.T. Kideco's main focus has shifted to exploration of the Samarangau deposit, currently the target of early development.

The Samarangau deposits are bordered on the east by the Kendilo River and by the Samarangau River to the south. Dips are moderate, ranging from 5 to 10 degrees. A major fault traverses the deposits in a north-south

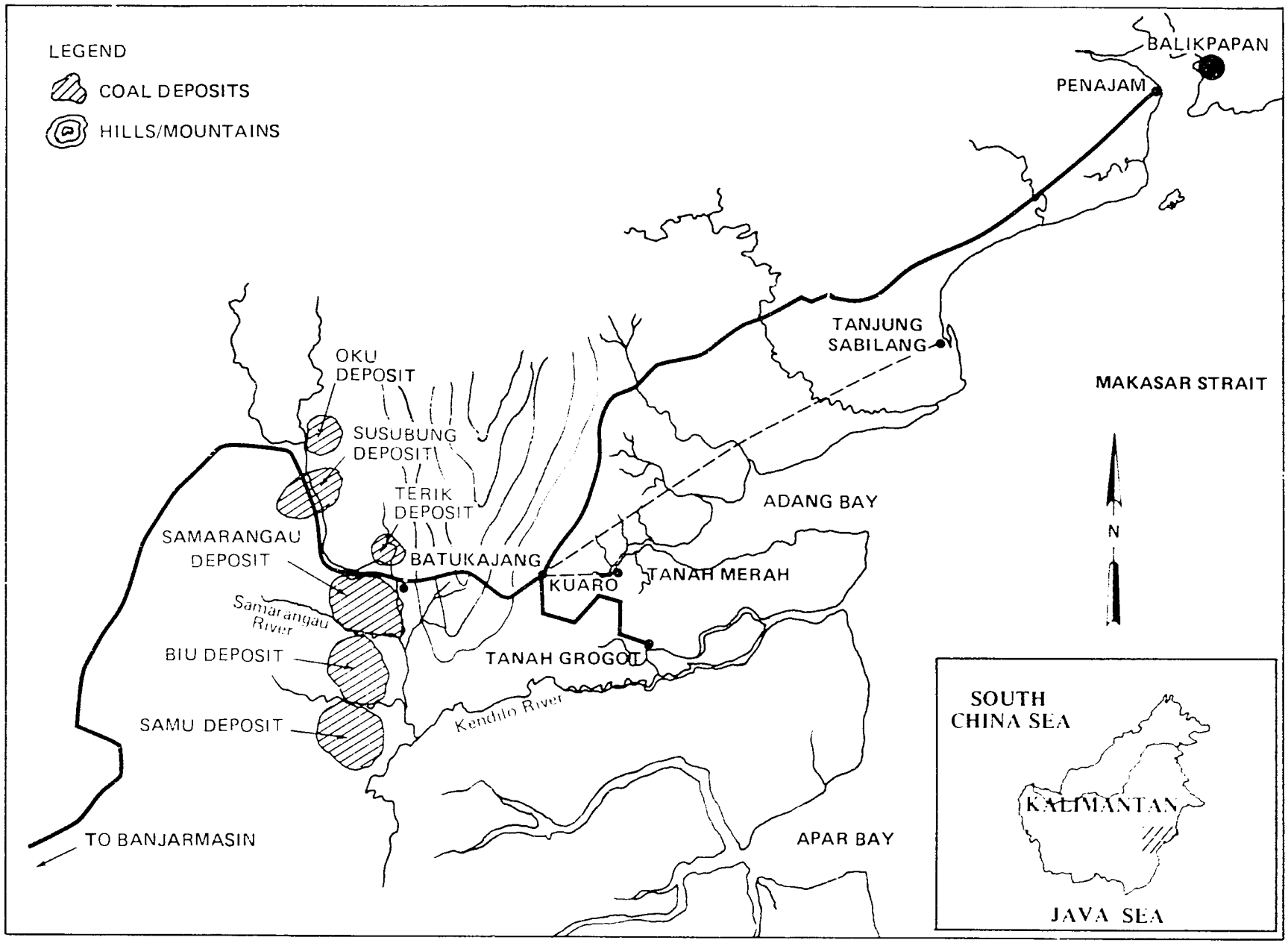

Figure 3.4-1 SAMARANGAU AREA

direction. Generally, coal on the western side of the fault appears to be of better quality than on the eastern side. Initial exploration effort concentrated on a 20 square kilometer area in the middle of the Samarangau deposits, where nine seams are identified, of which three exceed 10 meters in thickness. P.T. Kideco expects that continued exploration to the west and south of their current area of interest will prove additional reserves of similar or slightly better quality.

3.4.2 Quantity and Quality Estimates

Total resources (i.e., geological reserves) in the middle of the Samarangau deposits have been estimated as 215 million tonnes. Sixty-two million tonnes are less than 100 meters below the surface and are suitable for surface mining. The remainder is deeper, and is unsuitable for surface mining. As mentioned above, P.T. Kideco is confident that further exploration to the west and south will increase the initial estimates.

P.T. Kideco classifies the coal as a sub-bituminous coal. Coal quality analysis on a air dried basis indicates a heating value of 6,000 to 6,400 kcal/kg and a moisture content of 3.5 to 5.5 percent. On an as-received basis, the moisture content is as high as 20 to 25 percent. Volatile matter, sulfur, and ash on an air dried basis are 47 to 50 percent, 0.12 to 0.15 percent, and 3 to 5 percent, respectively. Thus, the coal is relatively low in sulfur, high in volatile matter, and moderate in ash. To further determine quality characteristics, P.T. Kideco will analyze a bulk sample of 200 tonnes of Samarangau coal.

One of P.T. Kideco's potential customers -- the National Korean Electric Company (KEL) -- classifies the coal more as a lignite. Moisture content as well as the high percentage of volatile matter are expected to provide insufficient quality to be burned in their existing power stations. However, KEL considers that the Samarangau coal "as is" is suitable for new power stations adapted to Samarangau coal specifications. Such new power stations are expected to come onstream in the early 1990s. To overcome the above-mentioned problem, P.T. Kideco has been exploring the

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possibility of upgrading the coal prior to transport. Upgrading could be accomplished, for example, by low temperature carbonization using a process such as the Lurgi-Ruhrgas process. Reference 3-9 reports the cost of upgrading as US$5 per tonne. If upgrading proves to be feasible, P.T. Kideco would consider upgrading the entire production.

3.4.3 Projected Coal Development

P.T. Kideco's development effort focuses exclusively on surface mining. Initial mine development would take place in the Samarangau area, where the reserves would allow the development of one mining area. Maximum production capacity is currently envisioned as 2 MMTPY, which could be expanded if more reserves are proven and the market exists.

P.T. Kideco considers Samarangau coal as quite competitive in the Korean market, and is actively pursuing this market with KEL. However, as with all other coal contractors in Kalimantan, potential domestic customers would have first preference on the coal. As such, Kideco would honor requests from domestic customers for Samarangau coal but is less inclined to put a major effort into development of a local market for its coal. It is expected that the Korean market will be able to absorb at least 2 MMTPY of Samarangau coal.

The initial production schedule provided to PN Tambang Batubara called for production levels of 100,000 tonnes in 1986, 800,000 tonnes in 1987, 1.5 million tonnes in 1988, and 2 MMTPY from 1989 on. Currently, this schedule is considered toc optimistic in view of the possible necessity of having to upgrade the coal, and the schedule is expected to be postponed at least one year.

3.4.4 Infrastructure and Coal Transport

General Overview. The Samarangau deposits are located west of the first group of foothills separating the Pasir area from P.T. Kideco's concession. The area is flat, approximately 100 meters above sea level and covered by rain forests. The foothills are approximately 350 to 400 meters above sea level (see Figure 3.4-1).

The area is very sparsely populated. Batukajang is the closest town to the Samarangau deposits and has a population of about 1,000 people. In the past the P.T. Tanjung Raya timber company logged the area, but there are currently no logging activities. It appears that there are few, if any, problems with conflicting land uses, as the area is not used for transmigration, agriculture, or forestry.

The main national road from Balikpapan to Banjarmasin goes through the middle of P.T. Kideco's concession area. The distance from Batukajang to Balikpapan is approximately 140 km, and from Batukajang to Kuaro in the Pasir area is about 30 km. There are no other major roads in the area, with the exception of some logging roads. P.T. Tanjung Raya built a not-all-weather timber road, which passes the likely Samarangau mine site at a distance of 6 km. Road transport of coal from the mine site would include this 6 km, plus 4 km to Batukajang via the timber road. The distance from the mine to Kuaro in the Pasir area would thus be approximately 40 km.

Transport. Although the Samarangau mine is further inland than P.T. Utah's deposits in the Pasir area, the main coal transport problem is essentially the same; selecting a site close to the mine where vessels can be loaded. Since the Kendilo and Samarangau rivers are both too shallow to allow river transport out of the Samarangau area, a site will need to be selected east of the foothills separating the area from the Pasir area. P.T. Kideco has considered two alternatives in principle:

- Truck the coal to a loading site on the Kuaro River near Kuaro
- Truck the coal first to Kuaro and then via a newly constructed road to a loading site on the Kalimantan coast

The advantage of the first alternative is that road haulage distance would be kept to a minimum of 40 to 50 km, and there could possibly be a jointly operated loading terminal with P.T. Utah. The disadvantage of this alternative is that type and size of vessel would be limited, as discussed in Subsection 3.2.4. If coal were to be shipped to Korea, this

alternative would by necessity imply either offshore transshipment or transshipment at another point in Kalimantan such as Balikpapan.

Tanjung Sabilang has been preliminarily identified as the site for the second alternative (see Figure 3.4-1). The advantage of the second alternative is the possibility of loading 50,000 to 60,000 DWT vessels to transport the coal directly to Korea. The disadvantage is the need to transport the coal by truck over a distance of at least 100 km. A new road from Kuaro to Tanjung Sabilang would have to be constructed crossing many rivers and swampy mangrove areas. Alternatively, part of the road from Kuaro to Balikpapan could be used, minimizing new road construction to Tanjung Sabilang. This would most likely require upgrading of the road and bridges to allow for higher axle loadings than currently possible. At present, P.T. Kideco is performing studies to determine which alternative is to be selected.

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3.5 MAHAKAM AREA

3.5 MAHAKAM AREA (Reference 3-26)

The Mahakam area covers a large area in east Kalimantan north of Balikpapan. Samarinda is the provincial capital, and the central and most important town in the region. The Mahakam River, one of Kalimantan's major rivers, flows through the area (see Figures 3.1-1 and 3.5-1).

Evidence of coal deposits is widespread throughout the area. Coal has been produced there for a long time, albeit in relatively small quantities. Four private companies are currently producing coal in concession areas licensed by the Ministry of Mines and Energy and outside the immediate jurisdiction of PN Tambang Batubara. They are:

- P.T. Kitadin
- P.T. Tanito Harum
- P.T. Fajar Bumi Sakti
- P.T. Bukit Baiduri

Exploration activities in the Mahakam area also have a relatively long history. Most recently, from 1978 to 1981, the Directorate of Mineral Resources with the assistance of the U.K. Institute of Geological Sciences carried out exploration work including core drilling in the Balikpapan-Samarinda area, south of the Mahakam River. When the government decided in 1981 to offer private contractors the right to explore and develop the coal resources that were not privately held concessions, the Mahakam area was split into two blocks. The eastern block, covering the area around Samarinda and the Mahakam delta, was contracted out to P.T. Kaltim Prima Coal; the western block, around Tenggarong, was contracted out to the joint venture Agip-Consol.

3.5.1 Exploration Overview

This exploration overview is limited to a discussion of the activities of P.T. Kaltim Prima and Agip-Consol. No information on exploration activities in the privately held concessions is available.

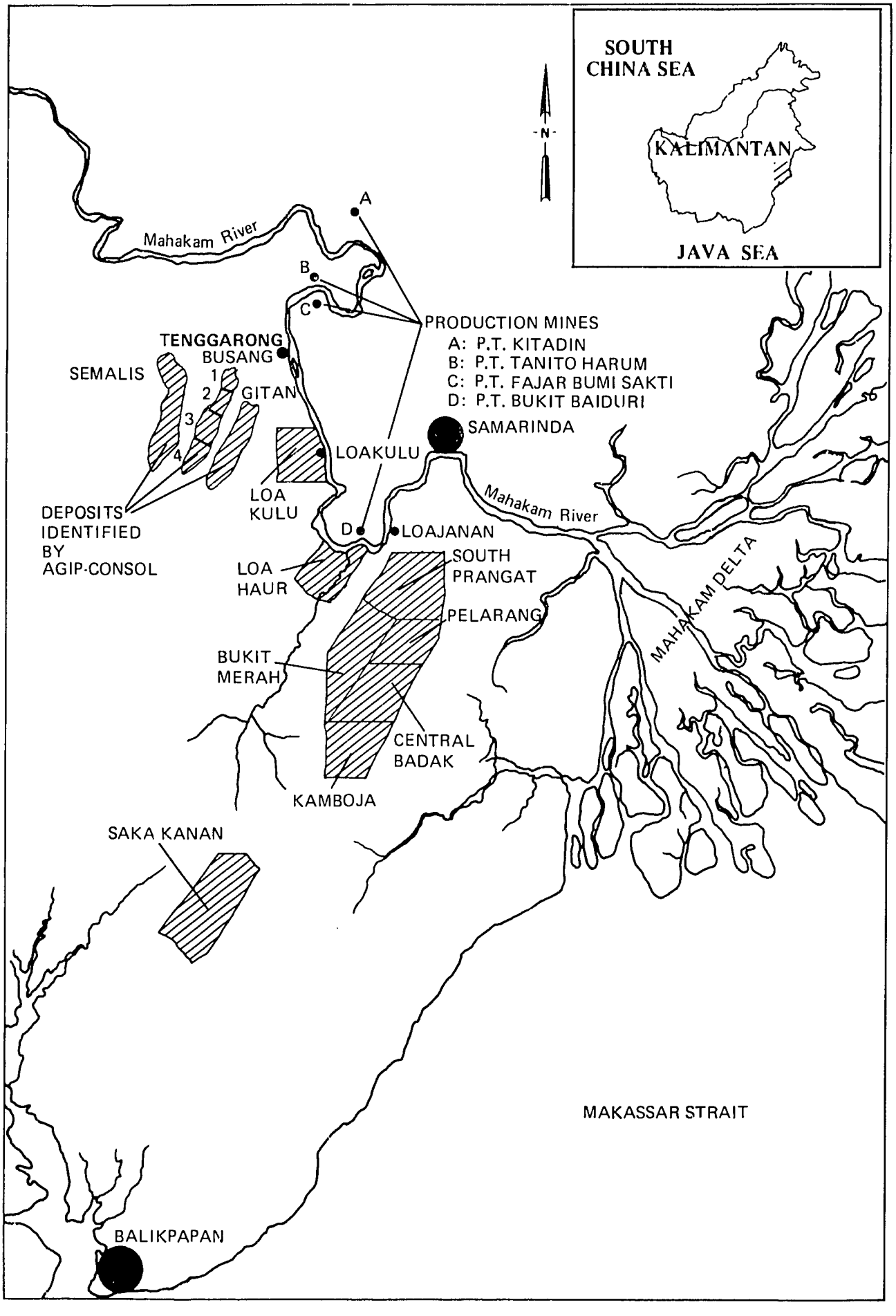

Figure 3.5-1 MAHAKAM AREA

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Western Mahakam Area (Agip-Consol). Work in this area started in May 1982 under the direction of Consol. From May 1982 to July 1983 Consol examined various potentially attractive areas and took outcrop and channel samples. During this general survey period, a limited amount of exploration was done, concentrated on the Semalis, Busung, and Gitan syncline areas, south of the Mahakam River and close to Tenggarong (see Figure 3.5-1). The Busang area appears to be the most promising of the three areas. Consol carried out a small core drilling program there; three holes were drilled to a maximum depth of 200 meters (totaling 450 meters). The northernmost part of the Busang area is approximately 9 km from the Mahakam River, and its southernmost point is about 25 km. Within the Busang area four zones were identified. The second zone contains the most attractive coal with multiple seams. Several seams are over 1 meter thick and there are seams 4 to 5 meters thick. Dips range from 0 to 20 degrees. Faulting in the area is a regular feature.

Consol's program was drastically reduced by the end of 1983. The local office in Balikpapan was closed and a small field office/base camp in Tenggarong was maintained. During 1984 no drilling or sampling was conducted and the program was limited primarily to surface reconnaissance.

Eastern Mahakam Area (P. T. Kaltim Prima). P.T. Kaltim Prima started fieldwork in this area of approximately 3,000 square kilometers in July 1982, first south of the Mahakam River and subsequently north of the river. Work has been limited to general survey and reconnaissance, including outcrop sampling and trenching. P.T. Kaltim Prima has not conducted a drilling program in the eastern Mahakam area.

In the area south of the Mahakam River, P.T. Kaltim Prima continued the previously mentioned work of the Directorate of Mineral Resources. The latter had identified resources in the following areas, shown in Figure 3.5-1:

- Loakulu
- Loa Haur
- South Prangat

- Bukit Merah
- Pelarang
- Central Badak
- Kamboja
- Saka Kanan

The fact that almost 90 percent of the reserves are suitable for underground mining only, with few opportunities for reasonably sized open cast mines, has lessened the attractiveness of this area to P.T. Kaltim Prima. In addition, quality characteristics and geological structure are such that P.T. Kaltim Prima has not continued exploration of the area south of the Mahakam River.

North of the Mahakam River P.T. Kaltim Prima found some interesting coals in the various syncline areas (e.g., Loa Haur syncline). Sizable deposits, called Santan and Sapari, with coal seams up to 3 to 4 meters thick and dips of less than 15 degrees have been identified. However, the quality of the coal, although variable, is generally regarded as lignitic with a relatively high moisture content and variable sulfur content (above 1 percent). P.T. Kaltim Prima considers the coal to be of sufficient quality for local use but less attractive for transport to Java or overseas. In addition, access to some of the areas is difficult and there are conflicts over land uses (e.g., transmigration). P.T. Kaltim Prima has not continued exploration in this area. Instead, it has focused attention on the Sangatta area, discussed in Subsection 3.6.

3.5.2 Projected Coal Development

As is clear from the sketchy information provided in the previous subsection, few definitive statements can be made about future coal development in the Mahakam area. The following paragraphs consolidate some observations based on short site visits and discussions with those involved in survey and exploration work.

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Private Coal Companies. Very little is known about the reserves and quality characteristics of the coal mined by the four private companies operating in the area. However, all four companies seem to be viable operations that produce primarily for the export market, indicating that the coal produced is most likely clean, good-quality, low in ash, and low in sulfur. Their production plans call for stepping up total production from 500,000 tonnes in 1983 to 1.8 million tonnes in 1986 (Reference 3-9). On average these companies currently have annual outputs of around 125,000 tonnes. Some (e.g., P.T. Kitadin) are capable of increasing annual production capacity significantly. Maximum production capacity at P.T. Kitadin is planned for 600,000 to 800,000 tonnes per year.

All companies sell their product on the spot market (i.e., they have no long-term contracts). The product has been sold to Japan, Korea, Taiwan, and the Philippines.

P.T. Bukit Baiduri is typical of the four private companies. It started in 1979 with an annual production of 5,000 to 10,000 tonnes per year and was able to sell two shiploads of around 4,000 tonnes each. In 1982 annual production increased to 76,000 tonnes. Some 200 people are employed at the mine site. The operation of P.T. Bukit Baiduri combines underground and surface mining. For surface mining, graders, shovels, and 15-tonne trucks are used. The open pit mine is approximately 3 km from the Mahakam River, and coal is transported by truck to a storage area close to the river. The run-of-mine coal is washed and crushed prior to transport by ship down the Mahakam River.

With intelligent and careful management and planning the private companies have been able to keep production costs relatively low so they they can sell at an attractive price. For example, it is reported that P.T. Kitadin exported coal to Taiwan in September 1984 for US$32 per tonne, FOB Ambalut, its loading port.

Coal is transported to overseas destinations by Indonesian flag carriers, such as P.T. Bahtera Adhiguna, in vessels of approximately 6,500 DWT. These vessels are partially loaded so they can navigate the Mahakam River

safely. The average cargo is about 4,700 tonnes, while the maximum recorded cargo is 5,300 tonnes. Kitadin coal is loaded by means of a fixed-point conveyor system capable of a loading speed of around 400 to 500 tonnes per hour. It takes approximately 10 to 12 hours to load a vessel at Ambalut.

Western Mahakam Area (Consol). Based on a selected number of channel samples and corehole information, the coal in the Busang area is considered a good steaming coal with relatively low sulfur (around 1 percent), low ash (around 4 to 5 percent) and approximately 15 percent total moisture. The heating value on a raw coal basis is estimated at around 6,000 to 6,5000 kcal/kg. The second zone in the Busang syncline area is estimated to have exploitable reserves of at least 25 million tonnes and could possibly support an open pit mining operation of 1 to 2 MMTPY. It is expected that this would be a truck-and-shovel operation for overburden removal, and scrapers, dozers, and backhoes would be used for coal mining. A mining operation such as this could be brought on line within 2 to 3 years, and most likely faster.

The western Mahakam area is approximately 10 km from a river loading point near Tenggarong on the Mahakam River. Coal would be crushed before transport by truck to the river loadout point.

Eastern Mahakam Area (P.T. Kaltim Prima). The Directorate of Mineral Resources developed estimates for total reserves for the areas investigated south of the Mahakam River and identified in Figure 3.5-1. A total of 1 billion tonnes suitable for underground mining and 133 million tonnes suitable for surface mining has been reported. As mentioned earlier, P.T. Kaltim Prima has accorded a lower priority to the eastern Mahakam area than the Sangatta area. As a result, at present no coal development is projected for this area.

3.5.3 Infrastructure and Coal Transport

The Mahakam area is a well populated area compared to most other parts of Kalimantan. Since early times the Mahakam River has served as the main transportation artery, in particularly for the timber industry.

Throughout most of the area, the river has a width of 200 to 250 meters. Timber-related industries such as saw mills and plywood factories have been established in Samarinda, which has developed into a comparatively large, thriving town. Ships up to 7,000 DWT call on Samarinda to transport goods to and from Kalimantan. Forestry and agriculture are the main industries along the Mahakam River. Several transmigration projects are located in the area.

The Mahakam area has excellent road connections to nearby towns in east Kalimantan. A major national road runs from Balikpapan to Loajanan on the Mahakam River, a distance of about 100 km. At Loajanan all traffic to Samarinda crosses the river by a regular ferry system. The distance from the ferry to Samarinda is about 14 km. From Samarinda a major road to the north connects the Mahakam area with the industrial area in Bontang, on the Kalimantan coast. The distance to Bontang is about 100 km. Generally, smaller roads have developed along both sides of the Mahakam River, extending westward from Samarinda. The town of Tenggarong can be reached from Loajanan along the bank of the river, a distance of about 31 km. A bridge is being constructed across the river to eliminate the ferry crossing at Loajanan.

Because of the extent of development in the Mahakam area, conflicts between prospective coal development companies and other industries are a more serious concern there than in most other coal development areas in Kalimantan. During its exploration efforts in the western Mahakam area, Consol experienced problems and delays in getting equipment to drilling sites because they had to negogiate for the use of logging roads owned and operated by other companies. Similar land-use conflicts exist in the areas surrounding Samarinda in the eastern Mahakam area. Although such conflicts can be resolved in most cases, they add to the complexity and cost of continued coal exploration.

Assuming that coal will be produced in the western Mahakam area and that Tenggarong will be the center of such development, the most efficient way to transport coal to customers outside Kalimantan is by river from a loading site near Tenggarong. The alternative of using truck transport

to the coast over a distance of at least 100 km, coupled with relatively low production levels, is in all likelihood more expensive than river transport.

Tenggarong is located approximately 30 nautical miles upstream from Samarinda, which is connected to the Makassar Strait via a 36-mile long and 100 meter-wide channel. The channel, which traverses the very wide Mahakam Delta (see Figure 3.5-1), needs to be continually dredged because of natural siltation. The design depth of the channel is 6.5 meters and annual maintenance dredging of 1.5 million cubic meters per year is required to maintain this depth. Because of tidal variations, the possible vessel draft varies continuously with a minimum of 5.9 meters, an average of 6.4 meters, and a maximum of 6.9 meters. The channel between Tenggarong and Samarinda also varies considerably. At some places, the depth is as low as 4 meters, while at other places depths of 8 to 10 meters exist. Therefore, the limited draft is a serious constraint to coal transport on the river. For the purpose of this report, it is assumed that in order to transport coal by river it will be economically feasible to maintain a sufficiently wide channel with a limiting draft of 7 meters. Although such a condition will require additional dredging, it is believed that given the current circumstances such effort is attainable. However, beyond 7 meters and in view of the length of the channel, the cost of dredging most likely would become prohibitive.

Two other important constraints to river transport are the bridge currently under construction at Loajanan and the strong currents during the wet season. The latter can be as high as 5 knots, making navigation of the river difficult. The bridge, scheduled for completion in July 1985, will have a height above the water of about 12 meters and a distance between the columns of 80 meters. With these dimensions no ships will be able to pass through to Tenggarong and only barges will be able to transport coal from Tenggarong as well as from the loading sites of the private coal companies. This would imply using either barge transport to final destinations or barge transport to a transshipment point located somewhere beyond the bridge.

3.6 SANGATTA AREA

3.6 SANGATTA AREA (Reference 3-27)

3.6.1 Exploration Overview

The Sangatta area, covering approximately 5,000 square kilometers, is part of P.T. Kaltim Prima's total exploration area. It is located along the Kalimantan coast, north of the Mahakam/Samarinda area, and separated from the latter by the Kutai Wildlife and Nature Preserve (see Figures 3.1-1 and 3.6-1). Survey and exploration work during 1983 and 1984 identified two main deposits, the Lembak deposit and the West Pinang deposit. The West Pinang is considered the better prospect of the two.

The Lembak deposit is located north of the Bungalun River and the West Pinang deposit is located south of the Bungalun River and north of the Sangatta River. Both are close to the coast. On a "straight line," the West Pinang deposit is approximately 20 km inland. Preliminary investigations, carried out in mid-1983, in the Lembak area indicated gently dipping seams of 3 to 5 meters thick. However, quality comparisons between the Lembak and West Pinang deposits showed a generally lower coal quality for the Lembak area. Coal samples from Lembak indicated higher sulfur and ash contents. Moisture content on an air dried basis ranged from 10 to 25 percent. As a consequence, P.T. Kaltim Prima focused its attention on the West Pinang area.

The West Pinang deposit is in hilly, intersected terrain with relief variation of 100 to 150 meters. Generally rough with high points of about 800 meters above sea level, the area is similar to the northern section of the East Senakin deposits in South Kalimantan. The area becomes flatter in the west and towards the north in the direction of the Bungalun River. Based on continued exploration in the area and core drilling to a depth of 250 meters, at least 10 seams have been identified over a strike length of 8 km, including one seam of 5 to 8 meters. Dips range from 10 to 25 degrees, with an average of 15 degrees. The quality of the coal is very attractive; total sulfur content is less than 0.5 percent, ash content is low (1 to 3 percent), and air dried moisture is approximately 10 to 12 percent. The heating value is estimated to average approximately 6,650 kcal/kg. A very rough estimate of reserves

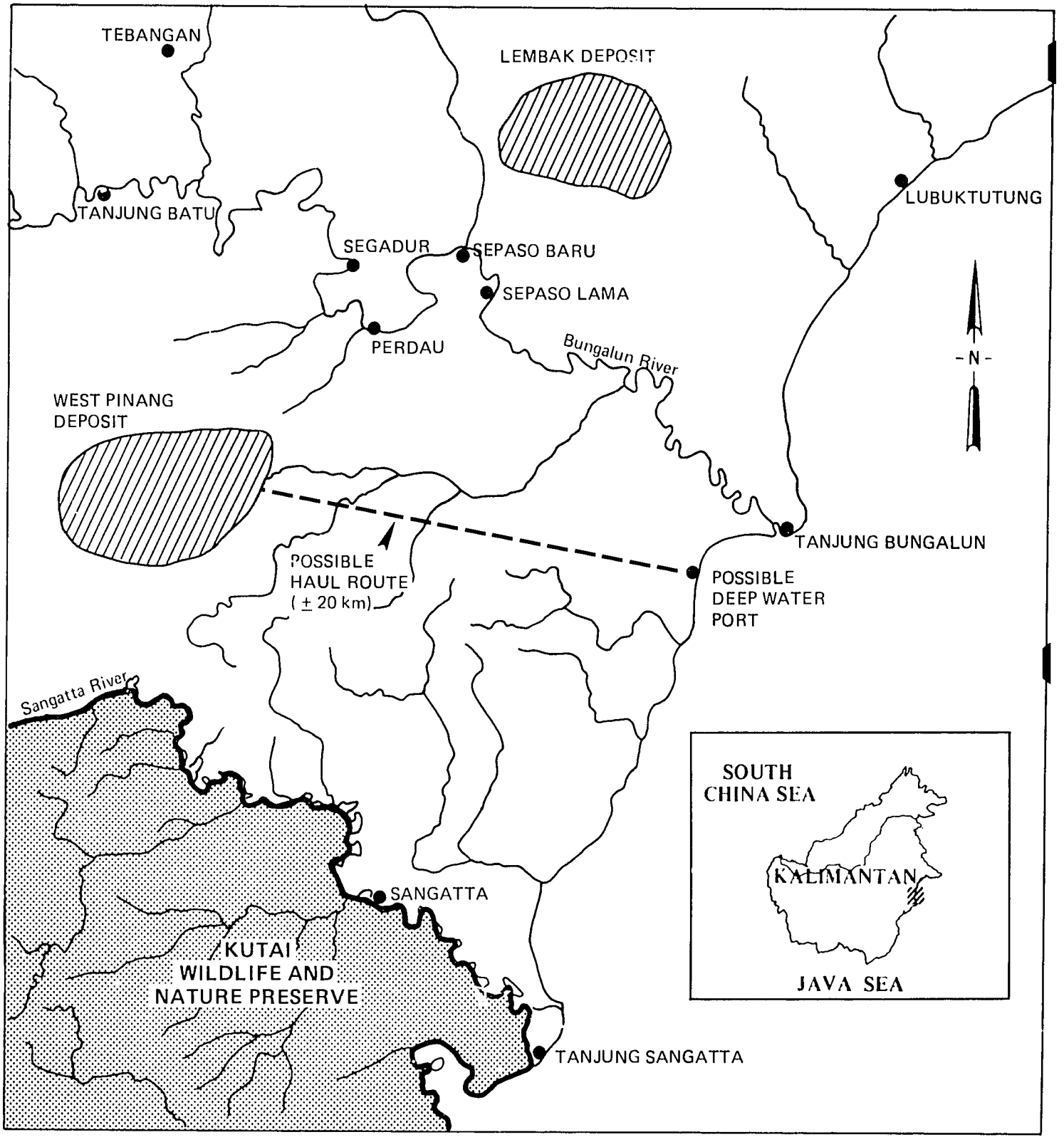

Figure 3.6-1 SANGATTA AREA

is 50 to 100 million tonnes in this area, potentially suitable for surface mining. Possibly 20 to 50 million tonnes could be recovered economically with an open pit operation. As exploration in the area is continued and additional reserves are identified, the area may hold the potential of a 2 MMTPY mining operation producing relatively high-quality coal. This operation could start as early as 1988, if the necessary sales contracts can be secured.

3.6.2 Infrastructure and Coal Transport

Development in the West Pinang area is very sparse since most settlements are located along the Bungalun and Sangatta rivers and along the coast. Forestry and logging constitute the primary land use in the area and a number of timber roads have been built. One road connects the Bungalun and Sangatta rivers and passes through the West Pinang deposit. A new national road from Sangkulirang to Muara Wahau passes not far from the coal area. In addition, the Department of Public Works is constructing a road east of the coal area.

The Bungalun and Sangatta rivers are generally shallow, with their minimum depth not exceeding 4 to 5 meters and their width not exceeding 40 to 50 meters. While the Bungalun River can be considered navigable for small crafts (up to 200 to 300 DWT), the Sangatta River offers limited opportunities. At the mouth of the Bungalun River, at Tanjung Bungalun, there is a sandbar limiting the draft to 2 to 3 meters. Use of the Bungalun River will most likely be restricted to bringing in equipment on small vessels.

It is not envisioned that coal will be transported by river. Instead, a deepwater port on the coast of Kalimantan can be built at a site between Tanjung Bungalun and Tanjung Sangatta (see Figure 3.6-1). At the coast the 14 meter depth contour line is approximately 1 km offshore. Thus, coal could be transported by truck over a 20 km new haul road to the port and loaded directly onto deep draft vessels. The ease with which coal from the West Pinang area could be transported out of Kalimantan is a very attractive feature.

3.7 BERAU AREA

3.7 BERAU AREA (Reference 3-28)

3.7.1 Exploration Overview

The Berau area is the most northern area in east Kalimantan being explored by P.T. Berau (see Figures 3.1-1 and 3.7-1). The initial exploration area is approximately 5,000 square kilometers. The Segah, Kelai, and Berau rivers form the main transport system in the area. The Segah and Kelai rivers join at Tanjung Redeb to form the Berau River, which drains into the Sulawesi Sea. Since no roads connect the Berau area with other parts of Kalimantan, access to Berau is by air (from Samarinda in the south or Tarahan in the north to Tanjung Redeb) or by water (by sea and up the Berau River).

The Berau area is one of the few areas in Kalimantan where significant coal development activities have taken place. Other areas are Pulau Laut and Gunung Batu Besar in South Kalimantan and Mahakam. Exploration activities in the Berau area were started by the Dutch in the nineteenth century. In 1914 coal mining started, and the coal was used to fuel Dutch steamships. Two mines were operated; a surface mine at Parapattan, which produced 336,697 tonnes between 1914 and 1923, and an underground mine at Rantau Panjang, which produced 5.3 million tonnes between 1916 and 1955. Both mines were located close to the confluence of the Segah and Kelai rivers (see Figure 3.7-1). Coal from the Rantau Panjang mine was hauled in small rail cars five km north to Teluk Bayur on the Segah River, where the coal was sized and loaded into 3,000 DWT vessels. In 1978, a group of Japanese companies conducted extensive investigations in the area. One of the companies, Nissho Iwai, later joined with Mobil and formed P.T. Berau. P.T. Berau started survey work in 1983 and reconnaissance drilling in mid-1984.

Evidence of coal is widespread throughout the Berau area, in particular near Tanjung Redeb. Coal is found in multiple seams and is expected to be of very good quality; low in ash, sulfur, and moisture, and with calorific values of around 6,000 to 6,500 kcal/kg. At the old Parapattan mine 18 seams, dipping 10 to 30 degrees, were exploited. At the Rantau

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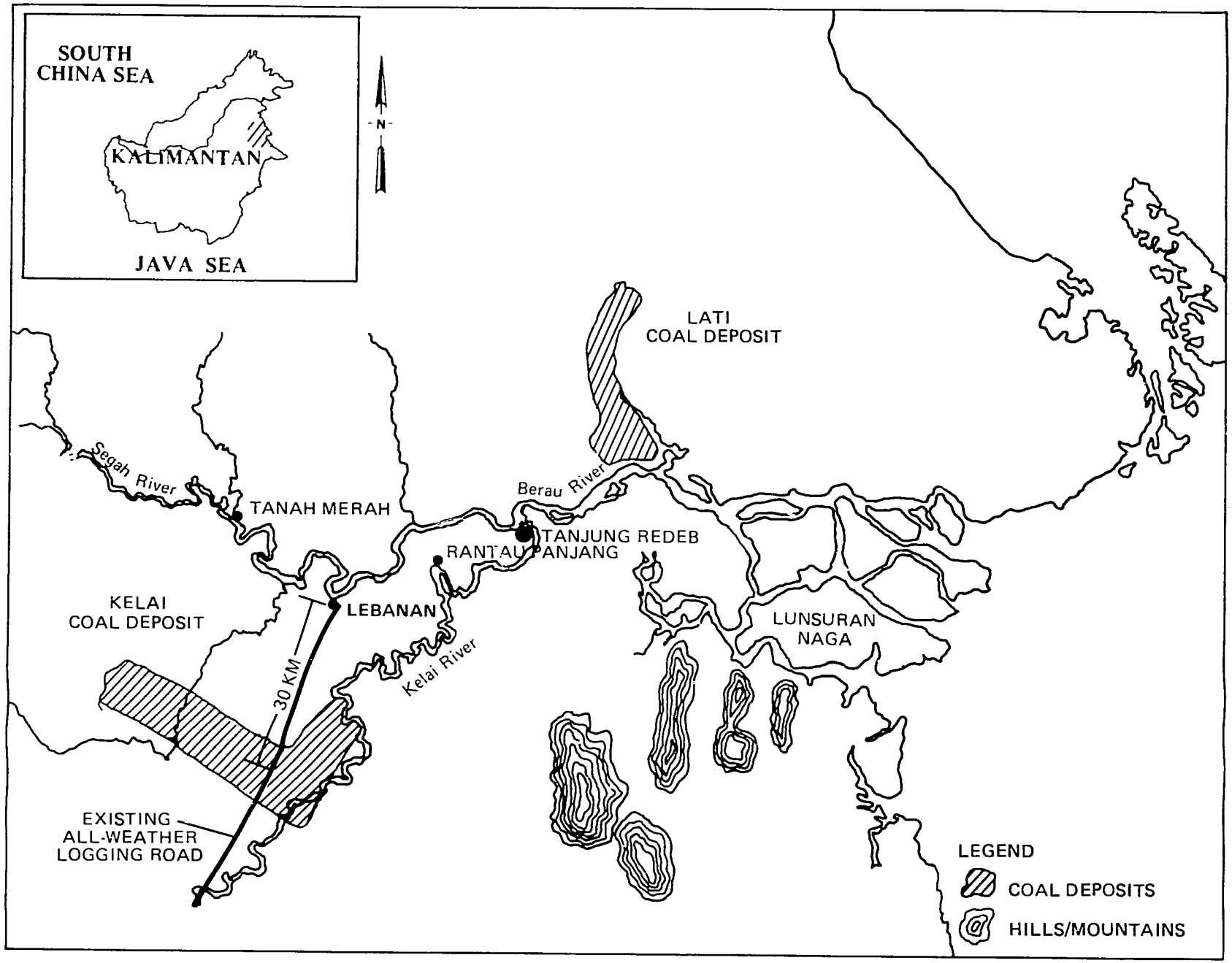

Figure 3.7-1 BERAU AREA

Panjang underground mine there were 70 seams, dipping 40 to 55 degrees, of which 25 were mineable. This totalled over 60 meters of coal.

Based on initial survey work, P.T. Berau has identified two major coal deposits suitable for surface mining: the Kelai and Lati deposits. The Kelai deposit is located between the Segah and Kelai rivers and the Lati is located north of the Berau River (see Figure 3.7-1). The Kelai area is about 6.5 km wide, with a strike length of about 25 km. Coal dips at an average of 12 to 18 degrees with seams of up to 5 meters. Channel samples indicate coal with low ash and low sulfur contents and low to moderate moisture contents. Several hundred million tonnes are expected to be suitable for surface mining. Most of the Lati area is covered with swamps, and therefore is far more difficult to access than the Kelai area. In contrast, the Kelai area is generally softly rolling terrain covered with a secondary rain forest. Therefore, P.T. Berau focused its drilling program in the Kelai area. A total of 4,000 meters or 40 holes up to 100 meters will be drilled between mid-1984 and mid-1985. Exploration in other parts of the Berau area is still in progress.

With respect to actual coal production from the Berau area, P.T. Berau's objective is to reach at least a level of 2 MMTPY, possibly starting in the early 1990s. Whether this can be accomplished will depend in large part on the ability to develop an efficient system for transporting the coal out of the mining area to the Kalimantan coast. This is discussed in the next subsection.

3.7.2 Infrastructure and Coal Transport

General Overview. As already mentioned, the Berau area is a relatively isolated frontier area. Tanjung Redeb is the major population center with some 25,000 people. There are few roads and schools, and the number of vehicles is limited. Communications are also limited and the electricity supply is on a 6 pm to 6 am basis. Several government offices are located in Tanjung Redeb and they have helped spur development. Recently a new water supply system was completed for the city, and the small airfield has helped to improve communications with the outside world.

The road system is limited to some roads in Tanjung Redeb and in some smaller towns. One road, in relatively poor condition, connects Tanjung Redeb to Tanjung Selor in the north, a distance of about 90 km. There are primarily trails and numerous unimproved logging roads, which penetrate the jungle from the rivers. The best road in the area is an all-weather logging road, recently constructed by Georgia Pacific from Lebanan on the Segah River to the Kelai River, a distance of about 60 km. It has a limited grade, is about 3 meters wide, and can accommodate trucks of about 10 to 15 tonnes. The distance from the Kelai deposit to Lebanan is about 31 km. Lebanan is connected to Tanjung Redeb by an armed forces road, which is in relatively bad condition, in particular during the rainy season.

River Transport. Rugged mountains to the east of the coal deposits in the Berau area and extensive swamplands and mangroves along the coast make it virtually impossible to consider coal transport over land to the coast of Kalimantan. Therefore, the only feasible solution appears to be to use the river system, as was done in the past, but current river conditions severely limit the type and size of vessels. The river system comprises the Berau, Kelai, and Segah rivers.

Berau River. The distance from Tanjung Redeb to the Sulawesi Sea along the Berau River is about 28 miles. The river is affected by tides and the direction of flow is reversed during high tides. Vessels of 3,000 to 4,000 tonnes can travel approximately 9 miles upstream, where sandbars prevent further passage.

Kelai River. The Kelai River is the least accessible of the three rivers because it has a strong current, numerous sandbars and rock shoals, and is generally very shallow (large stretches are 1.5 to 3 meters deep).

Segah River. The Segah River up to Teluk Bayur (a distance of about 5 miles from Tanjung Redeb) is fairly deep, with depths ranging from 7 to 15 meters. Farther upstream at Lebanan (about 16 miles from Tanjung Redeb), Georgia Pacific loads timber on barges with a draft of 1.5 meters.

River Transport Scenario. The most likely scenario for river transport is to use the Segah and Berau rivers. Assuming the Kelai area is a future mining site, the closest and most convenient river loading point would be Lebanan because of the existing all-weather road. In this case, coal transport to reach open waters would involve three steps:

- 31 km of truck transport
- Loading of vessels at Lebanan
- 44 miles of river transport to open water

To navigate the river in sufficiently large vessels, it will be necessary to dredge a channel. In principle, two alternatives will have to be investigated:

- Dredging the entire channel to allow oceangoing vessels (i.e., ships or barges) to reach Lebanan
- Dredging to allow barge transport from Lebanan to a transshipment point in sufficiently deep water near the mouth of the Berau River

The first alternative was used in the past to allow passage of 3,000 DWT vessels up to Teluk Bayur. To satisfy the second alternative, transshipment could be implemented on several islands or reefs "in front" of the Berau River. One such island, Lunsuran Naga (see Figure 3.7-1) has been used in the past as a transshipment point for lumber. Vessels of 7 meters draft can reach the coast of the island at low tide. Given the current conditions of both the Berau and Segah rivers as well as the limited expectations of annual coal production levels, it appears that the second alternative will be the most attractive economically. However, only detailed surveys of the rivers, future coal destinations, quantities to be transported, and economic analysis of transport alternatives can provide a definitive answer.

3.8 TANJUNG AREA

3.8 TANJUNG AREA

P.T. Adaro has undertaken exploration of the Tanjung area, which is located about 15 to 20 km north of the town of Panjang in the northwestern part of the South Kalimantan province. P.T. Adaro started its efforts in the beginning of 1983, and has completed its general survey program, consisting primarily of reconnaissance surveys and mapping. In 1981 the Directorate of Mineral Resources carried out an investigation of the Tanjung area. This included studies of existing oil drilling logs as well as fieldwork. In addition, Sumitomo of Japan briefly investigated the area as a contractor to PN Tambang Batubara, but, early in 1982 ceased all its efforts in the area.

Reference 3-2 provides an estimate of huge coal resources in the area. It is hypothesized that some 5.5 billion tonnes are present in five locations; some 900 million tonnes are classified as inferred resources. The quality of the coal is reported to have the following characteristics, based on eight samples: moisture, 13.56 percent; ash, 1.89 percent; sulfur, 0.41 percent; and calorific value, 5,854 kcal/kg. No further information is available regarding either quantity or quality, and it is believed that P.T. Adaro is continuing its exploration efforts, albeit at a low level of activity.

Generally, the terrain of the Tanjung area is flat and accessible. The area is located near the Negara River, which drains into the Barito River, a major river passing the city of Banjarmasin. The principal drawback of the area is its inland location. The main national road from Balikpapan to Banjarmasin goes through the city of Panjang. By road, the distance to Banjarmasin from Panjang is about 200 km, and the distance to Balikpapan is more than 220 km. In addition to road transport, river transport on small barges is possible. However, such river transport from the Tanjung area to Banjarmasin, for example, requires several days.

3.9 FUTURE COAL PRODUCTION LEVELS IN KALIMANTAN

3.9 FUTURE COAL PRODUCTION LEVELS IN KALIMANTAN

3.9.1 General

In October 1983 PN Tambang Batubara projected that total coal production in Kalimantan would start in 1987 at a level of 1 MMTPY and increase to 17 MMTPY in 1994 (Reference 3-1). Subsequently, in March 1984, PN Tambang Batubara projected that coal production would start in 1985 and provided a production schedule for six of the contractors (Reference 3-8), shown in Table 3-9.1.

This subsection briefly reviews these production estimates in view of the information already provided and postulates a production schedule that also identifies the mining locations where production is expected to take place. This schedule is used with the schedule of potential Kalimantan coal use (see Section 4) to develop a coal supply strategy (or a set of coal flows between producers and consumers), which is the basis for the analyses of sea transport requirements in Section 5 and land transport requirements in Section 6.

It should be noted that although the production schedule postulated generally conforms with the ideas of PN Tambang Batubara, it is a hypothetical schedule. Actual production schedules will be developed and adopted by the various contractors once exploration is completed to the point that economically recoverable reserves can be estimated, once all required feasibility studies have been completed, and once sales contracts with consumers have been negotiated. Clearly, these conditions have not been met yet and any production schedule developed now, including the one in this report, is merely a hypothesis. However, the schedule postulated here is a reasonable starting point for addressing coal transport issues. The perspective taken is as follows: "If production evolves as postulated and if Kalimantan coal use materializes as postulated in Section 4, what type of transport problems would have to be resolved?" It is believed that deviations from the postulated schedule would not substantially alter the major transport issues to be addressed.

Table 3-9.1

FUTURE COAL PRODUCTION
(MMTPY)

Contractor	Annual Production					
	1985	1986	1987	1988	1989	1990
P.T. Arutmin	0.375	0.500	1.000	2.000	2.750	5.000
P.T. Utah	0.200	0.800	1.000	1.500	2.000	2.000
P.T. Kideco Jaya Agung	-	0.100	0.800	1.500	2.000	2.000
P.T. Kaltim Prima Coal	-	-	-	-	0.250	0.750
Agip-Consol	-	-	-	-	0.250	0.500
P.T. Berau	-	-	-	-	-	0.500
TOTAL	0.575	1.400	2.800	5.000	7.250	10.750

Source: Ref. 3-8, PN Tambang Batubara

The production estimates prepared by PN Tambang Batubara are reviewed here to verify or ensure that sufficient quality resources are available to support mining operations in the various areas for at least 25 years at the production levels indicated. To this end, Subsection 3.9.2 addresses quantity and quality information of all coal resources in Kalimantan. Future production estimates by mining location are developed in Subsection 3.9.3.

3.9.2 Quantity and Quality of Kalimantan Coal Resources

Previous subsections have discussed quantity and quality characteristics of Kalimantan coal resources. In addition, several references exist that provide some data on Kalimantan coal resources (see Subsection 3.11). In Appendix B these various "bits and pieces" of information have been compiled in two tables -- one on available quantity information and one on available quality information. The amount and quality of the

information available are such that few definitive statements can be made regarding the true extent and quality of the resources. Exceptions are to be made for the coal resources on the Senakin Peninsula and in the Pasir area, where recent investigations by P.T. Arutmin and P.T. Utah are sufficiently complete to estimate economically recoverable reserves.

In general, however, much more geological information is necessary to delineate Kalimantan's coal resources in detail. The one conclusion that can be made is that evidence of coal is widespread and the total amount of resources may be very large. Table B-1 shows that the total (including measured, indicated, inferred, and speculative resources) may be around 10 billion tonnes. The available information does not answer the question of how much coal may be developable in Kalimantan. Therefore, to focus on this resource information is frequently misleading, which is why it is in the Appendix and not the main body of this report.

It is, however, possible to follow a different approach by posing the question: "What is the minimum amount of coal resources in the various contractor areas that could be developed by surface mining?" This subjective (and admittedly unscientific) approach provides a conservative estimate for the amount of resources that could be brought into production. In the case of P.T. Arutmin and P.T. Utah, the estimates correspond to the results for the areas that have been extensively explored. For the other contractors, the estimates are generally initial expectations based on early exploration results. These estimates may thus be regarded as minimum quantities below which the contractors may not find it worthwhile to continue exploration. The results of this exercise are shown in Table 3.9-2, while Table 3.9-3 provides corresponding quality information for the resources identified. The following should be noted when examining these tables:

- Surface Mining. All contractors are only interested in surface mining projects. As a result, only resources suitable for surface mining are projected to come into production.

- Senakin. P.T. Arutmin considers its estimates of around 90 million tonnes up to a depth of 60 meters for this area as conservative. Resources of 200 to 300 million tonnes are considered developable. If 150 million tonnes could be economically recovered, the Senakin area could support a 6 MMTPY mining operation for 25 years.

- Pasir. Since P.T. Utah has completed its exploration of the area, the estimates in Table 3.9-2 are considered reasonable estimates for development purposes.

- Samarangau. The estimate for this area could easily be higher as a result of continued exploration by P.T. Kideco.

- Other Areas. Estimates for all other areas in Table 3.9-2 mainly reflect initial expectations and requirements of the various contractors. The higher amounts for the Berau and Tanjung area reflect the more difficult circumstances under which coal development and transport in these areas will take place as compared to, for example, the Sangatta area.

- Coal Quality. Table 3.9-3 indicates that for most areas coal quality most likely would be sufficient for domestic power and cement production. An exception is the Bindu-Betitit deposit in the Pasir area, where sulfur content makes it less suitable for power production.

Based on the above discussion, it can be concluded that about 1 billion tonnes are available in the seven contracting areas that could be developed by surface mining. At a recovery rate of 50 percent, this level of resources could support the 1994 production level of 17 MMTPY, as postulated by PN Tambang Batubara, or 425 million tonnes over the 25-year lifetime of the mines involved. This does not mean this production level will be reached. Notably, the inland locations of the Tanjung and Berau areas could preclude their economic development. As a result, the total estimate in Table 3.9-2 could drop significantly, making it unlikely that the 17 MMTPY production level would be reached.

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Table 3.9-2

PRELIMINARY QUANTITY ESTIMATES OF KALIMANTAN COAL RESOURCES
SUITABLE FOR SURFACE MINING
(million tonnes)

Contractor Area	Resources					Notes
	Measured	Indicated	Inferred	Specula-tive	Total	
South Kalimantan (Senakin)	90	-	-	-	90	P.T. Arutmin believes developable resources are around 200 to 300 million tonnes
Pasir						
Bindu-Betitit	37	-	-	-	37	Estimate considered accurate for purpose of development
Petangis	30	-	-	-	30	Estimate considered accurate for purpose of development
Samarangau	-	-	62	-	62	P.T. Kideco expects further exploration around initial area could significantly raise estimate
Mahakam (Consol)	-	-	-	100	100	Estimate merely reflects initial expectation of contractor based on early exploration
Sangatta	-	-	-	50-100	50-100	Estimate merely reflects initial expectation of contractor based on early exploration
Berau	-	-	-	250	250	Estimate merely reflects initial expectation of contractor based on early exploration
Tanjung	-	-	-	350	350	It is assumed that 5 percent of resources referred in 3-2 are suitable for surface mining
TOTAL	157	-	62	750-800	969-1,019	

Source: See Appendix B
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Table 3.9-3

PRELIMINARY QUALITY ESTIMATES OF KALIMANTAN COAL RESOURCES SUITABLE FOR SURFACE MINING IN VARIOUS CONTRACTOR AREAS

Location	Analytic Basis	Ash (percent)	Total Moisture (percent)	Sulfur (percent)	Calorific Value (kcal/kg)
South Kalimantan (Senakin)	Raw/air dried	14.5-20.5	4.5-7.0	0.2-1.0	5,600-6,500
Pasir Bindu-Betitit	Raw/air dried	28.2	3.2	3.17	5,470
Petangis	Raw/air dried	20.6	4.6	0.84	5,900
Samarangau	Raw/air dried	3.2-5.0	3.6-5.3	0.12-0.15	6,092-6,390
Mahakam (Consol)	As received	4-5	≈15	< 1	6,000-6,500
Sangatta	Raw/air dried	0.8-3.1	9.7-12.2	<0.5	6,638-6,692
Berau	Not Available for this Report				
Tanjung	Unknown	1.9	13.6	0.4	5,854

Source: See Appendix B

3.9.3 Production Estimates

Table 3.9-4 shows the coal production schedule developed for this study. Although this schedule is basically in conformance with the one developed by PN Tambang Batubara (see Table 3.9-1), minor changes were made for 1986, 1987, and 1988. Production estimates were increased slightly for these years because it was found there could be a market for more coal. Such a production increase would pose no technical problems. The following should be noted when examining Table 3.9-4:

- Start of Production. Within each area, the start of production corresponds to the development status of the various contractors, as described in previous

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Table 3.9-4

PRODUCTION ESTIMATE OF KALIMANTAN COAL RESOURCES
1984 - 1994
(million tonnes)

Mining Company	Area	Mining Location	Economically Recoverable Reserves	Annual Production Level										
				1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
P.T. Arutmin	Senakin	Sangsang	25.00	-	0.38	0.50	0.50	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		Sepapah	15.00	-	-	-	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
		East Senakin	100.00	-	-	-	-	0.50	1.25	2.50	3.00	3.50	3.50	4.00
P.T. Utah	Pasir	Petangis	25.00	-	0.20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		Bindu-Betitit	25.00	-	-	0.22	0.42	0.67	1.00	1.00	1.00	1.00	1.00	1.00
P.T. Kideco	Samarangau	Samarangau	50.00	-	-	0.50	1.00	1.70	2.00	2.00	2.00	2.00	2.00	2.00
Consol	Mahakam	Busang	50.00	-	-	-	-	-	0.25	0.50	1.50	1.50	2.00	2.00
P.T. Kaltim Prima	Sangatta	West Pinang	50.00	-	-	-	-	-	0.25	0.75	1.50	2.00	2.00	2.00
P.T. Berau	Berau	Kelai	50.00	-	-	-	-	-	-	0.50	1.00	1.50	2.00	2.00
P.T. Adaro	Tanjung	-	50.00	-	-	-	-	-	-	-	0.50	1.00	1.00	1.50
TOTAL PRODUCTION			440.00	-	0.58	2.22	3.42	5.37	7.25	9.75	13.00	15.00	16.00	17.00

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subsections. For example, P.T. Arutmin and P.T. Utah are the furthest along and are technically capable of starting production in 1985.

- Annual Increase in Production. The annual increases in production shown in Table 3.9-4 are generally gradual. Mines start out at production levels of 500,000 tonnes or less in the first year and annual increases are generally less than 1 million tonnes.

- Implied Economically Recoverable Reserves. Table 3.9-4 contains a column with estimates of economically recoverable reserves necessary to support the mining operations at the maximum production levels indicated. Comparison with Table 3.9-2 shows that these estimates are well below the amount of developable resources indicated for each area.

3.10 CONCLUSIONS

3.10 CONCLUSIONS

This section reviewed the current efforts of individual coal contractors, based on references, discussions with PN Tambang Batubara and private coal contractors, and visits to coal exploration areas in Kalimantan. Because of the still preliminary development status of each area, one cannot make precise statements about the size or quality of the coal resource base, the feasibility of developing each resource area, or transporting the coal to consumers. Nevertheless, the preliminary data does provide some indications of the prospects and problems to be faced in developing Kalimantan's coal resources. These indications, subjective at times, also help to delineate the type of coal transport systems to be considered.

3.10.1 Exploration

As of mid-1984, seven contractors were exploring various areas in south and east Kalimantan (see Figure 3.1-1). P.T. Arutmin and P.T. Utah essentially have finished all required initial work on the Senakin Peninsula and in the Pasir area. Continued investment and mine development by these companies requires obtaining sales contracts for the available coal. The status of P.T. Kideco's efforts is very similar to that of Arutmin and Utah; a sales contract with the Korean Electric Company for Samarangau would start mine development in this area. P.T. Kaltim Prima and P.T. Berau are continuing exploration. It is still too early to accurately evaluate the outcome of these efforts. The joint venture of Agip-Consol has essentially ceased operation in their areas. Agip discontinued its work in northeast Kalimantan, while Consol significantly reduced its efforts in the Mahakam area. P.T. Adaro, exploring the Tanjung area, is operating at a very low level of activity, possibly indicating that near-term coal development is unlikely.

3.10.2 Coal Resources and Future Production

Conservatively estimated, total coal resources suitable for surface mining in all areas could be around 1 billion tonnes (see Table 3.9-2). This coal is generally of a good quality for domestic power and current

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production (see Table 3.9-3). At a recovery rate of about 50 percent, this resource base could support an annual production level of about 17 MMTPY, as is postulated by PN Tambang Batubara. Whether this production level is achievable or will be surpassed will in large part depend on the outcome of exploration efforts and continuing investment decisions made by P.T. Kaltim Prima, P.T. Berau, and P.T. Adaro. Based on current results and assuming sales contracts are forthcoming, these minimum production levels can be postulated:

- Senakin, 4 to 5 MMTPY
- Pasir, 1 to 2 MMTPY
- Samarangau, about 2 MMTPY

In conclusion, future annual production of coal in Kalimantan is likely to fall within the range of 7 to 17 MMTPY.

3.10.3 Future Mines

All current indications point to a number of relatively small (about 2 MMTPY) mines scattered along the coast of south and east Kalimantan, with 4 to 5 MMTPY operations on the Senakin Peninsula being the exception rather than the rule.

Apart from the Tanjung area, most mines will be located close (less than 50 km) to tidal waters (a river, a bay, or the sea). Specifically, these distances are:

- Senakin, 25 to 30 km
- Pasir, 14 to 15 km
- Samarangau, 45 km
- Mahakam, 10 km
- Sangatta, 20 km
- Berau, 31 km

The Tanjung area is located inland, 200 and 220 km by road to Banjarmasin and Balikpapan, respectively.

3.10.4 Infrastructure

With the exception of the Mahakam area, most areas currently under investigation are in sparsely populated and remote areas. Mine development will require construction of a needed infrastructure (housing, camps, utilities, schools, hospital facilities, etc.), construction or upgrading of roads to haul coal, and harbor and loading facilities. The anticipated limited production levels (about 2 MMTPY in most areas), proximity of the mines to loading points, and the low level of development in most areas (resulting in few land use conflicts) indicates that construction of these facilities and related infrastructure will not be a serious constraint on mine development. The contractors will have to plan and provide for these items in their mine development plans in cooperation with local authorities.

In most areas, mine development also will require that manpower be brought into the areas (perhaps 500 to 600 people for a 2 MMTPY operation). Although this will require careful planning to obtain skilled and trained workers, this certainly does not present an insurmountable problem.

In conclusion, infrastructure requirements for Kalimantan coal development are not expected to stand in the way of opening mines. The only exception worth mentioning is the Mahakam area, where current development (e.g., transmigration, agriculture, and forestry) poses a potential land use conflict to developing coal mines. Such a conflict could be a serious constraint.

3.10.5 Transport of Coal Out of Kalimantan

Since current and future use of coal in Kalimantan is negligible in comparison with anticipated production levels, practically all coal will have to be "exported" out of Kalimantan. Resolution of how coal will be transported out of Kalimantan is one of the most important issues in Kalimantan coal development. Table 3.10-1 summarizes transport characteristics for the various areas discussed in previous subsections.

For 6 out 10 future mining sites, the loading point will be on a river, thus requiring river transport to reach open and deep water. The lowest draft that would allow river transport to these locations (without a major dredging effort) is 4 to 5 meters for the Berau River and about 7 meters for the Mahakam River. In addition, navigational factors, such as channel width and physical obstructions like the bridge over the Mahakam River that limits vessel height to 12 meters, must be considered. Navigational considerations coupled with limited drafts present a serious constraint on the type and size of vessels that can carry coal out of Kalimantan.

Generally, the maximum type and size of vessels that can be considered are barges up to 10,000 DWT and mini-bulk carriers up to 6,000 DWT. Distances to be traveled before open water is reached range from 24 nautical miles for the Pasir area (Linding) to 66 nautical miles for the Mahakam area (Tenggarong). If, for economic reasons, the above type and size of vessels are too small for inter-island transport, coal would have to be transshipped at Kalimantan into larger vessels. This could be accomplished either by using floating transshipment facilities near the mining areas or shore-based facilities.

Three of the ten future mining sites are in the Senakin area, with Tanjung Batu as the loading point. Although no river transport is involved in this case, the sandbar at the entrance of Klumpang Bay limits the type and size of vessel that can enter to a fully loaded 10,000 DWT bulk carrier. Dredging would be required to allow for larger ships.

The only location where draft restriction plays no role is the Sangatta area. Deep water along the coast near Tanjung Bungalun allows for a loading facility that could accommodate large bulk carriers. This facility would only be 20 km from a future mine site.

The implications of draft restrictions on types and sizes of vessels that can carry coal out of Kalimantan will be discussed in Section 5, which discusses sea transport requirements.

Table 3.10-1

SUMMARY OF TRANSPORT CHARACTERISTICS

Item	Area									
	Senakin			Pasir		Samarangau	Mahakam	Sangatta	Berau	Tanjung
Contractor	P.T. Arutmin			P.T. Utah		P.T. Kideco	Consol	P.T. Kaltim Prima	P.T. Berau	P.T. Adaro
Deposit	Sangsang	Sepapah	East Senakin	Bindu-Betitit	Petangis	Samarangau	Busang	W. Pinang	Kelai	Tanjung
River transport	No	No	No	Yes	Yes	Yes	Yes	No	Yes	Likely
River	-	-	-	Apar	Kuaro	Kuaro	Mahakam	-	Segah and Berau	Negara and Barito
Coastal water/bay	Teluk Klumpang	Teluk Klumpang	Teluk Klumpang	Teluk Apar	Teluk Adang	Teluk Adang	Mahakam Delta	Makassar Straits	Berau Delta	-
Limiting draft without major dredging (meters)	8	8	8	6	6.5	6.5	7	13	4 - 5 (Berau) 8 (Delta)	?
Possible loading point	Tanjung Batu	Tanjung Batu	Tanjung Batu	Linding (near)	Tanah Merah (near)	Tanah Merah (near)	Tenggarong Bunglaun (near)	Tanjung	Lebanan/Lunsuranaga	?
Approximate land distance loading point (km)	25	30	30	14	15	45	10	20	31 to Lebanan	If Banjarmasin: 200 If Balikpapan: 220
Approximate loading port distance to open water/sea (nautical miles)	5 - 10	5 - 10	5 - 10	24	32	32	66	-	44 from Lebanan to Lunsuranaga	150+
Approximate river transport distance (nautical miles)	-	-	-	16	7	7	66	-	44	150+
Approximate bay/coastal transport distance (nautical miles)	5 - 10	5 - 10	5 - 10	8	25	25	-	-	-	-

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3.11 REFERENCES

3.11 REFERENCES

3-1 Prijono, Ir. A., Long Range Development Plans of Indonesia to Fulfill Projected Demands, P. N. Tambang Batubara. Paper presented at the Coal/Lignite Development Symposium, Jakarta, October 18-22, 1983.

3-2 Johannas Drs., Update on the Coal Program in Indonesia, Directorate for Coal, Ministry of Mines and Energy. Paper presented at the Coal/Lignite Development Symposium, Jakarta, October 18-22, 1983.

3-3 Prijono, Ir. A. and Kusuma, Ir. A., Status and Prospect of Indonesia Coal Development. Paper presented at the ASCOPE 1981 Conference: Strategies for Energy Resource Development and Utilization, Manila, October 7-9, 1981.

3-4 Energy Development and Transport in Indonesia, Assessment of Requirements for Coal Industry Development: 1982-2003. Prepared by BBP Teknologi in Association with Bechtel Group Inc., June 1982.

3-5 Proyek Konservasi Pertambangan Endapan Batubara di Indonesia, Lampiran Peta. Direktorat Teknik Pertambangan, Sub Direktorat Konservasi, Jakarta, 1979.

3-6 Buku Inventarisasi Bahan Galian Tambang di Daerah Tingkat I Kalimantan Timur. Dinas Perindustrian Daerah Tingkat I Kalimantan Timur Kerjasama Dengan Kantor Wilayah Department Pertambangan dan Energy, Propinsi Kalimantan Selatan, 1979.

3-7 Indonesia's Coal Sector, American Embassy, Jakarta. Prepared by J. R. Cunningham, Resources Officer, June 1984.

3-8 Official correspondence related to Kalimantan Coal Development. Joint working paper on the use of coal in the power and cement industry, prepared by the Directorate General of Basic Chemicals, P. N. Tambang Batubara, and the Department of Communications, discussed in a meeting at the Department of Industry, attended by the Ministers of Communications, Industry, and Mines and Energy, March 15, 1984. Report of meeting prepared by Drs. Soetaryo Sigit, Secretary General of the Ministry of Mines and Energy (Pengadaan Batubara Untuk Pembangkitan Listrik dan Industry), March 20, 1984, and enclosed in letters sent to the Ministers of Mining and Energy, Industry, and Communications dated March 21, 1984.

3-9 Financial Times, International Coal Report, Issue No. 95, April 27, 1974.

3-10 Crystal, E., Preliminary Social Impact Overview of Southeast Kalimantan Coal Area. Prepared for P.T. Arutmin, August 1979.

3-11 Coal Port Facilities on Senakin Peninsula. Report of a reconnaisance survey prepared for P.T. Arutmin by Haskoning, Royal Dutch Consulting Engineers and Architects, July 1983.

3-12 Senakin Coal Resource, Block 6 Kalimantan, P.T. Arutmin. November 1983.

3-13 Coal Specification P. T. Arutmin Block 6 Senakin Steaming Coal, P. T. Arutmin. February 1984.

3-14 Production and Shipping Schedule, P. T. Arutmin Block VI, P.T. Arutmin. February 1984

3-15 Report on Marine Reconnaisance Survey Block 6, Senakin Peninsula Kalimantan, Indonesia. Prepared for P.T. Arutmin by Connell Eddie and Associates, March 1984.

3-16 Penyelidikan Awal Kelautan Bagi Fasilitas Pelabuhan Batubara, P.T. Arutmin. August 1984.

3-17 Information for Senakin Area - P. T. Arutmin. Collected by Energy Planning Team BPP Teknologi, November 1983 and April 1984.

3-18 Prihiastoto Ir. J. and Surharyono Ir. H., Laporan Perjalanan Dinas ke Kalimantan. BPP Teknologi, November 1983.

3-19 Transportation Study Palmoil and Rubber Estate, Pasir, East Kalimantan, Design Aspects and Design Criteria of Tanah Merah Project Wharf, Bulking Station Area and Access Road. Prepared by Witteveen and Bos, Consulting Engineers for Directorate General of Estates Ministry of Agriculture, June 1983.

3-20 Technical Presentation Block 5 Coal Project Kalimantan, P.T. Utah Indonesia. January 1984

3-21 Block 5 Coal Project, Product Quality-Petangis Area, P.T. Utah Indonesia. February 1984

3-22 Block 5 Coal Project, Product Quality-Bindu Area, P.T. Utah Indonesia. February 1984

3-23 Information for Pasir Area - P. T. Utah. Collected by Energy Planning Team BPP Teknologi, November 1983 and April 1984.

3-24 Status Report on Port Site Evaluation South Kalimantan. Prepared by Connell Eddie and Associates for Utah International Inc., April 1984.

3-25 Information for Samarangau Area - P. T. Kideco Jaya Agung. Collected by Energy Planning Team BPP Teknologi, May 1984.

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3-26 Information for Mahakam Area - Consol. Collected by Energy Planning Team BPP Teknologi, November 1983.

3-27 Information for Sangatta Area - P. T. Kaltim Prima Coal. Collected by Energy Planning Team BPP Teknologi, November 1983 and April 1984.

3-28 Information for Berau Area - P. T. Berau. Collected by Energy Planning Team BPP Teknologi, April 1984.

Section 4

POTENTIAL KALIMANTAN COAL USE

This section contains the following subsections:

- o 4.1 Introduction
- o 4.2 Demand for Kalimantan Coal by Power and Cement Plants
- o 4.3 Review of Coal Demand Projections
- o 4.4 Conclusions
- o 4.5 References

4.1 INTRODUCTION

4.1 INTRODUCTION

In this section, the demand for Kalimantan coal by power and cement plants is discussed. The following information is provided:

- Name and location of power or cement plants
- Coal use projections
- Expected coal use timing

The power and cement industries will be the predominant users of Kalimantan coal. For this reason, other uses, such as medium and small industries (lime, brick, tile, sugar factories, etc.) or rural fuel briquettes production are not addressed in this report. This does not mean that these uses are unimportant. If aggressively developed these markets could be important, but they are currently relatively small compared with the coal market in the power and cement industries.

For the most part, the demand schedule in this section is based on projections made by Panitia Tekonis Energi (PTE), P.N. Tambang Batubara, and the Directorate General for Mining (see Reference 4-6). Specifically, the schedule reflects official projections up to 1990 (as of mid-1984). These projections have been extended through 1994 to cover a 10-year planning period. The results are given in Subsection 4.2. It should be noted that the authors of this report have not attempted to develop independent projections for Kalimantan coal use.

In Subsections 4.2 and 4.3, the projections for Kalimantan coal demand are applied to coal transport issues. The demand schedule has been analyzed to determine where, when, and how much Kalimantan coal will be delivered. This information, together with the information on future production presented in Section 3, permits an analysis of sea and land transport requirements for Kalimantan coal use.

The word "potential" in the title of this section reflects the substantial uncertainties that exist with respect to the future use of Kalimantan coal. In Subsection 4.3 these uncertainties are briefly

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reviewed. Whether Kalimantan coal will be used by any given power or cement plant will depend on the resolution of a great many issues, the least of which seems to be whether Kalimantan coal could be used. As shown in Section 3, high-quality coal is available in Kalimantan and can be used, but few (if any) integrated plans exist spelling out all the physical systems (from mine to burner tip or boiler) needed to use this resource. Only on the basis of such plans can a future user evaluate the feasibility of using Kalimantan coal and only on that basis would one be able to make an educated guess as to the future demand for Kalimantan coal. The active cooperation and coordination of many agencies is necessary to develop such integrated plans and, thus far, such development has been very slow.

4.2 DEMAND FOR KALIMANTAN COAL BY POWER AND CEMENT PLANTS

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4.2 DEMAND FOR KALIMANTAN COAL BY POWER AND CEMENT PLANTS

Figure 4.2-1 identifies the locations of power and cement plants in Java and Sulawesi projected to use Kalimantan coal. Table 4.2-1 provides further details on the various prospective users. This subsection focuses only on the amount of coal consumption projected and the time at which coal use is expected to start. Sections 5 and 6 deal with how the coal may be transported to the various plants.

4.2.1 Overview of the Market

Figure 4.2-1 shows that most of the demand will be in Java, except for three future power plants in Kalimantan, one existing cement plant at Tonasa in Sulawesi, and one projected cement plant in northern Sulawesi near Menado. Table 4.2-1 shows that the domestic power and cement market for Kalimantan coal consists essentially of three types of customers:

- The National Electricity Company (PLN)
- Privately owned cement plants (four existing and six planned)
- State-owned cement plants (two existing)

Power Industry. PLN is just beginning to implement its plans to significantly expand coal-fired generation capacity. Plans up to 1994 call for coal-fired power plants to be developed at:

- Ombilin (Salak), Sumatra
- Bukit Asam, Sumatra
- Tarahan, Sumatra
- Suralaya, west Java
- Paiton, east Java
- Unidentified location, central Java
- Banjarmasin, Kalimantan
- Balikpapan, Kalimantan
- Loakulu, Kalimantan

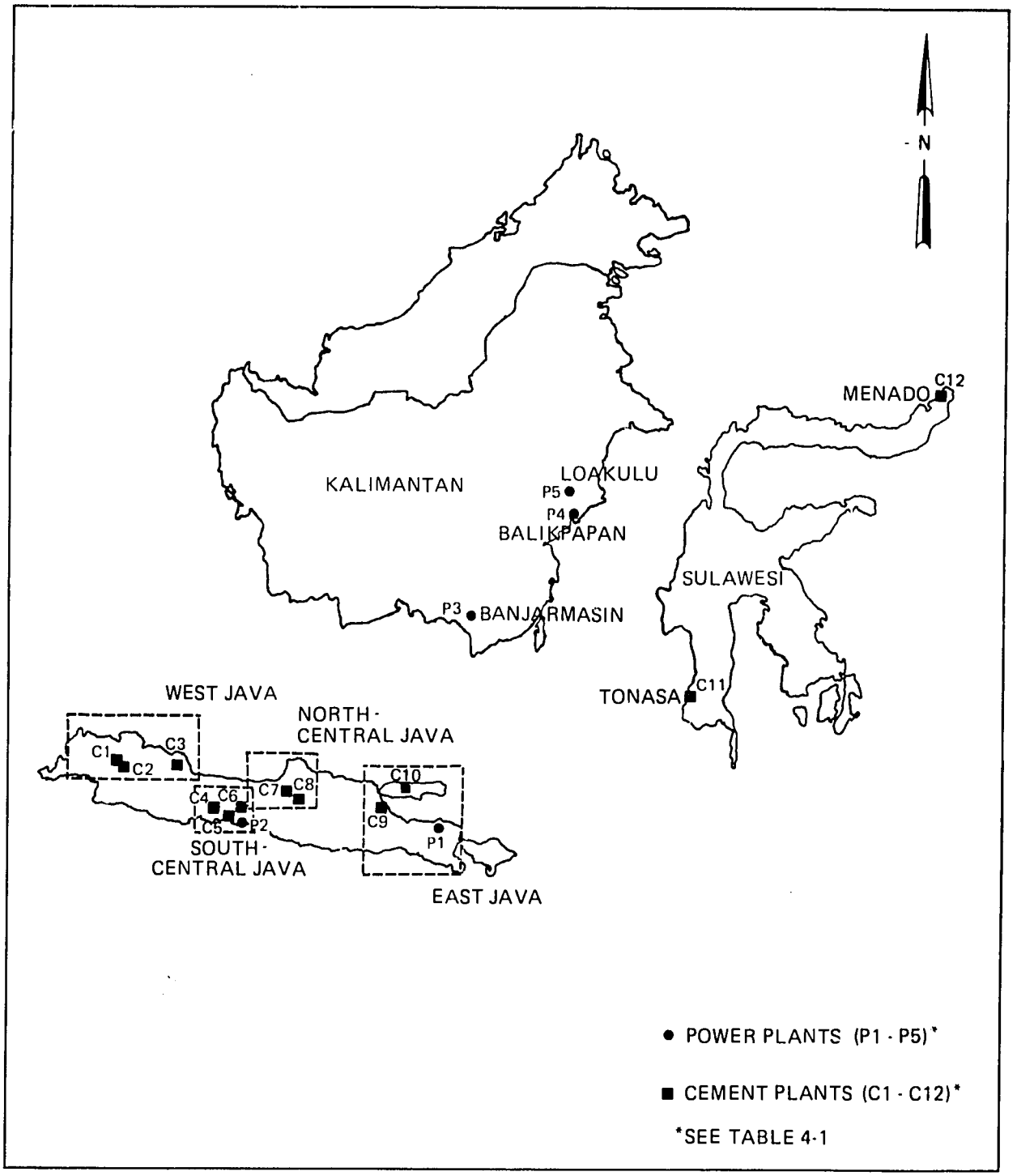

Figure 4.2-1 DEMAND LOCATIONS FOR KALIMANTAN COAL

Table 4.2-1

TYPE, LOCATION AND NAME OF POTENTIAL KALIMANTAN COAL USERS

Location No. (see Fig. 4.2-1)	Industry	Region	Name of Company	Location	Type of Ownership	Production/Capacity by Location[a]			
						1985	% of Total	1994[b]	% of Total
C1	Cement	W. Java	P.T. Semen Cibinong	Narogong	Private	1.5 MMTPY	12%	2.0 MMTPY	5%
C2	Cement	W. Java	INDOCEMENT Group P.T. Distinct Indonesia Cement Enterprise (P1,2) P.T. Perkasa Indonesia Cement Enterprise (P3,4) P.T. Perkasa Agung Utama Ind. Cem. Ent. (P6) P.T. Perkasa Inti Abadi Ind. Cem. Ent. (P7) P.T. Perkasa Abadi Mulia Ind. Cem. Ent. (P8) P.T. Perkasa Ansana Abadi Ind. Cem. Ent. (P10)	Citeurup	Private	6.6	53	9.5	25
C3	Cement	W. Java	INDOCEMENT Group P.T. Tridaya Manunggal Perkasa Cement (P9)	Palimanan (Cirebon)	Private	1.2	10	2.4	6
C4	Cement	S-C Java	INDOCEMENT Group P.T. Perkasa Sembada Karya Ind. Cem. Ent. (P12)	Cilacap	Private	-	-	3.0	8
C5	Cement	S-C Java	P.T. Semen Nusantara	Karang Talun (Cilacap)	Private	.75	6	1.75	4
C6	Cement	S-C Java	P.T. Semen Gombong	Gombong	Private	-	-	2.14	5
C7	Cement	N-C Java	P.T. Semen Sugih Harapan	Tanggung	Private	-	-	3.0	8
C8	Cement	N-C Java	P.T. Semen Purwodadi	Purwodadi	Private	-	-	3.0	8
C9	Cement	E. Java	P.T. Semen Gresik	Gresik	State	1.5	12	4.0	10
C10	Cement	E. Java	INDOCEMENT Group P.T. Perkasa Krida Hasta Ind. Cem. Ent. (P11)	Karang Pandan	Private	-	-	3.0	8
C11	Cement	Sulawesi	P.T. Semen Tonasa	Tonasa	State	0.86	7	2.55	7
C12	Cement	Sulawesi	P.T. Semen Menado	Menado	Private	-	-	2.4	6
CEMENT INDUSTRY TOTAL						12.41 MMTPY	100%	38.74 MMTPY	100%

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Table 4.2-1 (Cont'd)

Location No. (see Fig. 4.2-1)	Industry	Region	Name of Company	Location	Type of Ownership	Production/Capacity by Location			
						1985	% of Total	1994[b]	% of Total
P1	Power	E. Java	PLTU Paiton (PLN)	Paiton	State	-	-	2,000 MW	70 %
P2	Power	S-C Java	PLTU Paiton (PLN)	Near Cilacap	State	-	-	600	20
P3	Power	Kalimantan	PLTU Banjarmasin (PLN)	Banjarmasin	State	-	-	50	2
P4	Power	Kalimantan	PLTU Balikpapan (PLN)	Balikpapan	State	-	-	100	4
P5	Power	Kalimantan	PLTU Loakulu (PLN)	Loakulu	State	-	-	100	4
POWER INDUSTRY TOTAL								2,850 MW	100 %

(a) For cement: MMTPY of cement production
For power: MW of installed capacity
(b) Information from Reference 4-6

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The plants located in Sumatra will be fired with coal from either Ombilin or Bukit Asam.

The first 400 MW coal-fired unit at Suralaya started operation in October 1984. The second 400 MW unit will start up in July 1985. These two units will use coal from Bukit Asam in south Sumatra. However, because of delays in various projects to establish coal supply to Suralaya, Australian imports, augmented by limited amounts of Bukit Asam coal, will be used in the beginning. Approximately 1.5 to 2.0 million tonnes will be required before coal from Bukit Asam arrives at Suralaya as originally planned. Four or five additional units are planned for Suralaya, which, depending on unit size (400 or 600 MW), will raise the total installed capacity at Suralaya to between 2,400 and 3,900 MW.

Although it would be hypothetically possible to fire additional units at Suralaya with coal from sources other than Bukit Asam, such a solution appears economically unattractive. From the very beginning of the current mine and transport development project in south Sumatra (i.e., up to 3 MMTPY capacity), it was recognized that project economics would be improved significantly if additional coal production capacity were developed (Reference 4-7, page 59). Simply stated, if the fixed development cost for mining and transport components could be spread out over a larger annual throughput, the cost of coal to the Suralaya power plant would be reduced. Although this conclusion has to be checked against today's economic conditions and other feasibility requirements (e.g., existence of sufficient reserves to fuel additional units at Suralaya), it does provide a sound reason to continue using Bukit Asam coal for as many additional Suralaya units as possible.

For this reason, the major power market for Kalimantan coal is coal-fired plants planned by PLN for other locations in Java and Kalimantan. The first location is Paiton in east Java, where the first unit is projected to start up in the late 1980s. Hence, supply of Kalimantan coal to PLN power plants is not expected before this time. Specific coal demand projections, based on the PLN expansion plan for coal-fired generation, are given in Subsection 4.2.2.

Cement Industry. The cement industry is, after the power industry, the next potential large user of Kalimantan coal. It consists of privately owned and state-owned cement plants. If one considers all domestic cement plants that could use Kalimantan coal as a group, the 1985 production of the entire group is projected as follows (see Table 4.2-1):

- 81 percent (10.05 million tonnes) by four private plants
- 19 percent (2.36 million tonnes) by two state plants

Of the privately owned plants, the INDOCEMENT group, with plants at two locations, is by far the biggest potential customer, with a 1985 production level of 8.55 million tonnes. From a marketing perspective, the distinction between state-owned and privately owned plants is important. It might be easier to establish coal supply arrangements between the state coal company and state-owned cement plants than with privately owned cement plants. With regard to the latter, it can be expected that supply economics (considering sources other than Kalimantan, as well as resolution of infrastructure and transport issues) will require a more aggressive approach on the side of the government to ensure that these plants use Kalimantan coal. As shown in Table 4.2-1, the future split in cement production between private and state-owned plants is not expected to change. In 1994, 17 percent is projected to be produced by the state-owned plants at Gresik and Tonasa and 84 percent by privately owned plants at 10 different locations.

Despite some official projections, these cement plants in south-central Java are considered a potential market for Kalimantan coal (see Table 4.2-1):

- P.T. Perkasa Sembada Karya
- P.T. Semen Nusantara
- P.T. Semen Gombong

Alternatively, these plants can be supplied with Ombillin coal out of Teluk Bayur in west Sumatra. However, since it is envisioned that PLN will operate a major coal-fired power plant in the vicinity of Cilacap with Kalimantan coal, south-central Java should become a viable destination for Kalimantan coal, and the small demands from these three cement plants could also be accommodated.

4.2.2 Coal Demand Projections

Tables 4.2-2 and 4.2-3 provide the base information used to calculate coal requirements for power plants at 5 locations (2 in Java and 3 outside Java) and for cement plants at 12 locations (10 in Java and 2 outside Java).

Table 4.2-2 shows the PLN expansion plan for Kalimantan coal-fired power plants. The plant at Paiton in east Java is in the engineering and design stage, and the first 400 MW unit is expected to start up in 1988. Like Suralaya, Paiton is planned as a major coastal power complex with ultimate installed capacity of about 3,000 to 4,000 MW.

Another major power complex is in the initial planning stage, with startup of the first 600 MW unit projected for 1991. Several coastal sites in central Java are under study, but no decision has been made yet. One site is on the southern coast near Cilacap, and two sites have been considered on the northern coast of central Java, one east of Semarang in the vicinity of Murya and Rembang and one west of Semarang. In addition, a site on the southern coast of Java near Pelabuhan Ratu in west Java has been considered because of its shorter distance to the major load center of Jakarta. For the purpose of this study and because of relatively favorable coastal conditions at Cilacap (i.e., easy access to deep water), the site near Cilacap has been assumed as the location of the third major power complex in Java. Finally, Table 4.2-2 shows that three small coal-fired power plants are planned for Kalimantan. These plants are in the very early planning stage, with startup projected to be after 1991.

Table 4.2-2

GENERATION EXPANSION PLAN FOR POWER PLANTS
TARGETED FOR KALIMANTAN COAL USE[a]
(in Megawatts)

Location No. (see Figure 4.2-1)	Island	Location	Installed Capacity										
			1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
P1	Java	Paiton	-	-	-	-	400	800	800	800	1,400	2,000	2,000
P2	Java	Near Cilicap	-	-	-	-	-	-	-	600	600	600	600
SUBTOTAL			-	-	-	-	400	800	800	1,400	2,000	2,600	2,600
P3	Kalimantan	Banjarmasin	-	-	-	-	-	-	-	-	-	100	100
P4	Kalimantan	Balikpapan	-	-	-	-	-	-	-	-	50	50	50
P5	Kalimantan	Loakulu	-	-	-	-	-	-	-	-		100	100
SUBTOTAL			-	-	-	-	-	-	-	-	50	250	250
TOTAL			-	-	-	-	400	800	800	1,400	2,050	2,850	2,850

(a) Expansion schedule obtained from PLN, mid-1984. Although indicated plants will be coal-fired, PLN has not made commitment to use Kalimantan coal.

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Table 4.2-3

CAPACITY AND PRODUCTION OF CEMENT PLANTS TARGETED FOR KALIMANTAN COAL USE

Location No. (See Figure 4.2-1)	Name of Ce Complex (See Table 4.2-1)	Location	Design Capacity and Estimated Production(a) (thousand tonnes per year)												Design Capacity and Estimated Production(b) (thousand tonnes per year)									
			1984		1985		1986		1987		1988		1989		1990		1991		1992		1993		1994	
			DC	EP	DC	EP	DC	EP	DC	EP	DC	EP	DC	EP	DC	EP	DC	EP	DC	EP	DC	EP	DC	EP
C1	Cibinong	Narogong	1,200	1,200	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	2,000	1,800	2,000	2,000	2,000	2,000	2,000	2,000
C2	INDOCEMENT (P1,2,3,4,6 7,8,10)	Citeurup	6,000	4,800	7,500	6,600	7,500	7,500	9,000	8,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000	9,500	9,500
C3	INDOCEMENT (P9)	Palimanan	1,200	100	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	2,400	1,500	2,400	1,900	2,400	2,400	2,400	2,400
C4	INDOCEMENT (P12)	Cilacap	-	-	-	-	-	-	1,500	500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	3,000	2,000	3,000	3,000
C5	Nusantara	Karang Talun	750	750	750	750	750	750	750	750	750	750	750	750	750	750	1,750	1,000	1,750	1,500	1,750	1,750	1,750	1,750
C6	Gombong	Gombong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,000	400	3,000	1,000	3,000	1,550	3,000	2,140
C7	S. Harapan	Tanggung	-	-	-	-	-	-	-	-	3,000	1,200	3,000	1,425	3,000	1,500	3,000	1,800	3,000	2,100	3,000	2,500	3,000	3,000
C8	Purwodadi	Purwodadi	-	-	-	-	-	-	-	-	3,000	800	3,000	2,000	3,000	2,800	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
C9	Gresik	Gresik	1,500	1,500	1,500	1,500	1,500	1,450	1,500	1,500	3,500	3,000	4,000	3,600	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
C10	INDOCEMENT (P11)	Karang Pandan	-	-	-	-	3,000	500	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
C11	Tonasa	Tonasa	1,210	510	1,210	855	1,210	910	1,210	1,055	2,210	1,210	2,210	1,210	2,210	1,210	2,210	1,510	2,210	1,820	2,210	2,210	3,210	2,550
C12	Menado	Menado	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3,000	600	3,000	1,200	3,000	1,800	3,000	2,400
		TOTAL	11,860	8,860	13,660	12,405	16,660	13,810	19,660	17,505	28,660	23,160	29,160	25,185	29,160	26,460	37,860	29,110	37,860	32,020	39,360	35,220	40,860	38,740

DC = Design Capacity
EP = Estimated Production

(a) Information from Reference 4-6

(b) Design capacity and production determined as follows: Total production from all 12 locations is assumed to increase at approximately 10 percent per year. Production increases have been distributed over the 12 locations (largely judgmentally) and design capacity was increased to meet these increases, using the 1990 projected capacity as the base and using past increases as a guide (e.g., complexes at Gombong and Menado are assumed to have a capacity of 3 MMTPY, similar to what is shown for Purwodadi and S. Harapan)

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Projections for design capacity and production from 1984 to 1994 for all cement plants are given in Table 4.2-3. The data through 1990 were taken from official government information (Reference 4-6), which show cement production for the companies targeted for Kalimantan coal use is projected to increase between 1984 and 1990 at a rate of 20 percent per year. When extending the projections through 1990 to cover the planning period through 1994, it was assumed that total cement production at the 12 locations continues to increase, but at a rate of 10 percent per year. Total cement production for the companies involved is projected to increase from about 9 million tonnes in 1984 to 26 million tonnes in 1990, and 39 million tonnes in 1994.

The annual coal requirements for the power and cement plants identified in Tables 4.2-2 and 4.2-3 as potential users of Kalimantan coal are shown in Table 4.2-4. The following is noted regarding the data in Table 4.2-4:

- Coal requirements for the cement plants through 1990 were taken from Reference 4-6
- After 1990, coal requirements for cement plants were calculated by using a conversion factor of 0.14 tonne of coal per tonne of cement. This factor corresponds to coal with a calorific value of 6,500 kcal/kg and energy requirements for cement production of 900 kcal/kg
- Coal requirements for power production are based on a 65 percent capacity factor, a 33 percent conversion efficiency, and coal with a calorific value of 6,500 kcal/kg

Total requirements for Kalimantan coal are projected to increase from 0.22 million tonne in 1985 to 12 million tonnes in 1994. Throughout most of the planning period, the cement industry will be the largest user. Only towards the end (1993 and 1994) will the power industry become the largest consumer.

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Table 4.2-4

ESTIMATE OF KALIMANTAN COAL REQUIREMENT FOR POWER AND CEMENT PRODUCTION
(million tonnes per year)

Location No. (see Figure 4.2-1)	Name of Plant (see Table 4.2-1)	Location	Annual Coal Requirement										
			1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
C1	Cibinong	Narogong	-	-	0.25	0.25	0.25	0.25	0.25	0.25	0.28	0.28	0.28
C2	INDOCEMENT (P1, 2,3,4,6,7,8,10)	Citeurup	-	0.20	1.05	1.13	1.25	1.25	1.25	1.25	1.25	1.25	1.33
C3	INDOCEMENT (P9)	Palimanan	-	-	0.10	0.17	0.17	0.17	0.17	0.21	0.27	0.34	0.34
C4	INDOCEMENT (P12)	Cilacap	-	-	-	0.08	0.20	0.20	0.20	0.20	0.20	0.28	0.42
C5	Nusantara	Karang Talun	-	-	0.10	0.10	0.10	0.10	0.10	0.14	0.21	0.25	0.25
C6	Gombong	Gombong	-	-	-	-	-	-	-	0.06	0.14	0.22	0.30
C7	S. Harapan	Tanggung	-	-	-	-	0.17	0.20	0.21	0.25	0.29	0.35	.42
C8	Purwodadi	Purwodadi	-	-	-	-	0.10	0.26	0.38	0.42	0.42	0.42	0.42
C9	Gresik	Gresik	-	-	0.12	0.24	0.48	0.57	0.64	0.64	0.64	0.64	0.64
C10	INDOCEMENT (P11)	Karang Pandan	-	-	0.10	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
TOTAL JAVA CEMENT PLANTS			-	0.20	1.72	2.42	3.17	3.45	3.65	3.87	4.15	4.48	4.85
C11	Tonasa	Tonasa	-	0.02	0.14	0.18	0.19	0.24	0.30	0.30	0.30	0.31	0.36
C12	Menado	Menado	-	-	-	-	-	-	-	0.08	0.17	0.25	0.34
TOTAL SULAWESI CEMENT PLANTS			-	0.02	0.14	0.18	0.19	0.24	0.30	0.38	0.47	0.56	0.70
TOTAL CEMENT PLANTS			-	0.22	1.86	2.60	3.36	3.69	3.95	4.25	4.62	5.04	5.55

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Table 4.2-4 (Cont'd)

Location No. (see Figure 4.2-1)	Name of Plant (see Table 4.2-1)	Location	Annual Coal Requirement										
			1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
P1	Paiton	Paiton	-	-	-	-	0.69	1.60	1.82	1.82	2.85	4.22	4.56
P2	S-C Java	Near Cilacap	-	-	-	-	-	-	-	1.03	1.37	1.37	1.37
	TOTAL JAVA POWER PLANTS		-	-	-	-	0.69	1.60	1.82	2.85	4.22	5.59	5.93
P3	Banjarmasin	Banjarmasin	-	-	-	-	-	-	-	-	0.10	0.14	0.14
P4	Balikpapan	Balikpapan	-	-	-	-	-	-	-	-	-	0.18	0.22
P5	Loakulu	Loakulu	-	-	-	-	-	-	-	-	-	0.18	0.22
	TOTAL KALIMANTAN POWER PLANTS		-	-	-	-	-	-	-	-	0.10	0.50	0.58
	TOTAL POWER PLANTS		-	-	-	-	0.69	1.60	1.82	2.85	4.32	6.09	6.51
	TOTAL POWER AND CEMENT PLANTS		-	0.22	1.86	2.60	4.05	5.29	5.77	7.10	8.94	11.13	12.06

4.3 REVIEW OF COAL DEMAND PROJECTIONS

4.3 REVIEW OF COAL DEMAND PROJECTIONS

The purpose of this subsection is twofold:

- To discuss uncertainties in projecting the use of Kalimantan coal
- To discuss the usefulness of the projections given in Subsection 4.2, for analyzing coal transport requirements in the next two sections

4.3.1 Uncertainties in Projections

Introduction. The subject of uncertainties in projecting the future use of coal in Indonesia has received considerable attention (References 4-1 through 4-6). It is instructive to review some of the comments made.

After mentioning several reasons for changes in plans and projections, Ir. Prijono, President Director of PN Tambang Batubara, prefaced his paper, "Long Range Development Plans of Indonesia to Fulfill Projected Demands," as follows (Reference 4-2):

> My contemplations stated above are an attempt to caution against simplification and the risk of long range prediction with its many pitfalls. Still, national development planners will require such a long term scenario for obvious reasons, and intelligent assessment or educated guesses of existing long term projections, based on experience and taking into account leadtimes required for financing arrangements and project implementation, is the only possible way to resort to.
>
> In the collection of information for making an assessment, one has also to deal with the human nature and the subjectivity of certain project-officers who in their enthusiasm sometimes fail to distinguish between "das sollen and das sein," between wishful thinking and what is realistically possible to achieve.
>
> It is against this background of unforeseen circumstances and constraints that the audience is reminded to interpret long term projection tables when such tables in a later part of this article will be presented.

To avoid making a projection that would prescribe what ought to happen (i.e., "das sollen") or one that would predict what would happen (i.e., "das sein"), a previous BPPT effort developed a range of future coal demand for all of Indonesia, describing what possibly could happen. It was recognized that many issues would have to be taken into account (Reference 4-1).

Considerations Involved in Projecting Demand. Whether or not the projected demands will be realized depends on a number of considerations such as:

- Fuel Cost. The decision to use coal in a new cement plant of power plant depends on the actual costs incurred in using coal as compared to competitive fuels. These costs depend on location, amount of fuel needed, and convenience of the particular fuel. Especially in the case of subsidized fuels, some consumers may be slow to convert to coal

- Availability of Funds. The expansion plan for the electric power sector calls for very large investments in coal-fired power plants. Construction of Suralaya 1 and 2 alone will require between $800 and $900 million. The availability of funds for future coal-fired power plants depends on the future economic climate in the country and the availability of capital

- Construction Lead Time. Large coal-fired power and cement plants require long lead times for engineering, design, and construction. Unexpected delays can cause major changes in the amount of coal projected to be used in specific years

- Market Changes. For example, current plans for expanding the domestic production capacity of cement are based on assumptions regarding the future market. Changes in the demand/supply situation for cement in Southeast Asia influences the need for domestic capacity and for new coal-fired cement plants

- Alternative Supplies for Power Generation. Currently, expansion plans are made through approximately 1994. However, if new information becomes available, these plans may change. For example, if the significant geothermal resources in central Java can be developed faster, plans for coal-fired generation on Java may be delayed

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- Delays in Coal Receiving Facilities. As mentioned earlier, harbors and facilities for receiving, storing, and handling coal need to be in place

Not all of these considerations can be easily projected or controlled, which makes projecting coal demands a risky undertaking at best. In general, accurate predictions of coal demand can be made only for the next few years since coal demand is determined by plans for coal-fired power and cement plants that are currently in the implementation stage. In fact, it is not uncommon for even these short-term coal demand predictions to change as a result of unexpected problems that surface during detailed engineering and construction of a major coal-fired plant. Long-term coal demand projections frequently contain large uncertainties and should not be used to predict "precisely" what will happen in the future. Instead, their function is to help determine the order of magnitude of future coal demand so that appropriate early attention can be given to the types of coal systems needed.

With the above qualifications, the previous BPPT effort in June 1982 predicted that total coal demand in Indonesia by 1990 could possibly be between 10.6 and 20.66 million tonnes (Reference 4-1). Ir. Prijono comments on what happened in the span of less than 1 year (Reference 4-2):

> Having expressed my caution over the risks and pitfalls of long term predictions at the start of this paper, I like now to present the latest estimates of coal requirements in Indonesia.
>
> While most projections for coal demand in 1990 shortly before May 1983 hover around the 15 million tonnes figure, current estimates taking into account the drastic rephasing measures of the Government of Indonesia, will only come to the 11 million level as shown in Table III.
>
> This latest updated table was construed after the rephasing programs were announced and after consultation with representatives of PLN and the Department of Industry.

The new aggregate figure of a little more than 11 million tonnes coal requirement for 1990 was a drastic reduction from the earlier mentioned 15 million tonnes and is close to the lower alternative projection of the BPPT/Bechtel study of June 1982, which showed a figure of 10.6 million tonnes. The high alternative projection of BPPT/Bechtel was 20.66 million tonnes, an impossible amount in today's circumstances.

This rather large difference is due to the delay in the construction plans of Suralaya V & VI power plants and the Paiton power plant in east Java.

Types of Uncertainties in Projecting Coal Demand. The foregoing discussion illustrates the pitfalls in projecting future coal use. The relevant question is: Are there any ways to prevent these pitfalls? Generally, uncertainties in projecting coal use can be categorized as follows:

- System-related uncertainties
- Institutional uncertainties
- External uncertainties

System-Related Uncertainties. System-related uncertainties occur if the entire chain of system elements (i.e., loading, shipping, unloading, land transport, storage, coal preparation facilities, etc.) between coal producers and coal consumer is not well defined. If, for example, there are not existing transportation facilities to bring coal to a consumer's facility, that consumer cannot evaluate the desirability of coal via-a-vis other fuels. A case in point is the new private cement plant near Cirebon. When opened in 1985, the plant will initially use fuel oil and later natural gas, despite the government's expressed desire to use coal for cement production. At the time the fuel decision was made, the coal system alternative was not sufficiently defined to allow for detailed cost comparison with fuel oil or natural gas. Fuel oil, on the other hand, was readily available, and natural gas could be obtained from a nearby Pertamina distribution point. The only thing known about coal was that it would be difficult, and therefore costly, to bring it to the

plant. In situations like this, there is little rationale to project that the plant would use coal in the future.

Institutional Uncertainties. Institutional uncertainties refer to those unknowns that are introduced into the planning process as a result of the requirement to obtain approval/coordination of various agencies and institutions in implementing a coal supply project. Since logistics and transportation are generally far more complex for coal than for fuel oil and natural gas, many agencies are involved, such as the directorate for Sea Communications, the Directorate for Land Communications, PJKA, national shipping companies, etc. Since neither the coal producers nor PN Tambang Batubara are responsible for supplying coal to consumer facilities and since the consumer normally does not help determine how coal will be supplied at his facility, the crucial link between producer and consumer depends on the actions, policies, and capabilities of other agencies. In effect, these institutions have a major influence on whether coal will be used at a particular facility. Clearly one would have to anticipate their actions to project coal use at a particular facility.

External Uncertainties. External uncertainties are caused by forces entirely beyond the control of either the coal industry or the potential coal consumer. The most important examples are general economic conditions for both the power and cement industries, the world oil price, and the regional supply/demand balance for cement. Each of these three factors has an important bearing on the availability of funding for coal conversion and transportation projects, the competitiveness of coal vis-a-vis other fuels, and the expansion possibilities for the industries involved.

Conclusions. Despite the basic uncertainties in projecting future coal use, projections could be improved significantly by virtually eliminating the system-related and institutional uncertainties so that one has to cope only with the external uncertainties defined above. This requires the development of very specific plans and prefeasibility studies detailing how the coal from the Senakin, Pasir, or other areas can be

transported to and used by any power or cement plant. These plans would have to spell out all required systems on the basis of which delivered coal cost could be estimated and future coal use projected. Such plans should go well beyond the usual coal conversion studies and focus on how coal will arrive at the plants. In the current institutional framework, this crucial task is performed by an interministerial task force. However, there is no agency or institution empowered to see to it that the above plans are actually drawn up. If such plans existed, it would be considerably easier to cope with external uncertainties because meaningful sensitivity analyses of economic parameters could be performed, providing insight into the likelihood of future Kalimantan coal use.

As a first step toward the development of the aforementioned plans, it would be useful if the discussions between PN Tambang Batubara and the various Kalimantan coal contractors, on the one hand, and the potential coal consumers (i.e., PLN and the various cement companies), on the other, were expanded to focus specifically on the type of technical systems needed. It is believed that a technical dialogue on how Kalimantan coal can be used is crucial in determining whether Kalimantan coal will be used. It is with the objective of facilitating and contributing to such dialogue that BPPT has analyzed sea and land transportation requirements associated with the use of Kalimantan coal.

4.3.2 Kalimantan Coal Projections Used in the Report

In the absence of detailed studies or plans for the use of Kalimantan coal by individual users, the approach followed in official projections (described in Subsection 4.2) can be summarized as follows:

- Based on electric power and cement production expansion plans, facilities (both state and private) that could potentially use Kalimantan coal were identified. Infrastructure (ports, etc.), transportation systems, economics, or finance requirements received little attention in this identification

- Coal demand was projected by calculating the amount of coal such a facility could potentially use based on projected output in terms of cement or power production

This two-step procedure does produce an answer. However, in view of the previous discussion, the answer may not be too accurate.

Several examples can be given to further illustrate this point. The first one relates to the INDOCEMENT complex at Citeurup near Jakarta. In all official projections, it is shown that this complex will use Kalimantan coal, but from discussions with INDOCEMENT planners it has been learned that (1) coal specifications provided to the manufacturers supplying the coal conversion equipment for the various cement kilns are based on Australian coal and (2) initial plans call for obtaining Australian coal.

The second example concerns the Paiton power plant. Engineering and design of the Paiton power plant reportedly will be based on the specifications of three types of coal: Kalimantan coal, Bukit Asam coal, and Australian coal.

Finally, coal from the Ombilin mines in west Sumatra is a potential competitor to Kalimantan coal. Currently, a major effort is under way to increase the output of these mines. Ombilin coal is supplied to domestic customers and also is exported. If in future years there were a reduction in exports of Ombilin coal, a strong incentive would exist to find additional domestic customers for this coal, thus reducing market possibilities for Kalimantan coal. Although the above comments show Kalimantan coal use is still not certain, the official projections have been used for analyzing sea and land transportation requirements in the next two sections. There are three reasons for this:

- These are the only official projections and developing different projections requires considerable effort

- Insofar as the projections can be regarded as optimistic (i.e., annual use of Kalimantan coal at possibly too high a level and too early at date), they provide a good starting point for the analysis of what is involved in bringing this coal to market. The underlying assumption is that if transportation systems could be developed to meet the official projections, it would certainly be possible to meet a lower level of use

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- Review of the contractor efforts in Kalimantan (see Section 3) indicates that possible production appears to be sufficient to meet the projected domestic demand for Kalimantan coal. Thus, contractors are ready, and the next major effort would be to ensure that those domestic facilities that could potentially use Kalimantan coal would, in fact, use it. In this regard, the projections can be regarded as a target to be achieved in government efforts to promote Kalimantan coal development

4.4 CONCLUSIONS

4.4 CONCLUSIONS

This section has reviewed the domestic market for the use of Kalimantan coal by power and cement plants. Based on this review, the following conclusions are drawn.

4.4.1 Market

In general, the domestic market for Kalimantan coal is limited and not yet established. The market consists in essence of three types of customers: PLN, state-owned cement plants, and privately owned cement plants. Use of Kalimantan coal by PLN is expected to start in the late 1980s (not before 1988) when the first unit at Paiton will start operation. Two existing state-owned cement plants - one at Gresik in east Java and one at Tonasa in Sulawesi - can use Kalimantan coal as soon as the required coal conversion projects are completed. The rest of the cement industry - now and in the future - consists of privately owned cement plants. It is projected that the number of such plants will increase from four in 1985 to ten in 1994, accounting for approximately 80 percent of the cement production that can be considered a target for Kalimantan coal.

4.4.2 Demand Projections

Table 4.4-1 summarizes the detailed projections discussed in Subsection 4.2. Kalimantan coal is projected to be used at 12 different cement plants and 5 different power plants. Total demand for Kalimantan coal is projected to increase from zero at present to about 4 million tonnes in 1988, about 7 million tonnes in 1991, and about 12 million tonnes in 1994. As shown in Table 4.4-1, the island of Java is and will remain the most important destination - about 90 to 95 of total demand is destined for Java. In the early years, cement plants in west Java will account for most of the demand. As time passes, the cement industry will be overtaken by the power industry as the major market for Kalimantan coal. In 1994, 54 percent of total demand will be destined for power plants and 46 percent for cement plants (see Table 4.4-1).

Table 4.4-1

SUMMARY OF POTENTIAL KALIMANTAN COAL DEMAND[a]
(million tonnes)

Region	Industry[b]	Projected Annual Coal Requirements		
		1988	1991	1994
West Java	Cement	1.67	1.71	1.95
South-central Java	Power	-	1.03	1.37
	Cement	0.30	0.40	0.97
North-central Java	Cement	0.27	0.67	0.84
East Java	Power	0.69	1.82	4.56
	Cement	0.93	1.09	1.09
TOTAL JAVA		3.86	6.72	10.78
Kalimantan	Power	-	-	0.58
Sulawesi	Cement	0.19	0.38	0.70
TOTAL DEMAND		4.05	7.10	12.06

(a) Total Java demand as a percentage of total demand is 95% in 1988 and 1991, and 89% in 1999

(b) Total power as a percentage of total demand is 17% in 1988, 40% in 1991, and 54% in 1999; total cement is 83% in 1988, 60% in 1991, and 46% in 1999

4.4.3 Uncertainty in Demand Projections

Projections for Kalimantan coal demand have a high degree of uncertainty. Uncertainties can be categorized as:

- System-related (lack of knowledge as to how Kalimantan coal is transported to and used by potential customers)

- Institutional (lack of knowledge/coordination in implementing Kalimantan coal supply projects)
- External (those caused by external factors such as economic conditions)

The accuracy of projections can be improved significantly by developing plans and prefeasibility studies linking specific Kalimantan coal producers to specific potential consumers. As a first step in the development of such plans, the technical dialogue between producers and consumers should be expanded and aggressively promoted. The real test in the development of Kalimantan coal resources is for the government to be able to market and sell the coal produced, taking into account customer requirements for quality, price, and security of supply. Only on the basis of knowing the various technical systems that will have to be implemented in order to bring Kalimantan coal to the consumer will it be possible to evaluate how much Kalimantan coal will be used domestically.

4.5 REFERENCES

4.5 REFERENCES

4-1 Energy Development and Transport in Indonesia, Assessment of Requirements for Coal Industry Development: 1982-2003. Prepared by BPP Teknologi in Association with Bechtel Group, Inc., June 1982.

4-2 Prijono, Ir. A., Long Range Development Plans of Indonesia to Meet Projected Demands, P.N. Tambang Batubara, Paper presented at the Coal/Lipnite Development Symposium, Jakarta, October 18-22, 1983.

4-3 Financial Times, International Coal Report, Issue No. 95, April 27, 1984.

4-4 Raschke, M.G., Coal and the Current Indonesian Energy Situation, International Bulk Journal, October 1984.

4-5 Hargreaves, D., Indonesian Coal - Assessing the Prospects, International Bulk Journal, October 1984.

4-6 Pengadaan Batubara Untuk Pembangkitan Listrik dan Industri, Directorate General for Mining, March 20, 1984.

4-7 Staff Appraisal Report, Indonesia, Bukit Asam Coal Mining Development and Transportation Project, Report No. 3581-IND, World Bank, Washington, D.C., Dec. 9, 1981.

Section 5

SEA TRANSPORT

This section contains the following subsections:

- 5.1 Introduction
- 5.2 Sea Transport and Kalimantan Coal Development
- 5.3 Approach and Perspective for Sea Transport System Analysis
- 5.4 Analysis Methodology and General Shipping Considerations
- 5.5 Formulation of Alternative Sea Transport Systems
- 5.6 Evaluation of Alternative Sea Transport Systems
- 5.7 Conclusions and Recommendations
- 5.8 References

5.1 INTRODUCTION

5.1 INTRODUCTION

This and the next section analyze coal transport requirements associated with the use of Kalimantan coal by domestic consumers. More specifically, this section:

- Identifies key issues in developing a system for sea transport of Kalimantan coal to domestic consumers
- Develops a framework within which system development can be expected to take place
- Formulates alternatives in the development of a sea transport system
- Evaluates these alternatives to identify areas that should be pursued further in follow-on feasibility studies

5.1.1 Coal Transport Analysis

Usually, coal transport analysis is part of the negotiation process to arrive at a sales contract between individual producers and consumers. Terms of a contract can include quantity and quality of the coal, price to be paid, means of delivery, the delivery schedule, and other items, including retribution cost in case deliveries are not on schedule.

There are many ways to develop sales contracts. For example, consumers may ask for tenders from several coal producers and transport companies to arrive at a negotiated price for delivered coal. This price would actually consist of two prices: a price for the coal "free on board" (FOB) to be paid to the producer, and a transportation charge to be levied by the transport company. Many variations exist in actual sales contracts. For instance, consumers can buy (and producers can sell) on a long-term contract basis or in the spot market; producers also may agree to undertake delivery and charge the consumer on a cost including insurance and freight (CIF) basis; transport may be arranged by charter or by individual consumers owning their own transport fleet; or consumers may form a consortium for buying in larger quantities.

The above portrays the "real world," in which coal transport analysis is part of the process for reaching agreement between producers and consumers. To achieve actual use of Kalimantan coal by domestic consumers it will be necessary to start a similar process as soon as possible, giving due consideration to transport requirements.

The coal transport analyses in this section and the next are not tied to a particular producer or potential consumer as discussed above, but instead consider the entire Kalimantan coal production system, potential domestic consumers, and combined transport requirements. This approach will provide important background information on such questions as:

- What order of magnitude transport charge can be expected between various loading and unloading ports?
- What type and size of transport vessels appear most promising?
- What problems need to be resolved to arrive at an efficient transport system?
- What actions should be taken to guarantee cost-efficient shipping between Kalimantan producers and domestic consumers?

5.1.2 Summary of Subsections

Subsection 5.2 discusses the importance of sea transport of Kalimantan coal and emphasizes the need to develop a cost-effective transport system between Kalimantan loading ports and domestic unloading ports, in order to achieve and retain the competitive advantage of Kalimantan coal vis-a-vis other supply sources. Subsection 5.3 presents the approach used in developing the sea transport system. Subsection 5.4 briefly discusses the method used to calculate sea transport cost, with an emphasis on the assumptions made. Illustrative route calculations are presented, with the objective of uncovering general guidelines applicable to the development of a sea transport system between Kalimantan and domestic consumers. Subsections 5.5 and 5.6 formulate and evaluate, respectively, two generic transport systems that form the basis for further system development. Finally, Subsection 5.7 summarizes conclusions regarding sea transport and makes recommendations for follow-on work.

emphasis on the assumptions made. Illustrative route calculations are presented, with the objective of uncovering general guidelines applicable to the development of a sea transport system between Kalimantan and domestic consumers. Subsections 5.5 and 5.6 formulate and evaluate, respectively, two generic transport systems that form the basis for further system development. Finally, Subsection 5.7 summarizes conclusions regarding sea transport and makes recommendations for follow-on work.

5.2 SEA TRANSPORT AND KALIMANTAN COAL DEVELOPMENT

5.2 SEA TRANSPORT AND KALIMANTAN COAL DEVELOPMENT

Until now, most efforts related to Kalimantan coal have concentrated on exploration work to prove reserves, market analyses, and preliminary feasibility studies establishing the viability of mine development at various locations (see Section 3). Projections were also made identifying which consumers might use Kalimantan coal, by what time, and in what quantity (see Section 4).

5.2.1 Market Development

The next step in the development and use of Kalimantan coal must by necessity be the emergence of a market for the product in which producers and consumers negotiate sales agreements. Emergence of such a market requires resolution of two issues:

- Assurance of supply
- Price of delivered coal

Assurance of Supply. Producers, confident they can supply a domestic market based on exploration results to date, are reluctant to invest additional funds to start production unless market guarantees are established that ensure a fair return on their investment. Domestic consumers, on the other hand, are reluctant to enter into sales agreements until they are sure Kalimantan coal will be produced. Because no coal is yet produced in Kalimantan, none of the producers can demonstrate production capability.

Resolution of this issue lies in extensive technical information exchange between producers and consumers, in which consumers can learn about the minimal risks involved. In addition to actively promoting and contributing to such an information exchange, the government may want to provide additional guarantees to consumers to further minimize risks.

Price of Delivered Coal. It must be shown that cost of delivery from Kalimantan to unloading ports in Java can be competitive with coal from alternative supply sources. The domestic capability to economically transport coal by sea from Kalimantan to Java and other islands has not been established because it is not yet clear what type of sea transport will be used. This cost uncertainty affects both producers and consumers. On the producer side, a high transport charge would affect the competitiveness of their product compared to other supply sources, notably Australia. On the consumer side, the uncertain costs of sea transport could make consumers even more reluctant, because they would not know the "bottom line" price for coal delivered to their facilities.

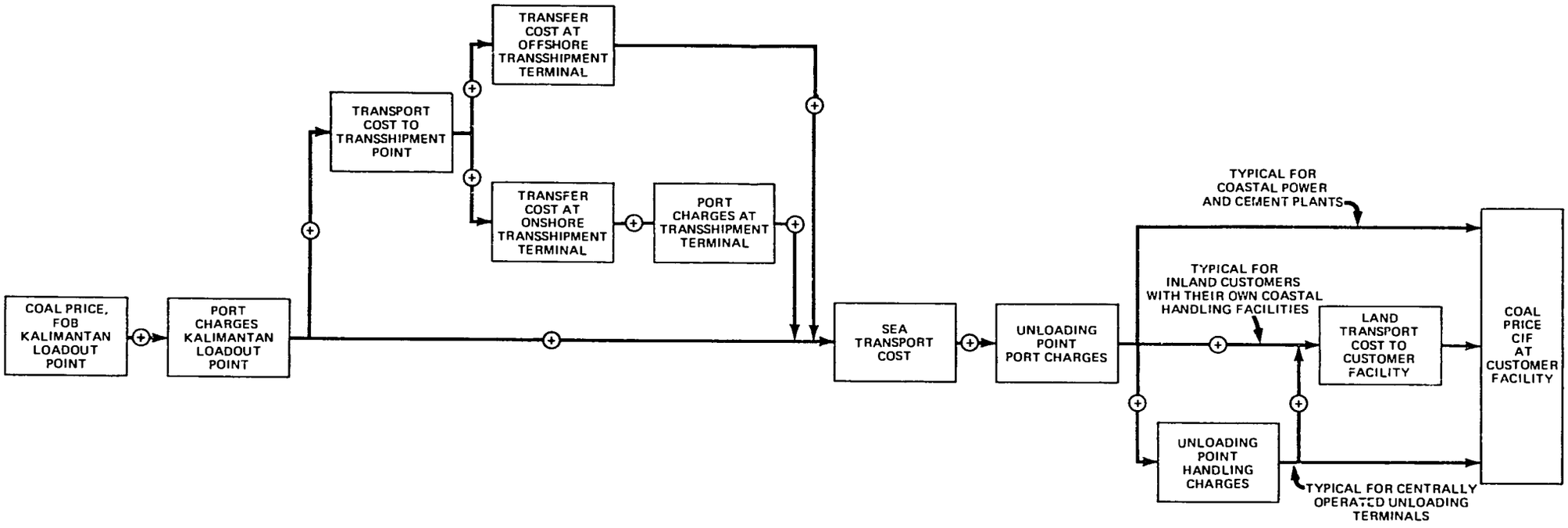
The price of delivered coal is made up of several charges, as illustrated in Figure 5.2-1. The delivered price of coal may contain the following major components:

- Coal price, FOB the Kalimantan loading point
- Port charges in Kalimantan
- Transfer charges from small vessels to larger vessels
- Transshipment terminal port charges
- Sea transport charges
- Unloading port charges
- Unloading port handling charges
- Land transport charges to customer's facility

Most of the above charges can only be determined precisely once an actual transport system is in operation. It is important to assess the magnitude of transport costs, however, so we may determine if Kalimantan costs are likely to be in the same price range as imported coal.

5.2.2 Hypothetical Case Study

The following is a hypothetical comparison of coal transport from Australia to Java and from Kalimantan to Java. The objective of this



Price is an accumulation of charges (⊕) depending on customer location and participation in coal handling and transport.

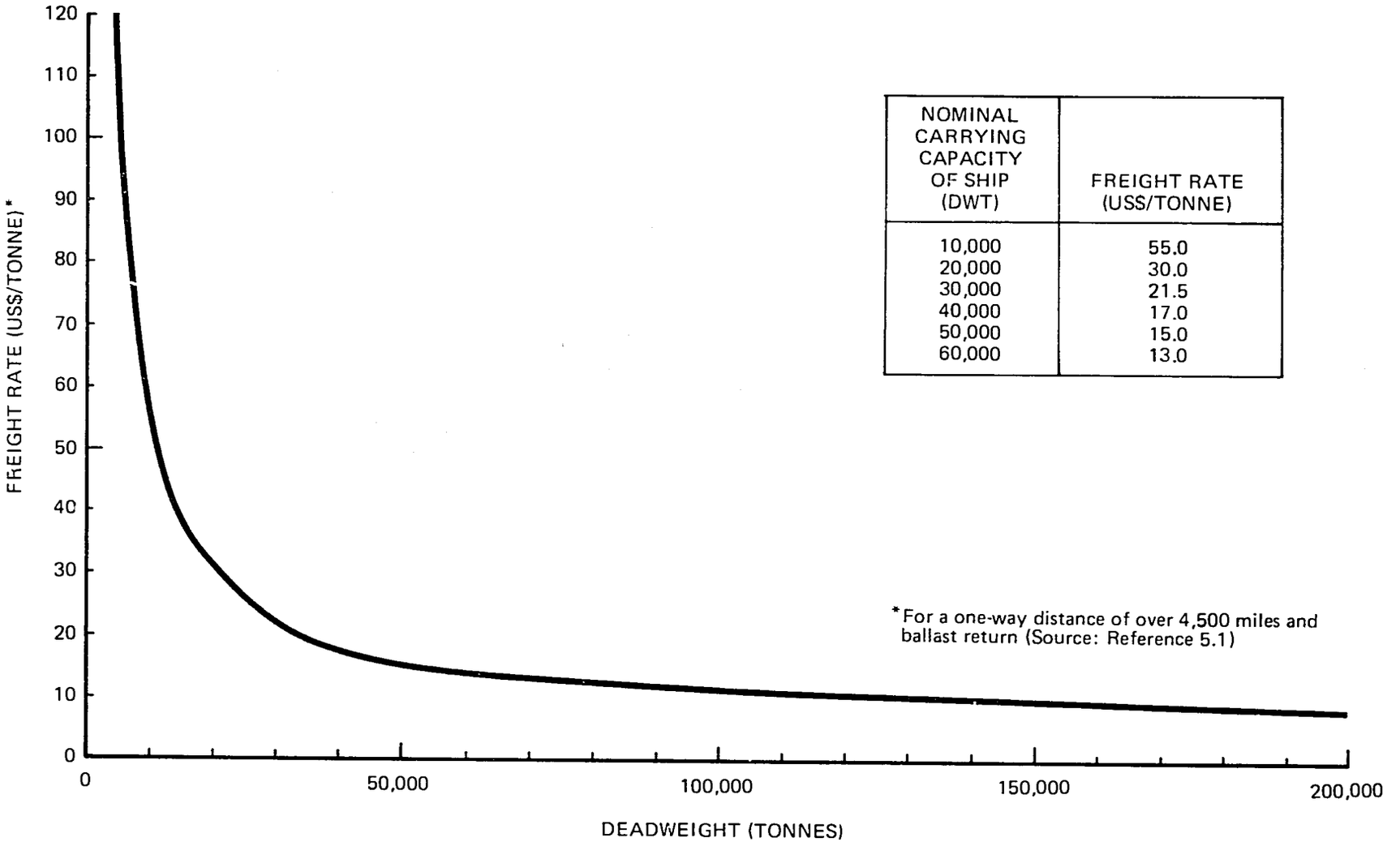
Figure 5.2-1 PRICE OF DELIVERED COAL

example is to analyze the difference in delivery cost between Australian and Kalimantan coal, and its implications for the development of a domestic sea transport system. For the purpose of illustration only, coal was assumed to be supplied to the Paiton power plant in east Java from either the Senakin area in Kalimantan or Gladstone, Australia. The distance between Senakin and Paiton is about 450 nautical miles, while the distance from Gladstone to Paiton is approximately 2,770 nautical miles. No consideration was given to the potential differences between production cost in Australia and in Kalimantan, so the coal price used for both FOB Australia and FOB Kalimantan was identical (approximately US$40 per tonne). It was also assumed that the quality of the coal from Australia and Kalimantan is identical in terms of heat-content and provides the same amount of energy.

Gladstone to Paiton. To estimate the transport charge from Gladstone to Paiton, data used were from the relatively recent feasibility study on the Batam Island Coal Center (Reference 5-1). This study was performed in the spring of 1983, and it is assumed that estimates in the report are still valid.

Based on the freight rates in Table 5.2-1 (from Reference 5-1), and the distance to Paiton, a freight rate for coal transport from Gladstone to Paiton in 30,000 DWT ships can be extrapolated at US$13.27 per tonne. Figure 5.2-2 (based on Reference 5-1) shows the typical relationship between a ship's nominal carrying capacity and the freight rate for a one-way distance of over 4,500 miles, including ballast return. Using the above estimate of US$13.27 per tonne, and a similar relationship as shown in Figure 5.2-2, Table 5.2-2 gives Gladstone to Paiton freight rate estimates for vessels larger than 30,000 DWT.

There would be no problem receiving ships of 60,000 DWT or larger at Paiton since water depth at the coal unloading jetty is between 15 and 20 meters (Reference 5-2). It follows that Australian coal could be transported to Paiton for not more than approximately US$8.00 per tonne.



NOMINAL CARRYING CAPACITY OF SHIP (DWT)	FREIGHT RATE (US$/TONNE)
10,000	55.0
20,000	30.0
30,000	21.5
40,000	17.0
50,000	15.0
60,000	13.0

Figure 5.2-2 TYPICAL RELATIONSHIP BETWEEN A SHIP'S NOMINAL CARRYING CAPACITY (DWT) AND FREIGHT RATE

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Table 5.2-1

COAL FREIGHT RATES: GLADSTONE TO SOUTHEAST ASIA[a]

Destination	Distance (nautical miles)	Freight Rate (US$/tonne)
Bintan	3,582	15.66
Bangkok	4,392	18.04

(a) Using 30,000 DWT ships
Source: Reference 5-1

Table 5.2-2

ESTIMATED FREIGHT RATE: GLADSTONE TO PAYTON

Nominal Carrying Capacity of Vessel (DWT)	Point Estimate (US$/tonne)	Approximate Range (US$/tonne)
30,000	13.27	-
40,000	10.49	10.25 - 10.75
50,000	9.26	9.00 - 9.50
60,000	8.03	7.75 - 8.25

Based on Reference 5-1

This $8.00 per tonne upper cost limit for transport of Australian coal to Java in 60,000 DWT vessels (i.e., Panamax size), was based on extrapolation of data from Reference 5-1. The validity of this upper cost limit is further underscored by a recent (Sept. 1984) contract negotiated by PN Tambang to supply Australian coal in 40,000 DWT vessels to Suralaya. The contract calls for delivery of 440,000 tonnes at a total cost of 23,298,000 Australian dollars (A$) or A$52.95 per tonne and an FOB Australian price of A$40.00 per tonne. This implies a transport

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and delivery charge of A$12.95 per tonne or US$11.52/tonne, assuming a conversion rate of A$0.89 per US$1.00. Because the distance between Australia and Paiton is approximately 400 miles less than Australia to Suralaya, the transport charge of US$11.52 per tonne in 40,000 DWT could be reduced by approximately US$1.00, resulting in a charge of about US$10.50 per tonne, which is similar to what is contained in Table 5.2-2 for 40,000 DWT vessels.

Kalimantan to Paiton. Transport cost from Kalimantan to Paiton was estimated based on calculation procedures and assumptions explained in detail in Subsection 5.4. Table 5.2-3 presents the results of these calculations and indicates three types of charges:

- Round-trip transport cost
- Loading cost at Kalimantan
- Port charges in Kalimantan

Unloading cost and port charges at Paiton have not been included because such charges would be the same whether the coal came from Senakin or Australia.

Round-trip transport cost corresponds approximately to a transport charge for a route with annual transport requirements of at least 5 million tonnes. It was assumed that at this level of throughput barge loading would cost US$2 per tonne and bulk carrier loading would cost US$3 per tonne. Port and other miscellaneous charges were set at US$1.50 per tonne for any type of vessel and include all duties, taxes, and levies. All costs in Table 5.2-3 assume a highly efficient fleet operation and could easily be 20-25 percent higher, particularly at lower throughput levels.

As further explained in Subsection 5.4, the maximum vessel size to be used in inter-island bulk transport was limited to 40,000 DWT because average distances between loading and unloading ports and the annual transport requirements per route do not seem to warrant consideration of larger vessels. In addition, if larger vessels were used, the decrease

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Table 5.2-3

ILLUSTRATIVE MINIMUM COSTS OF TRANSPORTING KALIMANTAN COAL TO PAITON[a]

Type of Vessel	Nominal Cargo Carrying Capacity (DWT)	Round-trip Sea Transport Cost[b] (US$/tonne)	Loading Cost[b] (US$/tonne)	Port and Other Charges in Kalimantan (US$/tonne)	Total Coal Transport Costs (CIF-Paiton)	
					Including Loading Cost (US$/tonne)	Excluding Loading Cost (US$/tonne)
Barge and tug	2,000	10.73	2.00	1.50	14.23	12.23
Barge and tug	5,000	8.93	2.00	1.50	12.43	10.43
Barge and tug	10,000	6.14	2.00	1.50	9.64	7.64
Mini-bulk carrier	6,000	6.69	3.00	1.50	11.19	8.19
Bulk carrier	10,000	4.93	3.00	1.50	9.43	6.43
Bulk carrier	20,000	4.11	3.00	1.50	8.61	5.61
Bulk carrier	30,000	3.86	3.00	1.50	8.36	5.36
Bulk carrier[c]	40,000	3.74	3.00	1.50	8.24	5.24

(a) For a 450 nautical mile one-way trip, comparable to Tanjung Batu to Paiton
(b) See Subsection 5.4 for details of the calculation procedure
(c) Although ships larger than 50,000 DWT will be able to berth at Paiton, no ships larger than 40,000 DWT are considered for inter-island bulk transport. As shown in Subsection 5.4.4, no significant reduction in transport cost per tonne can be expected beyond 40,000 DWT.

in transport cost per tonne would be relatively small, as can be seen by comparing the round-trip transport costs in Table 5.2-3 for 30,000 and 40,000 DWT vessels.

5.2.3 Conclusions

Taking into full account the various caveats and assumptions mentioned in the beginning of this subsection, the following can be concluded by comparing Table 5.2-3 with the estimated charge of US$8 per tonne for transport of coal from Australia:

- Excluding loading cost in Kalimantan, which according to current plans will be the responsibility of Kalimantan coal contractors, it should be possible to deliver coal to Paiton from Kalimantan at lower cost than from Australia

- The transport cost differential of Kalimantan coal over Australian coal is relatively small and could be quickly eroded if:

  - Bulk carriers smaller than 40,000 DWT, or 10,000 DWT barges, have to be used

  - Miscellaneous charges are significantly greater than US$1.50 per tonne (a possible condition without careful planning)

  - Loading costs in Kalimantan are added to the round-trip transport cost (e.g., by having a government-owned company or any company other than the coal contractor be responsible for loading)

As stated earlier, the above is not intended to accurately reflect coal transport charges from either Kalimantan or Australia. Yet it is clear from the above discussion that transport of Kalimantan coal is not categorically cheaper than transport of coal from Australia. Therefore, because sea transport is critical to the actual development and production of Kalimantan coal for domestic consumption, every effort should be made to develop a sea transport system that will always result in a lower coal transport cost compared to other supply sources.

This discussion did not take into account that purchase of Australian coal would require foreign exchange, while Kalimantan coal probably could be paid for in Rupiahs. From a national economic point of view, this difference favors use of Kalimantan coal. However, for private consumers and (to some extent) government-owned companies, it would only be beneficial to use Kalimantan coal if the price is at least as good as the next best alternative, meaning the actual price for Australian coal. Therefore, it would be beneficial to both the national interest and private consumers to develop a sea transport system that can always deliver coal at prices competitive with other supply sources.

5.3 APPROACH AND PERSPECTIVE FOR SEA TRANSPORT SYSTEM ANALYSIS

5.3 APPROACH AND PERSPECTIVE FOR SEA TRANSPORT SYSTEM ANALYSIS

As explained earlier, the coal transport analysis in this section is not tied to particular delivery schedules specified in sales contracts between producers and consumers. Instead, this transport analysis is based on a coal supply strategy developed after review of possible annual production targets in the various producing areas in Kalimantan (see Table 3.9-4) and requirements projected by power and cement plants in Java and Sulawesi (see Table 4.2-4).

5.3.1 Coal Supply Strategy

The coal supply strategy allocates coal from various producing areas to meet projected demands from specific consumers (see Table 5.3-1). Figures 5.3-1 and 5.3-2 show the implied coal flows for the years 1988 and 1994.

The allocation of supply to demand was performed by inspection using a combination of the following principles:

- Shortest distance. To minimize transport costs, coal generally should be supplied to consumers on Java and Sulawesi over the shortest possible route.

- Minimum number of suppliers per consumer. It is desirable for single producers to meet the long-term requirements of single consumers so the consumer does not have to enter into multiple supply contracts.

- Quality considerations. Allocation should reflect the coal quality requirements of the various consumers. Thus, coal with higher sulfur content would be more suitable for cement plants than power plants.

- Opportunity for cooperation among producers. The supply and transport system could be greatly enhanced if the risks of supply interruptions and quality variations are minimized. This principle argues for allocating supplies geographically close together to consumers with compatible demands. In this way, coal from several producing areas could more easily be interchanged, minimizing supply interruptions. In addition, uniform coal quality could be guaranteed if

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coal from various areas were blended, which could be more easily done by producers close to each other. Joint coal preparation and blending could be desirable if coal variations in producing areas are unacceptable to the consumer.

- Projected production and consumption schedules. The projected time to start production varies for specific producers in Kalimantan, based on the status of exploration efforts. Similarly, the time when consumers require specific quantities varies. This principle recognizes that in the beginning of system development consumers can only be supplied by those producers whose preparatory efforts are sufficiently advanced to meet demand.

Using these principles, coal from the Senakin Peninsula was selected to supply Paiton because it is currently the only single source large enough to supply the first four units of this power station. Initial demands will be met by coal from the Sangsang deposit, and the deposits on the east side of the peninsula will be used as Paiton's demand increases. Initial demands of the cement industry will be met by deposits in the Pasir (Petangis and Bindu-Betitit deposits) and Samarangau areas because of their projected early production. Increases in demand from cement plants during the study period will be met by expanded production in these areas and production in the Sangatta area. A relatively low level of production is assumed for the Tanjung and Berau areas by the end of the study period, with Tanjung supplying a power plant in Banjarmasin, and Berau supplying customers in northern and eastern parts of Indonesia (such as the cement plant to be built in Menado on Sulawesi). Coal from the Mahakam area will be used to supply a projected power plant on the southern coast of central Java.

The coal supply strategy in Table 5.3-1 and the coal flows in Figures 5.3-1 and 5.3-2 are certainly not the only ones possible. Other allocations may emerge as producers enter into agreements with specific consumers. The coal supply strategy assumed here is intended only to provide a sound starting point for considering development of the sea transport system. The actual system is expected to be a variation of the

Table 5.3-1

KALIMANTAN COAL SUPPLY STRATEGY

FOR 1988 AND 1994

Region	Plant Name	Coal Demand (millions of tonnes) 1988	Coal Demand (millions of tonnes) 1994	Coal Supply For Domestic Use (millions of tonnes): Tanjung Area 1988	Tanjung Area 1994	Senakin Area: Sangsang 1988	Sangsang 1994	Sepapah 1988	Sepapah 1994	E. Senakin 1988	E. Senakin 1994	Pasir Area: Petangis 1988	Petangis 1994	Bindu-Betitit 1988	Bindu-Betitit 1994	Samarangau Area 1988	Samarangau Area 1994	Mahakam Area 1988	Mahakam Area 1994	Sangatta Area 1988	Sangatta Area 1994	Berau Area 1988	Berau Area 1994
Cement Plants																							
Java	Semen Cibinong	0.25	0.28	-	-	-	-	-	-	-	-	-	-	0.25	0.28	-	-	-	-	-	-	-	-
	INDOCEMENT																						
	-Phase 1,2,3,4,6,7,8	1.05	1.05	-	-	-	-	-	-	-	-	1.00	1.00	0.05	0.05	-	-	-	-	-	-	-	-
	-Tridaya M.P.	0.17	0.34	-	-	-	-	-	-	-	-	-	-	0.17	0.34	-	-	-	-	-	-	-	-
	-P.K. Hasta	0.45	0.45	-	-	-	-	-	-	-	-	-	-	-	-	0.45	0.45	-	-	-	-	-	-
	-P.S. Karya	0.20	0.42	-	-	-	-	-	-	-	-	-	-	-	-	0.20	-	-	-	-	0.42	-	-
	-P.A. Abadi	0.20	0.28	-	-	-	-	-	-	-	-	-	-	0.20	0.28	-	-	-	-	-	-	-	-
	Semen Cresik	0.48	0.64	-	-	-	-	-	-	-	-	-	-	-	-	0.48	0.64	-	-	-	-	-	-
	S. Nusantara	0.10	0.25	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	0.25	-	-
	Sugih Harapan	0.17	0.42	-	-	-	-	-	-	-	-	-	-	-	-	0.17	0.42	-	-	-	-	-	-
	S. Purwodadi	0.10	0.42	-	-	-	-	-	-	-	-	-	-	-	-	0.10	0.42	-	-	-	-	-	-
	Semen Gombong	-	0.30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.30	-	-
Total Java		3.17	4.85	-	-	-	-	-	-	-	-	1.00	1.00	0.67	0.95	1.50	1.93	-	-	-	0.97	-	-
Sulawesi	Semen Tonasa	0.19	0.36	-	-	-	-	-	-	-	-	-	-	-	-	0.19	-	-	-	-	0.36	-	-
	Semen Menado	-	0.34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.34
Total Sulawesi		0.19	0.70	-	-	-	-	-	-	-	-	-	-	-	-	0.19	-	-	-	-	0.36	-	0.34
Total cement plants		3.36	5.55	-	-	-	-	-	-	-	-	1.00	1.00	0.67	0.95	1.69	1.93	-	-	-	1.33	-	0.34
Power Plants																							
Java	Paiton 1	0.69	0.91	-	-	0.69	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Paiton 2	-	0.91	-	-	-	-	-	-	-	0.91	-	-	-	-	-	-	-	-	-	-	-	-
	Paiton 3	-	1.37	-	-	-	-	-	-	-	1.37	-	-	-	-	-	-	-	-	-	-	-	-
	Paiton 4	-	1.37	-	-	-	-	-	-	-	1.37	-	-	-	-	-	-	-	-	-	-	-	-
	Jateng 1	-	1.37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.37	-	-	-	-
Total Java		0.69	5.93	-	-	0.69	0.91	-	-	-	3.65	-	-	-	-	-	-	-	1.37	-	-	-	-
Kalimantan	Loakulu 1	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-	-	-	-
	Loakulu 2	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-	-	-	-
	Balikpapan 1	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-	-	-	-
	Balikpapan 2	-	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-	-	-	-
	Banjarmasin	-	0.14	-	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Kalimantan		-	0.58	-	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	0.44	-	-	-	-
Total power plants		0.69	7.09	-	0.14	0.69	0.91	-	-	-	3.65	-	-	-	-	-	-	-	1.81	-	-	-	-
Summary																							
Total cement and power plants		4.05	12.06	-	0.14	0.69	0.91	-	-	-	3.65	1.00	1.00	0.67	0.95	1.69	1.93	-	1.81	-	1.33	-	0.34
Estimated Kalimantan supply		5.37	17.00	-	1.50	1.00	1.00	0.50	0.50	0.50	4.00	1.00	1.00	0.67	1.00	1.70	2.00	-	2.00	-	2.00	-	2.00
Surplus Kalimantan coal		1.32	4.94	-	1.36	0.31	0.09	0.50	0.50	0.50	0.35	-	-	-	0.05	0.01	0.07	-	0.19	-	0.67	-	1.66

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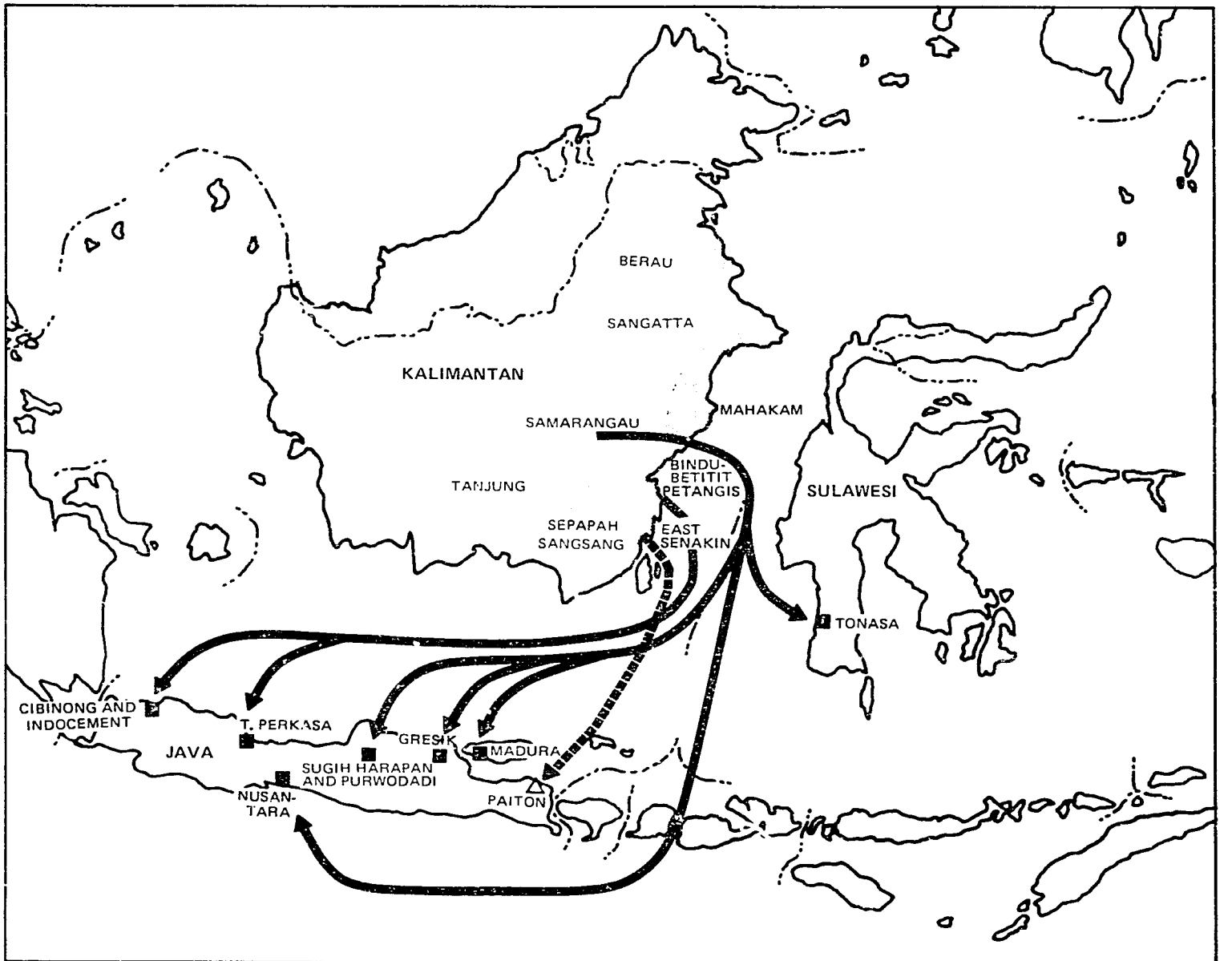

COAL FOR POWER
COAL FOR CEMENT
POWER PLANTS
CEMENT PLANTS

Figure 5.3-1 KALIMANTAN COAL FLOWS: 1988

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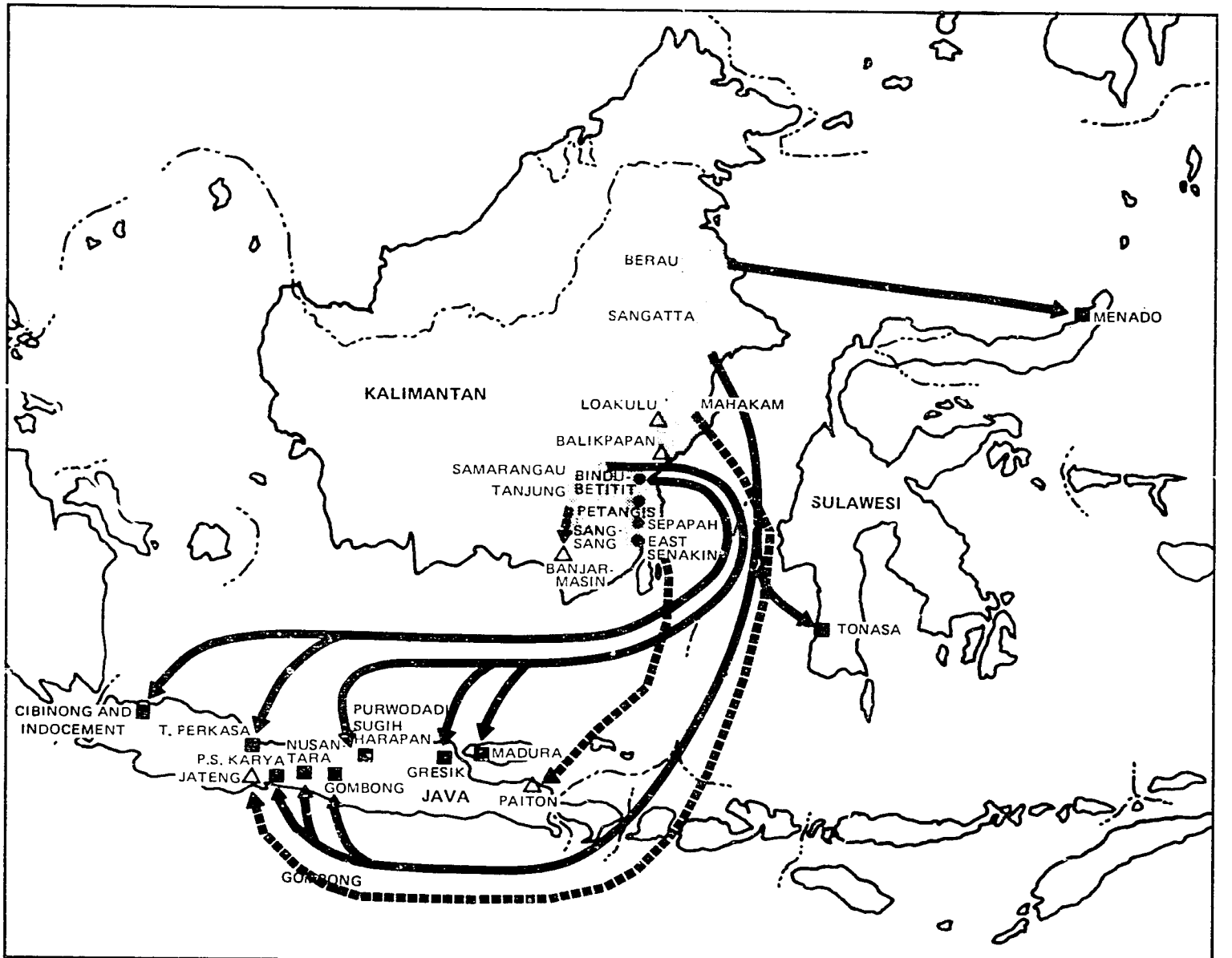

COAL FOR POWER
COAL FOR CEMENT
POWER PLANTS
CEMENT PLANTS

Figure 5.3-2 KALIMANTAN COAL FLOWS: 1994

system developed in this section, but the main conclusions and recommendations are expected to remain valid in spite of changes in the allocation of Kalimantan coal to consumers.

5.3.2 Analysis Premises

Generically, there are two types of systems for transport of Kalimantan coal. Option 1 is a direct shipping system between individual producing areas in Kalimantan and consumers on Java and Sulawesi. With this option, individual transport arrangements would be made between producers and consumers. Under Option 2, a transport company would collect the coal from several producer areas and transfer it to suitably sized vessels at a point in Kalimantan for subsequent transport to consumers on Java and Sulawesi.

These options represent the "end points" of the spectrum of shipping possibilities to be investigated by the transport agency or company. The focus of the sea transport analysis in this section is on determining the advantages and disadvantages of each option, as well as the degree to which each option could be implemented. Based on the results of this analysis, follow-up studies to implement one or a combination of these options can then be defined.

Development of these alternative sea transport systems was guided by these assumptions and premises:

- A single transportation entity
- Coordinated development
- Phased development
- Existing policies, conditions, and agreements

Single Transportation Entity. It was assumed that one entity will be responsible for the transport of coal from all producing areas in Kalimantan to the power and cement plants on Java and Sulawesi. This entity can be a public or private company, a joint venture company between the government and private companies, a foreign company, or any

other type of company. The only assumption here is that only one entity is responsible for all coal transport. This entity would be interested in the system to be implemented, in terms of type and size of vessels to be used, routes to be traveled, sea transport costs, etc. Under Option 1 the transport company would service the direct shipping needs of all producers and consumers. Under Option 2 the company would also be engaged in transshipment. This assumption will be further discussed in Subsection 5.6.2.

Coordinated Development. It was assumed that development of the sea transport system would be coordinated closely with all producers and consumers to achieve a cost-effective transport system. In this regard, the above mentioned entity would be expected to provide a service not only to those production-sharing contractors associated with PN Tambang Batubara, but also to other private coal companies operating in Kalimantan, notably the four private companies operating concessions along the Mahakam River.

Phased Development. Development of the transport system must coincide with development of the market for Kalimantan coal. Figure 5.3-3 displays how demand from the two major consumer groups (power and cement plants) is projected to increase. Market development consists of three phases:

- Phase I - startup phase. Until approximately 1988, initial coal production is projected to be used by the cement industry. This involves relatively small sales contracts for amounts to be delivered to state-owned and private plants currently operating on Java and Sulawesi.

- Phase II - transient phase. From 1988 to approximately 1991, the introduction of relatively large sales contracts for the startup of major coal-fired power plants units will require the transport system to satisfy significantly larger transport requirements over a few dedicated routes.

- Phase III - steady-state phase. Starting in approximately 1991, a stable market will emerge for Kalimantan coal, with the power industry the dominant user, followed closely by the cement industry.

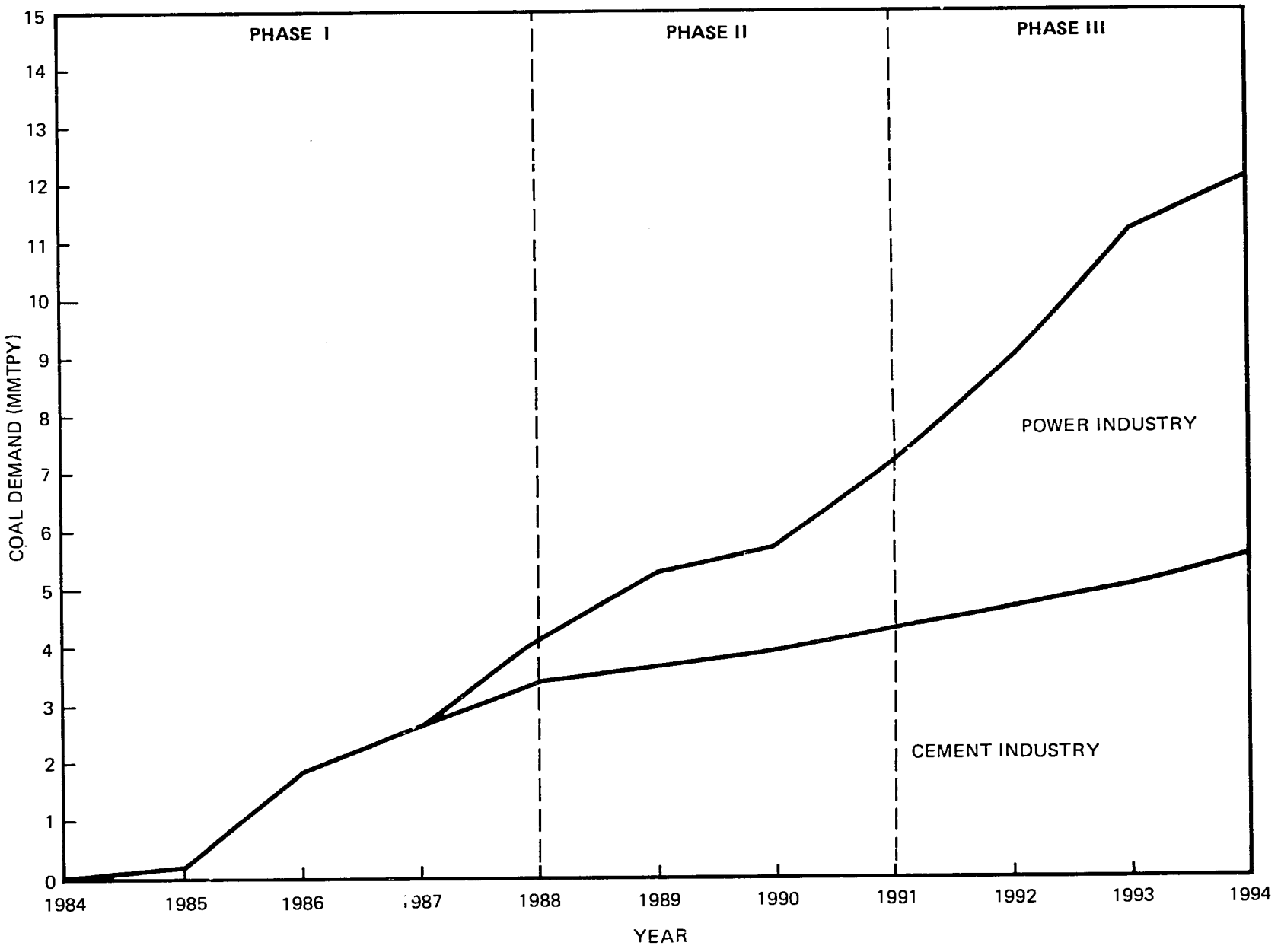

Figure 5.3-3 MARKET DEVELOPMENT FOR KALIMANTAN COAL

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Uncertainty about the market for Kalimantan coal undoubtedly will be greatest during Phase I and production will not start until a few sales contracts are signed. The importance of Phase II is that any sales contract to deliver coal to a power plant on Java will greatly enhance the position of Kalimantan coal producers and contribute to establishing Kalimantan as a secure domestic supplier. Phase III reflects what is envisioned for Kalimantan coal; a steady and secure domestic energy supply.

Investments in the development of the transport system will reflect similar phasing. During Phase I, the emphasis must be on starting transport of coal without extensive capital outlays, to go "slow but sure." During Phase I, suitably sized existing vessels may be used to transport coal with minimal investment in needed Kalimantan ports, and loading and unloading facilities. Dredging of Kalimantan ports to allow larger vessels would not yet be justified because annual transport requirements would still be too small.

Sales contracts with the power industry during Phase II will provide the justification to consider transport options that provide lower transport costs but also require greater capital outlays. This would require reevaluation of the types and size of vessels used, as well as the adequacy of port facilities.

Finally, during Phase III, when a firm market for Kalimantan coal is established and uncertainty regarding Kalimantan coal supply has been eliminated, design and implementation of the best overall transport system to provide the lowest possible freight rates can proceed. At this point, the full implications of the two generic options -- direct shipping versus transfer in Kalimantan -- will have to be considered together with the necessary facilities (such as onshore or offshore transfer facilities and centralized coal treatment facilities) and optimum fleet composition.

Existing Policies, Conditions, and Agreements. The sea transport analysis in this section fully considers the policies and agreements that

exist or have been developed in relationship to Kalimantan coal development. Examples include:

- Plan to use Cigading as the unloading point in west Java
- Responsibility for loading assigned to Kalimantan coal producers
- Power plant design and construction to include unloading facilities at major power plants

5.3.3 Analysis Approach

The approach for the analysis conducted in this section is shown in Figure 5.3-4. Based on the assumed coal supply strategy, two sets of tasks have been conducted. The first set (displayed on the left side of Figure 5.3-4) consists of review and analysis of conditions specific to the development of any system for Kalimantan coal transport. The second set of tasks (displayed on the right side of Figure 5.3-4) consists of specification of each of the two generic options mentioned earlier.

Each of these sets of tasks is further discussed in the subsections identified in Figure 5.3-4. A few important general points that should be noted here are:

- "Optimum" transport system. There is no attempt here to determine the "optimum" transport system for the postulated supply strategy. Too many parameters currently influencing system design cannot be determined to warrant such detailed planning. The objective here is to identify in which direction transport system development should proceed and to analyze the relative merits of the two options.
- Analysis of local conditions. Transport development will take place under very specific conditions, such as a limited number of designated routes, generally shallow loading ports in Kalimantan, relatively short transport distances, and annual transport requirements per route that vary from several hundred thousand tonnes to several million tonnes. Analysis of local conditions is useful in order to limit the number of choices that realistically are available.

- Order of magnitude costs. This analysis is aimed at determining order of magnitude transport costs that may be expected. Costs include both the transport cost per round-trip between a loading port in Kalimantan and an unloading port on Java and Sulawesi, as well as the annual cost of operating a domestic fleet for coal transport. This cost information is intended as benchmark information to further evaluate the prospects of Kalimantan coal production and use.

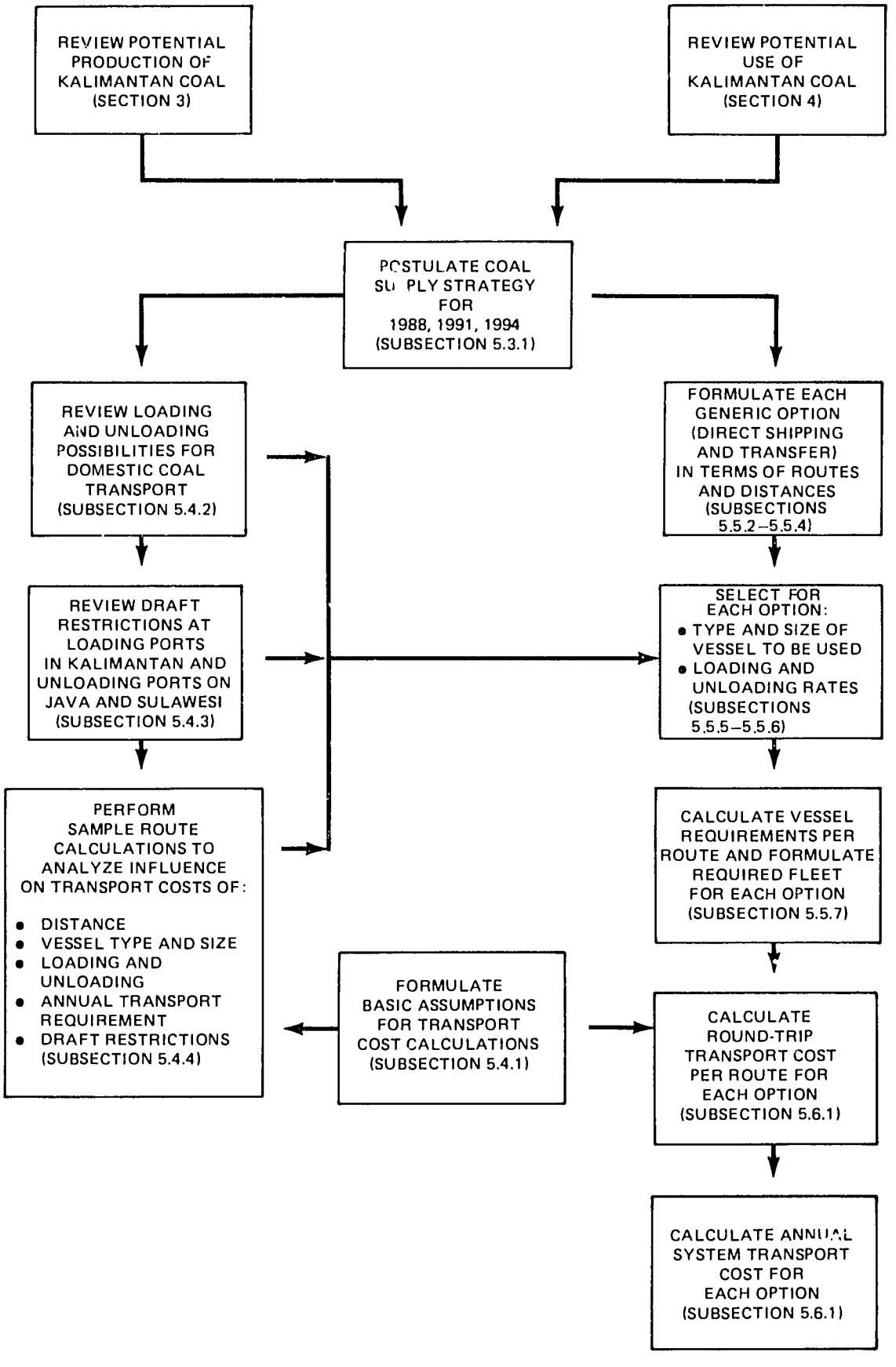

Figure 5.3-4 APPROACH FOR SEA TRANSPORT ANALYSIS

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5.4 ANALYSIS METHODOLOGY AND GENERAL SHIPPING CONSIDERATIONS

5.4 ANALYSIS METHODOLOGY AND GENERAL SHIPPING CONSIDERATIONS

This subsection describes the various cost concepts used in this analysis and focuses on the assumptions made. Generalized cost calculations are presented in order to identify guiding principles that are important to the development of a coal transport system between Kalimantan, and Java and Sulawesi.

5.4.1 Methodology and Key Assumptions

The cost of transporting coal is principally dependent on:

- Type and size of transport vessel
- Type and size of loading and unloading equipment
- Harbor time for mooring, unmooring, and possible waiting
- Route distance and annual transport requirements

Transport Vessels. For the purpose of this study different types and sizes of vessels have been considered. The type and size of vessel determine the following parameters (the letters will be used as symbols in the generalized cost calculations):

A = Nominal cargo carrying capacity in DWTs

B = Effective cargo carrying capacity in tonnes

C = Maximum draft in meters

D = Service speed in nautical miles per hour (knots)

E = Service power requirements in horsepower (HP)

F = Fuel consumption in liters per day

The parameters and associated assumptions for each vessel are identified in Table 5.4-1. Barges smaller than 2,000 DWT were not considered, as they are expected to be uneconomical at the levels of coal transport envisioned. On the other end, no ships larger than 40,000 DWT were considered because route distances for domestic transport will be relatively short, resulting in proportionally high loading, unloading,

Table 5.4-1

VESSEL CHARACTERISTICS

Type of Vessel	Nominal Cargo Carrying Capacity (DWT)	Effective Cargo Carrying Capacity[a] (tonnes)	Maximum Draft[b] (meters)	Service Speed (nautical miles per hour)	Service Power Requirement[c] (horsepower)	Fuel Consumption to Maintain Service Speed[d] (liters/day)
Barge and tug	2,000	2,000	3.5	8	2,000	8,568
Barge and tug	5,000	5,000	4.5	8	4,000	17,136
Barge and tug	10,000	10,000	6.0	8	5,000	21,420
Mini-bulk carrier	6,000	5,580	6.75	10	3,000	12,852
Bulk carrier	10,000	9,300	7.5	12	4,000	17,136
Bulk carrier	20,000	18,600	9.0	15[e]	11,000	47,124
Bulk carrier	30,000	27,900	9.9	15[e]	13,000	55,692
Bulk carrier	40,000	37,200	10.6	15[e]	15,000	64,260

(a) Capacity utilization was assumed as follows: barges = 100 percent; bulk carriers = 93 percent
(b) In view of the fact that draft restrictions prevail in most Indonesian coastal wasters, it was assumed that wherever possible shallow draft vessels will be used. The maximum drafts indicated correspond to such vessels. For barges, 0.5 meter was added to accommodate the tug
(c) Service power requirements correspond to requirements to maintain indicated service speed, and were used to calculate fuel requirements
(d) Fuel requirements were calculated using the following assumptions: 0.17 kg of fuel oil per HP per hour; 1 kg fuel oil equals 1.05 liters
(e) Speeds for vessels of this type and size are normally in the range of 12 to 13 knots in order to save on fuel consumption. Selection of vessel speed involves a tradeoff between the sum of the capital cost and operating cost components, and the fuel cost component in the round-trip transport cost per tonne. Because full construction cost recovery is assumed in the analysis, a speed has been selected that the vessel is capable of attaining. This point is further discussed at the end of Subsection 5.4.1 under the heading "Vessel Speed."

and harbor time, compared to longer routes in which the majority of round-trip time is on the sea. There may be economic justification to employ ships larger than 40,000 DWT on specific routes, as discussed later in this section. In general, however, 40,000 DWT can be considered a reasonable maximum size, especially during the first ten years of system development.

It should be noted that only domestic coal transport is taken into account. If export of Kalimantan coal is considered, ship size should be increased to at least Panamax size (60,000 DWT) and possibly larger.

Loading and Unloading Equipment. Type and size of loading and unloading equipment are the determining factors for the parameters:

G = Loading time in days

H = Unloading time in days

Selection of type and size of loading and unloading equipment, as well as the assumptions made, are discussed in Subsections 5.4.2 and 5.5.6.

Harbor Time. Harbor time for mooring, unmooring, and waiting can vary considerably, depending on the actual operation of the transport system. For this study the following value was assumed:

I = 16 hours or 0.7 days = total harbor time at both loading and unloading port

Distance and Tonnage. In addition to type and size of vessel, loading and unloading equipment, and harbor time, the cost of transporting coal is dependent on:

J = Route distance between loading and unloading port in nautical miles

K = Annual transport requirements for the route in tonnes per year

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Definition and Calculation of Transport Cost. Two specific definitions of transport cost are used:

X = Round-trip transport cost on a given route in U.S. dollars per tonne

Y = Annual cost of meeting the transport requirements for a given route in U.S. dollars per tonne

Round-trip transport cost is calculated with the assumption that annual throughput on a given route is in essence "unlimited." To meet larger requirements, additional vessels of the same type and size would be assumed with the same round-trip cost. On the other hand, annual transport cost takes into account that a finite number of vessels are required to meet specified annual transport requirements for a given route. It can be equated to the cost of operating a fleet of vessels of the same type and size on a given route. To calculate annual transport cost the following parameter is needed:

Z = Number of vessels (integer) of the same type and size required to meet annual transport requirements on a given route

Other Parameters. Additional parameters used to calculate transport cost are:

N = Number of commission days for the vessel (i.e., number of days per year the vessel is assumed capable of being operated and earning revenue)

P1 = Cost of fuel oil in U.S. dollars per liter

P2 = Capital cost of the vessel in U.S. dollars per day

P3 = Operating cost of the vessel in U.S. dollars per day

Cost Calculations. The round-trip transport cost (X), required number of vessels (Z), and annual transport cost (Y) were calculated with the following simple expressions:

1. $$X = \frac{FP1}{B} \cdot \frac{2J}{24D} + \frac{P2 + P3}{B}\left(\frac{2J}{24D} + G + H + I\right)$$

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2. $$Z = \frac{K}{B \cdot N}\left(\frac{2J}{24D} + G + H + I\right)$$ (Z is rounded up to the nearest integer)

3. $$Y = \frac{FP1}{B} \cdot \frac{2J}{24D} + (P2 + P3) \cdot \frac{ZN}{K}$$

Each of the above expressions can be simply interpreted. Expression 1 states:

[Round-trip transport cost per tonne] = [Fuel cost per day per tonne transported] x [Sailing time of the vessel in days] + [Capital and operating cost per tonne transported] x [Round-trip time of the vessel in days]

Expression 2 states:

[Required number of vessels] = [Annual transport requirements in tonnes] ÷ [Effective carrying capacity of 1 vessel per year]

Expression 3 states:

[Annual transport cost per tonne] = [Fuel cost per day per tonne transported] x [Sailing time of the vessel in days] + [Capital and operating cost per day] x [Number of "cost-bearing" commission days per tonne of annual requirements]

Values for the parameters N, P1, P2, and P3 were assumed as follows:

- o <u>N - Number of commission days</u>. It was assumed that any vessel can be operated 340 days out of the year, leaving 25 days for maintenance, repair, etc., during which time the vessel does not earn revenue. Although low by international standards, this number is high by Indonesian standards and assumes a highly efficient management and operations system for coal transport.

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- P1 - Fuel cost per liter. Fuel cost was assumed at 200 Rupiahs or US$0.20 per liter. This price corresponds to the current domestic fuel oil price and the average fuel oil price in Southeast Asia.

- P2 - Capital cost. Annual capital cost for each type and size of vessel was calculated by amortizing the new built cost of the vessel over a period of 20 years, assuming 12 percent interest and zero salvage value (see Table 5.4-2). Note that new built costs were used instead of new built prices, which are dictated by supply and demand, and can vary significantly. Currently (mid-1984) ship prices are at a record low. To shield the analysis from such fluctuations, a new built cost is assumed. A significantly lower new built price would affect average transport costs but would not necessarily affect the type of transport system selected. New built costs have been determined by comparison of a number of different sources, including Reference 5.3. The procedure used was to estimate an average building cost for vessels built in Southeast Asia and to increase this estimate by 25 percent to reflect increased building costs in Indonesia. As a result, the new built costs shown in Table 5.4-2 are high. They are reasonable, however, for the purpose of this analysis, particularly in view of the government efforts to build up domestic yards to be able to construct bulk transport vessels in the country. Costs for barges are for gearless vessels, while costs for bulk carriers are assumed to correspond to geared vessels (including unloading equipment).

- P3 - Operating cost. The annual operating cost of each type and size of vessel was calculated as the sum of annual costs for insurance, labor, maintenance, and overhead. Table 5.4-3 shows the results using the following assumptions:

  - Insurance: 2.75 percent of new built costs

  - Labor costs: US$5,000 per crew member per year

  - Labor requirements: see Table 5.4-3

  - Maintenance, repairs, and supplies: 2.5 percent of new built costs

  - Overhead: 15 percent of insurance, labor, and maintenance costs

Table 5.4-2

CAPITAL COST COMPONENT OF SEA TRANSPORT COST FOR DIFFERENT VESSELS

Vessel Type	Nominal Cargo Carrying Capacity (DWT)	Number of Commission Days[a]	New Built Cost of Vessel[b] (million US$)	Capital Cost per Year[c] (million US$)	Capital Cost per Commission Day (US$)
Barge	2,000	340	0.5	0.07	197
Tug (2,000 HP)		340	2.8	0.37	1,103
Total			3.3	0.44	1,300
Barge	5,000	340	1.5	0.20	591
Tug (4,000 HP)		340	5.5	0.74	2,165
Total			7.0	0.94	2,756
Barge	10,000	340	2.7	0.36	1,063
Tug (5,000 HP)		340	6.5	0.87	2,560
Total			9.2	1.23	3,623
Mini-bulk carrier	6,000	340	7.5	1.00	2,953
Bulk carrier	10,000	340	10.0	1.34	3,938
	20,000	340	15.5	2.08	6,103
	30,000	340	20.0	2.68	7,875
	40,000	340	23.0	3.08	9,057

(a) Days the vessel is capable of being operated. Corresponds to a 93 percent annual utilization factor, and assumes a highly efficient system for managing and operating the coal transport fleet

(b) Since there is currently no domestic capability to build bulk transport vessels of the size indicated, there exists no basis to assess the cost for Indonesian-built ships. New built costs indicated were assumed to roughly correspond to average building costs in Southeast Asia, with a 25 percent increase added to reflect Indonesian conditions. The assumed costs do not equate to market prices, which, depending on market conditions, could be significantly lower. Costs for barges correspond to gearless vessels, while costs for bulk carriers assume unloading cranes are installed (i.e., geared vessels, not self-unloading vessels)

(c) Calculated by amortizing the new built costs over 20 years at a 12 percent annual interest rate with no salvage value

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Table 5.4-3

OPERATING COST COMPONENT OF SEA TRANSPORT COST FOR DIFFERENT VESSELS

Vessel Type	Nominal Cargo Carrying Capacity (DWT)	Crew Size[a]	Number of Commission Days	New Built Cost (million US$)	Annual Insurance Cost[b] (thousand US$)	Annual Labor Cost[c] (thousand US$)	Annual Maintenance Cost[d] (thousand US$)	Overhead[e] (thousand US$)	Total Annual Operating Costs[f] (thousand US$)	Operating Cost per Commission Day (US$)
Barge	2,000	2	340	0.5	13.75	10.00	12.50	5.44	41.69	123
Tug (2,000 HP)		11	340	2.8	77.00	55.00	70.00	30.30	232.30	683
Total		13		3.3	90.75	65.00	82.50	35.74	273.99	806
Barge	5,000	3	340	1.5	41.25	15.00	37,50	14.06	107.81	317
Tug (4,000 HP)		12	340	5.5	151.25	60.00	137.50	52.31	401.06	1,180
Total		15		7.0	192.50	75.00	175.00	66.38	508.88	1,497
Barge	10,000	3	340	2.7	74.25	15.00	67.50	23.51	180.26	530
Tug (5,000 HP)		12	340	6.5	178.75	60.00	162.50	60.19	461.44	1,357
Total		15		9.2	253.00	75.00	230.00	83.70	641.70	1,887
Mini-bulk carrier	6,000	25	340	7.5	206.25	125.00	187.50	77.81	596.56	1,755
Bulk carrier	10,000	25	340	10.0	275.00	125.00	250.00	97.50	747.50	2,199
	20,000	30	340	15.5	426.25	150.00	387.50	144.56	1,108.31	3,260
	30,000	33	340	20.0	550.00	165.00	500.00	182.25	1,397.25	4,110
	40,000	35	340	23.0	632.50	175.00	575.00	207.38	1,589.88	4,676

(a) Crew size is slightly larger than minimum requirements in accord with Indonesian practice
(b) Annual insurance costs was assumed to be 2.75 percent of building costs. Cover basis is Lloyd's Institute Time Clauses for All Risk Cover
(c) Annual labor cost based on an average of US$5,000 per crew member.
(d) Annual maintenance, repairs, and supplies estimated at 2.5 percent of building costs
(e) Annual overhead estimated as 15 percent of insurance, crew costs, and maintenance costs
(f) Total annual operating cost is sum of insurance, labor, maintenance, and overhead costs

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Finally, with respect to the above calculation methods and assumptions, the following is noted:

- Vessel Draft. (See Table 5.4-1) Most coastal waters around Kalimantan and Java are relatively shallow. In order to avoid draft problems as much as possible, it was assumed that a special effort will be made to use shallow draft wide-beam vessels rather than standard bulk carriers. This is further discussed in Subsection 5.4.3. In addition, the drafts shown in Table 5.4-1 make no allowance for clearances required for navigation.

- Vessel speed. (See Table 5.2-3) Generally, vessel speeds are representative of what the vessel can attain in open waters. Lower speeds often may be used to save fuel. Because full capital and operating cost recovery was assumed in the analysis, fuel cost savings were assumed to cancel out increased capital and operating costs in the round-trip transport cost per tonne. For example, a 40,000 DWT sailing for 5 days at 15 knots has the following trip costs (based on Tables 5.4-1, 5.4-2, and 5.4-3):

Fuel cost	US$64,260	(5 x 64,260 x US$0.20)
Capital cost	US$45,285	(5 x US$9,057)
Operating cost	US$23,380	(5 x US$4,676)
TOTAL	US$132,925	(US$3.57/tonne)

The same vessel sailing at 12 knots could save 25 percent in fuel cost, but the trip would increase 1.25 days to 6.25 days. Total cost for the trip would then be:

Fuel cost	US$48,195	(0.75 x US$64,260)
Capital cost	US$56,606	(6.25 x US$9,057)
Operating cost	US$29,225	(6.25 x US$4,676)
TOTAL	US$134,026	(US$3.60/tonne)

In view of the above, vessel speeds selected represent design speeds for which the vessel is constructed, which are generally higher than normal practice, particularly in situations where a shipping company is only recovering fuel and operating costs.

- Fuel Requirements. In addition to fuel oil requirements, diesel oil is required. Generally, these requirements are on a smaller order of magnitude and have not been included in the analysis.

- "Constant Dollars". All calculations and results in this section are stated in 1984 dollars. Thus, influences of inflation and/or other cost escalation were not included.

5.4.2 Loading and Unloading

This subsection discusses general considerations regarding loading and unloading, and the specific approach to this subject used in developing the proposed Kalimantan coal transportation system.

General Considerations. Where transport distances are relatively small (such as is the case here), the cost of loading and unloading can easily approach 50 to 100 percent of the total round-trip cost, depending on distance and type of vessel used. Consequently, selection of type and size of loading and unloading facilities is very important to the design of an economical domestic sea transport system.

Loading facilities can consist of stationary loaders, in which case the vessel is moved, or traveling loaders, which move along the vessel while loading. More complex and expensive loading arm and conveyor systems can accommodate different size ships (e.g., a luffing type loader). Similarly, unloading equipment and facilities come in different types, such as stationary and traveling unloaders for gearless vessels, cranes on deck of geared vessels, and special unloading equipment on so-called self unloading vessels. In addition to type of equipment, loading and unloading facilities are primarily characterized by their design capacity expressed in tonnes per hour. The average (actual) loading and unloading capacities are a percentage of the design capacity depending on the type of equipment (see Table 5.4-4).

Table 5.4-4

LOADER AND UNLOADER CAPACITIES

Equipment	Average Capacity as Percent of Design Capacity
Stationary loaders	50
Traveling loaders	70
Stationary unloaders	25
Traveling unloaders	50
Self unloaders	80

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Figure 5.4-1 provides a rough approximation of costs for loading and unloading equipment as a function of the design loading and unloading capacity. For any given design capacity, ship loaders are several times cheaper than ship unloaders, so it is generally more critical to determine the right unloading than loading equipment.

Selection of design capacity and type of loading and unloading equipment is based on two closely related criteria; desired flexibility and cost. Desired flexibility influences the type and complexity of the system, and thus, its cost.

Loading and unloading capacities affect round-trip transport cost through the loading and unloading equipment charge, and the ship's waiting cost while loading and unloading. The optimum loading and unloading capacities are a function of the type of vessel to be serviced and the annual amount of coal to be loaded or unloaded. High loading and unloading capacities require more expensive equipment, resulting in high equipment charges. On the other hand, high loading and unloading capacities cause ships to spend less time loading and unloading than lower capacities, reducing the ship's cost while loading and unloading. The annual throughput is probably the most important consideration, because total annual equipment cost divided by total annual throughput determines the equipment charge. Generally, low annual throughput calls for low loading and unloading capacities so that fast, expensive equipment is not standing idle for most of the year.

Loading and Unloading of Kalimantan Coal. The equipment charge for coal loading and unloading will be borne in most cases by either the producer or the consumer. Loading will be the responsibility of the individual coal contractors, so the loading charge will be included in the FOB coal price. Power plants such as Paiton will have their own unloading and material handling system, the design and cost of which will be an integral part of the engineering and design of the power plant. Cement plants located near the coast (i.e., at Gresik, Madura, Biringkassi, and Cilacap) are most likely to make the coal unloading equipment part of

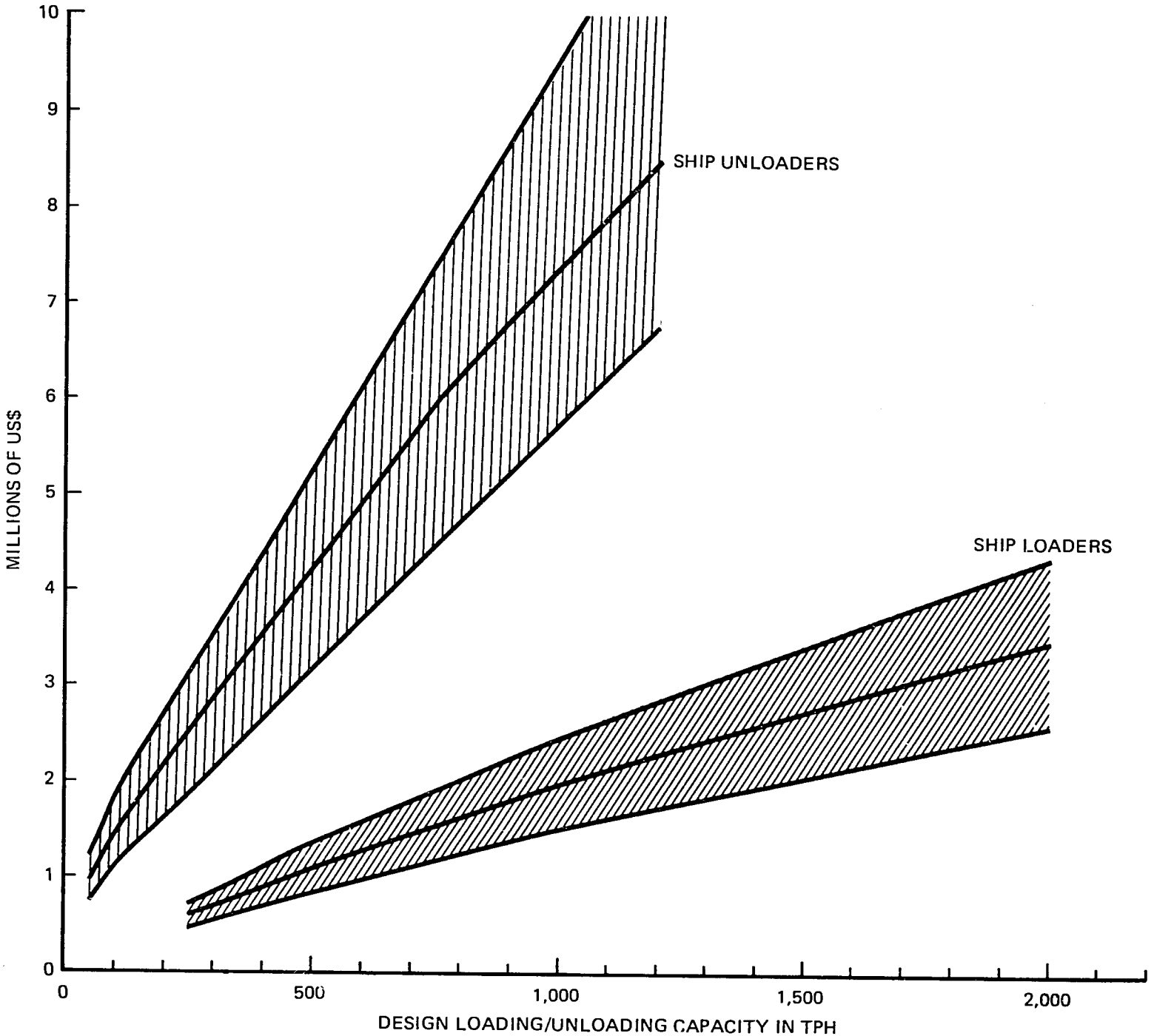

Figure 5.4-1 GROSS ORDER OF MAGNITUDE CAPITAL COSTS FOR VARIOUS TYPES AND SIZES OF SHIP LOADERS AND UNLOADERS

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their existing facilities. Although selection of the appropriate equipment is important to both producer and consumer, the actual charges for loading and unloading are outside the realm of the transport company carrying coal from Kalimantan to Java and Sulawesi.

To develop a transport system, however, it will be necessary to know the time vessels will spend loading and unloading. To determine these times and the resulting cost to the transport company, loading and unloading capacities must be specified. Generally, it was assumed that loading ports with relatively small throughputs (1 to 2 MMTPY, serving barges or other small vessels) will use stationary loaders with a design capacity of 1,000 TPH. This is simple equipment requiring modest investments. If throughput increases, multiple units may be required to load more than one ship at a time. For ports with larger throughputs, traveling loaders with a design capacity of 1,000 to 1,500 TPH have been assumed.

As mentioned earlier, specification of unloading equipment is more critical because of the capital cost involved. Therefore, the basis for specifying unloading capacities has been treated in more detail. Based on the experience of other coal ports, it was assumed that a berth occupancy of approximately 65 percent would result in an efficient port operation leading to reasonable unloading equipment charges. This means that during some 240 days out of the year, a ship would be alongside the unloading berth engaged in unloading.

To facilitate analysis of required unloading capacities, the unloading ports considered (in Subsection 5.5) were categorized in terms of annual throughput, as shown in Table 5.4-5. Table 5.4-6 shows the average and design unloading capacities that would be required to achieve berth occupancy of approximately 65 percent for the various types of unloading ports. It follows from Table 5.4-6 that for Type I and II ports the design capacities must be relatively low to achieve efficient port operations. As explained earlier, however, low unloading capacities give rise to longer port times, leading to a larger ship's cost component in the round-trip cost.

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Table 5.4-5

CLASSIFICATION OF UNLOADING PORTS

Port Type	Annual Throughput Required (TPY)	Port Names
I	350,000 - 450,000	Bitung (Menado) Biringkassi (Tonasa) Madura cement harbor
II	650,000 - 850,000	Gresik Semarang
III	1,500,000 - 2,000,000	Cigading
IV	2,000,000 - 6,000,000	Cilacap Paiton Balikpapan Kotabaru

To determine a reasonable benchmark for a ship's time spent unloading, a calculation was made of the total costs per tonne associated with loading, unloading, and harbor time for different types and sizes of vessels. The results are presented in Appendix C. From these results, practical and feasible loading and unloading capacities were extracted (see Table 5.4-7). For each type and size of vessel, different combinations of loading and unloading capacities were used to arrive at an average total ship's cost of approximately US$1.50 per tonne for loading, unloading, and harbor time (see Table 5.4-8).

With the benchmark times identified in Table 5.4-8, it can easily be seen from Table 5.4-7 that design unloading capacities of 150 and 300 TPH for most types and sizes of vessels are clearly too low and that such capacities would increase the transport cost component for the ship's unloading time significantly. Therefore, to develop a low cost efficient transport system, it is recommended that higher unloading capacities be used for Type I and II ports. Since higher unloading capacities would

Table 5.4-6

UNLOADING CAPACITIES AT VARIOUS PORTS ON JAVA AND SULAWESI[a]

Type of Port	Port Names	Annual Unloading Capacity (tonnes per year)	Required Unloading Rates[b] (tonnes per hour)		Design Capacity of Appropriately Sized Equipment	Average Unloading Capacity (tonnes per hour)	Berth Occupancy	
			Average	Design Average			Days per Year	Percent
I	Menado Biringkassi Madura	From: 350,000	61	122	1 x 150	75	194	53
		To: 450,000	78	156			250	68
II	Gresik Semarang	From: 650,000	113	226	1 x 300	150	181	49
		To: 850,000	148	296			236	65
III	Cigading	From: 1,500,000	262	524	1 x 750	375	167	46
		To: 2,000,000	349	698			222	61
IV	Cilacap Paiton Balikpapan Kotabaru	From: 2,000,000	349	698	1 x 1,000	500	167	46
		To: 2,500,000	436	872			208	57
		To: 3,000,000	523	1,046			250	68
		To: 3,500,000	610	1,220	2 x 1,000	1,000	145	40
		To: 4,000,000	697	1,394			167	46
		To: 4,500,000	785	1,570			188	51
		To: 5,000,000	872	1,744			208	57
		To: 5,500,000	958	1,916			229	63
		To: 6,000,000	1,046	2,092			250	68

(a) As a function of berth occupancy and assuming traveling unloading equipment
(b) To achieve berth occupancy of approximately 65 percent

Table 5.4-7

PRACTICAL LOADING AND UNLOADING CAPACITIES FOR VARIOUS TYPES AND SIZES OF VESSELS

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost per Day (US$)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time (days)	Total Time (days)	Loading Unloading, and Harbor Cost (US$/tonne)
				Design Capacity (TPH)	Loading Time (days)	Design Capacity (TPH)	Unloading Time (days)			
Barge and tug	2,000	2,000	2,105	500	0.2	150	1.1	0.7	2.0	2.11
						300	0.6		1.5	1.58
						750	0.2		1.1	1.16
	5,000	5,000	4,253	1,000	0.3	300	1.4	0.7	2.4	2.04
						750	0.6		1.6	1.36
						1,000	0.4		1.4	1.19
	10,000	10,000	5,510	1,000	0.6	300	2.8	0.7	4.1	2.26
						750	1.1		2.4	1.32
						1,000	0.8		2.1	1.16
				1,500	0.4	750	1.1		2.2	1.21
						1,000	0.8		1.9	1.05
Mini-bulk carrier	6,000	5,580	4,708	1,000	0.3	300	1.6	0.7	2.6	2.19
						750	0.6		1.6	1.35
						1,000	0.5		1.5	1.27
Bulk carrier	10,000	9,300	6,137	1,500	0.4	300	2.6	0.7	3.7	2.44
						750	1.0		2.1	1.39
						1,000	0.8		1.9	1.25
						2,000	0.4		1.5	0.99
	20,000	18,600	9,363	1,500	0.7	750	2.1	0.7	3.5	1.76
						1,000	1.6		2.9	1.46
						2,000	0.8		2.1	1.06
	30,000	27,900	11,985	2,000	0.8	750	3.1	0.7	4.6	1.98
						1,000	2.3		3.8	1.63
						2,000	1.2		2.7	1.16
	40,000	37,200	13,733	2,000	1.1	750	4.1	0.7	5.9	2.18
						1,000	3.1		4.9	1.81
						2,000	1.6		3.4	1.26

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Table 5.4-8

BENCHMARKS FOR TOTAL LOADING, UNLOADING, AND HARBOR TIME

Type of Vessel	Nominal Carrying Capacity (tonnes)	Capital and Operating Costs per Day (US$)	Assumed Time for Loading, Unloading, and Port Delays (days)	Ship's Cost for Loading, Unloading, and Harbor Delays (US$/tonne)
Barge and tug	2,000	2,105	1.5	1.58
	3,000	4,253	1.8	1.53
	10,000	5,510	2.5	1.38
Mini-bulk carrier	6,000	4,708	1.9	1.60
Bulk carrier	10,000	6,137	2.3	1.52
	20,000	9,363	2.8	1.41
	30,000	11,985	3.7	1.59
	40,000	13,733	4.7	1.74

preclude sufficiently high berth occupancy with shore-based equipment, it is recommended that Type I and Type II ports be serviced by geared vessels. Such vessels can have higher unloading capacities, as is shown in Table 5.4-9.

Preliminarily, geared bulk carriers are preferred to self-unloading vessels because they are cheaper and more flexible. Self-unloading vessels are special purpose vessels and lack the flexibility to be put to other uses if the need arises. However, in the actual design of the transport system, self-unloading vessels should be evaluated to verify this preliminary conclusion.

5.4.3 Harbors and Draft Restrictions

An important variable affecting the development of a sea transport system is the available draft of loading and unloading ports. Table 5.4-10 summarizes the limiting draft of the various coal loading ports in

Kalimantan, and unloading ports on Java and Sulawesi; based on discussions with P.T. Arutmin, P.T. Utah, P.T. Kaltim Prima, P.T. Berau, P. T. Krakatau Steel, Semen Gresik, and Semen Tonasa; and review of nautical charts and other reports (References 5-2, 5-4, 5-5, and 5-6).

Table 5.4-9

UNLOADING CAPACITIES FOR GEARED VESSELS

Geared Bulk Carrier Size (DWT)	Average Unloading Capacity (tonnes per hour)
6,000	500
20,000	750
40,000	1,000

Loading Ports. There are no existing ports in any of the potential coal producing areas that could be used for coal loading. Development of ports and loading facilities will be an essential part of the contractor's work to bring each area into production. The following summarizes the coal loading ports discussed in Section 3.

Bay ports. Three ports close to coal producing areas (Tanjung Batu, Linding, and Tanah Merah) are connected to open water (the Makassar Strait) via three bays; Teluk Klumpang, Teluk Apar, and Teluk Adang. Tanjung Batu is on Klumpang Bay with relatively deep water in the immediate vicinity of Tanjung Batu (15 to 20 meters). Linding and Tanah Merah are further inland and located on the Apar Kecil and Kuaro rivers, respectively, which flow into the connecting bays. The distance from Linding and Tanah Merah to the entrance of the respective bays (i.e., open and deep water) is approximately 24 and 32 nautical miles, and 16 and 7 nautical miles from the river ports to the bays. The presence of shallow bars at the entrance of all three of these bays precludes the use of large vessels without dredging.

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Table 5.4-10

LIMITING DRAFTS AT POTENTIAL COAL PORTS

Loading Ports			Unloading Ports		
Coal Production Company and General Area/Deposit	Potential Port	Limiting Draft (meters)	Potential Coal Consumer and Facility Location	Potential Port	Limiting Draft (meters)
P. T. Arutmin, Senakin Deposits	Tanjung Batu	8	P. T. Semen Cibinong, Narogong	Cigading	15
P. T. Utah, Petangis	Linding	6	Indocement Group, Citeurup		
P. T. Utah, Bindu-Betitit	Tanah Merah	6.5	I. Cement/P.A. Abadi, Citeurup		
P. T. Kideco, Samarangau			I. Cement/Tridaya M., Palimanan		
P. T. Kaltim Prima, Sangatta	Tanjung Bungalun	13	I. Cement/P.S. Karya, Cilacap	Cilacap	12
Agip-Consol, Mahakam	Tenggarong	7	P. T. Semen Nusantara, Karang Talun		
P. T. Berau, Kelai Deposit	Lebanan/ Lunsurannaga	4-5/8	P. T. Semen Gombong, Gombong		
			PLN Power Plant, Cilacap		
			P. T. Sugih Harapan, Tanggung	Semarang	7
			P. T. Semen Purwodadi, Purwodadi		
			Semen Gresik, Gresik	Gresik	11
			I. Cement/P.K. Hasta, Karang Pandan	Madura cement harbour	11
			PLN Power Plant, Paiton	Paiton	15
			Semen Tonasa, Tonasa	Biringkassi	9
			Semen Menado, Menado	Bitung	15

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River Ports. Two potential coal producing areas, Mahakam and Berau, are too far inland to consider coastal loading facilities. Instead, river ports and loading facilities are envisioned at Tenggarong on the Mahakam River and at Lebanan on the Segah River, which flows into the Berau River. The distance from these ports to open water is approximately 66 and 44 nautical miles, respectively.

The available draft on the Mahakam River up to Tenggarong is approximately 7 meters. Draft restrictions on the Segah and Berau rivers are more stringent, with a limiting draft of 4 to 5 meters or, in some places at low tide, 1.5 to 2 meters. In this case, selected dredging would be required to provide a river channel with a 4 to 5 meter draft from Lebanan to open water. At the Berau River delta there are deeper channels. Lunsurannaga, with an available draft of 8 meters, could be used for coal transloading.

Deep Water Port. The Sangatta area is the only area where it is envisioned that coal loading could be performed on the coast of Kalimantan with direct access to deep water. Deep waters (more than 13 meters) are near the coast between Tanjung Bungalun and Tanjung Sangatta.

Unloading Ports. Following is a brief summary of coal unloading ports on Java and Sulawesi discussed in Section 6.

Existing Special Purpose Ports. Cigading in west Java (the existing harbor for Krakatau Steel) has a draft of 15 meters. In Gresik and Biringkassi, Semen Gresik and Semen Tonasa operate their own port facilities with drafts of 11 and 9 meters, respectively.

Future Special Purpose Ports. The new cement harbor on Madura and the harbor at Paiton in east Java will be developed as special purpose ports for the new Madura cement plant and the Paiton power plant. It is assumed that the port on Madura will be similar to Gresik, with a draft of 11 meters, while the draft at Paiton will be at least 15 meters (based on Reference 5-2).

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Other Ports. Currently, little is known about coal unloading at Cilacap, Semarang, and in north Sulawesi (to supply a future cement plant at Menado). With respect to Cilacap, a port facility could be developed with a limiting draft of 12 meters based on the current draft in the approach channel and the fact that large Pertamina tankers berth at Cilacap. In north Sulawesi, waters near Bitung are relatively deep and draft restrictions should not present a constraint.

The situation in Semarang is the most difficult. Reference 5-4 indicates that the existing harbor at Semarang can only accommodate vessels with a maximum draft of 3.5 meters, and the approach channel has a limiting draft of 4 meters. Review of nautical charts of the coast near Semarang indicates that 7-meter deep water is relatively close to the coast, and a special purpose facility could be developed allowing a maximum vessel draft of 7 meters.

Draft Restriction and Vessel Selection. Figure 5.4-2 (based on References 5-7, 5-8, and 5-9) illustrates the relationship between the nominal carrying capacity in DWT of various types of vessels and the associated draft. In addition, Figure 5.4-2 shows the limiting drafts at each loading and unloading port.

For any given vessel size (in terms of deadweight tonnage) the difference in draft between deep draft and shallow draft vesssels is relatively small (1 to 1.5 meters). When considering the size of vessels that can enter a given harbor, however, the difference between deep draft and shallow draft wide-beam vessels becomes significant. For example, in Gresik, where the limiting draft is 11 meters, deep draft vessels up to 25,000 DWT are able to berth, but shallow draft vessels up to 46,000 DWT -- almost twice the size of the deep draft vessel -- can berth at the same facilities.

It is clear from Figure 5.4-2 that the limiting drafts of most coal loading ports and, to a lesser extent, of the unloading ports, is a severe constraint to the size of the vessel that can be selected. The

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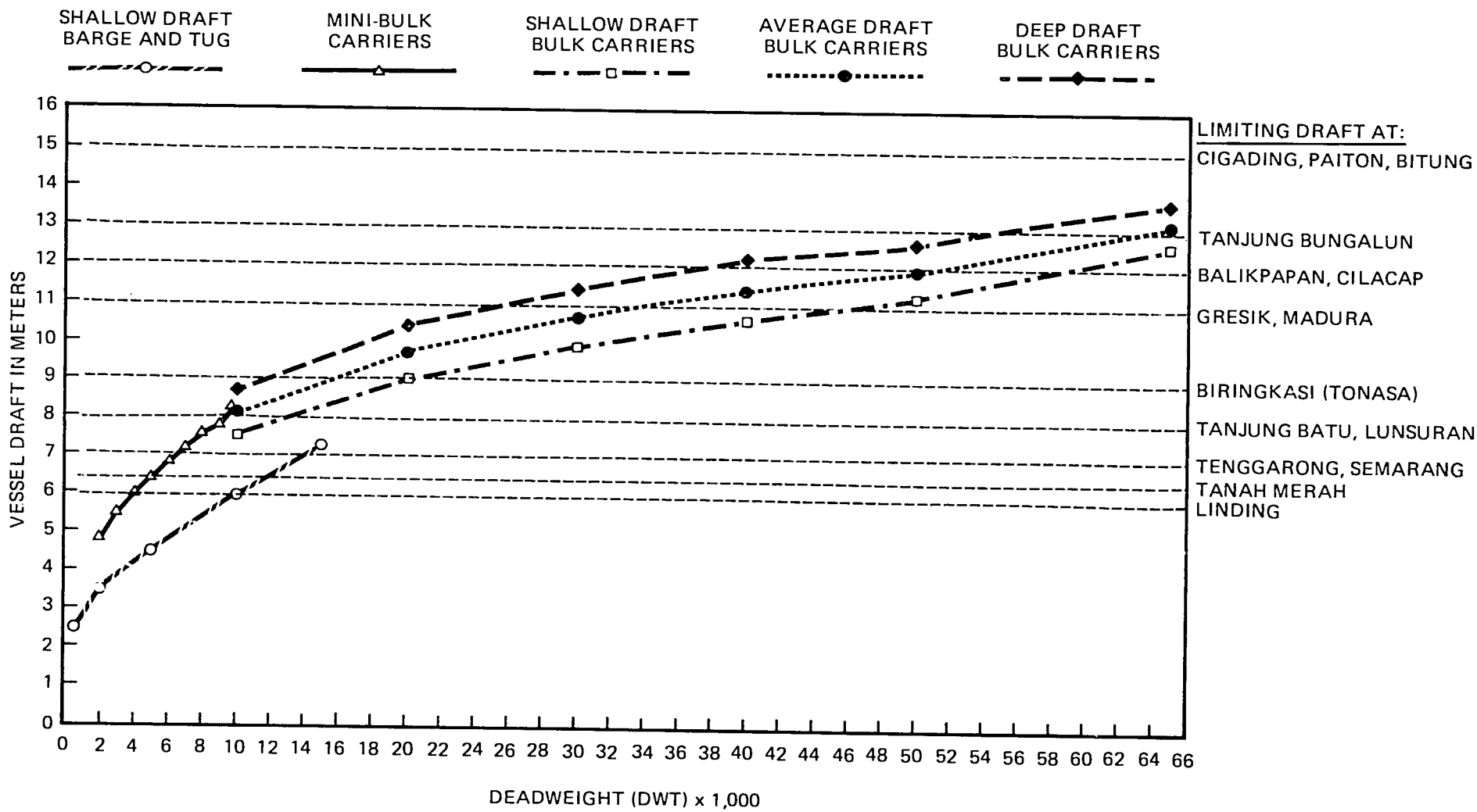

Figure 5.4-2 VESSEL DRAFTS AS A FUNCTION OF DEADWEIGHT AND LIMITING DRAFTS OF LOADING AND UNLOADING HARBORS

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general approach towards accommodating large vessels in shallow draft harbors is to dredge deeper channels. The extent to which dredging is desired for domestic coal transport can only be determined on the basis of specific feasibility studies. Such studies would have to consider:

- Expense. With the possible exception of Tanjung Batu and with the exception of Tanjung Bungalun, dredging may be expensive, involving significantly large initial dredging costs, possibly followed by annual maintenance dredging. The latter would be required in cases where siltation occurs, such as at the mouth of the Mahakam river. The river ports of Tenggarong and Lebanan, and the bay ports of Tanah Merah and Linding are located relatively far from open and deep water.

- Annual Coal Production Levels. In most coal production areas annual production levels are not currently expected to exceed several million tonnes per year. Low production levels tend to lessen the justification for large dredging costs because it would place too high a surcharge on the production cost of the coal.

- Phase I Development. In most areas the emphasis will be on getting coal production and transport started at the lowest possible cost. During Phase I there will be a tendency to minimize capital investment, including investments needed for dredging.

Without precluding the results of specific studies, it is expected that initially there will be limited scope for dredging. Tanjung Batu may be a possible exception because the specific location could lead to relatively low dredging costs, while annual production is projected to reach at least 5 MMTPY. Table 5.4-11 presents the results of preliminary engineering studies conducted by P.T. Arutmin for dredging an approach channel to Tanjung Batu. It shows, for example, that at US$2 per cubic meter, the cost to dredge the channel to 11.4 meters would be US$7.5 million. Such a channel would allow access to a 30,000 DWT average draft bulk carrier while providing an additional clearance of about 1 meter for navigational purposes.

Lack of adequate data has precluded further analysis of the dredging option in this study. However, in view of the possible severity of draft

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Table 5.4-11

DREDGING QUANTITIES FOR VARIOUS DEPTHS OF APPROACH CHANNELS TO TANJUNG BATU[a]

Channel Depth (m)	Channel Width (m)	Dredging Quantities[b] Material		
		Soft	Hard	Total
8.9	105	0.42	0.03	0.45
11.4	140	3.50	0.25	3.75
13.9	175	12.10	1.25	13.35

(a) Source: P.T. Arutmin
(b) Millions of cubic meters

restrictions on transport system development, the following recommendations are made:

- Use of special shallow draft wide-beam bulk carriers should be encouraged wherever possible as the cheapest alternative to dredging. Only vessels of this type have been considered in this study (see Table 5.4-1).

- During Phases II and III dredging of selected ports should be further considered in detailed feasibility studies. Ports should be selected based on projected savings in annual transport cost from using larger vessels.

5.4.4 Sample Cost Calculations

This subsection presents transport cost calculations for a number of generalized routes that are illustrative of the types of routes to be used in the domestic coal transport system. These calculations were used to develop the basis for selecting the type and size of vessel in the formulation of alternative transport systems (Subsection 5.5).

Two types of routes have been chosen for the calculations in this subsection (see Table 5.4-12). The first, generally representative of coastal transport, is a set of routes involving short distances; the

second represents the longer inter-island distances in the domestic transport system. Route E is approximately the distance from southeast Kalimantan to east Java; Route F represents the distance from east Kalimantan to west Java; and Route G represents some of the longest routes, between east Kalimantan and the south central coast of Java.

Table 5.4-12

REPRESENTATIVE DOMESTIC COAL TRANSPORT ROUTES

Route	Distance (nautical miles, one-way)
Short-distance	
A	25
B	50
C	100
D	150
Long-distance	
E	400
F	750
G	1,100

Cost calculations were made for two types of cost (per tonne); round-trip and annual transport. As explained in Subsection 5.4.1, annual transport cost per tonne is based on having a specific number of ships to meet annual transport requirements. Since this may make the actual capacity provided higher than really needed, annual transport cost per tonne could be higher than round-trip transport cost per tonne.

Round-Trip Transport Cost Per Tonne. Table 5.4-13 and Figure 5.4-3 present round-trip transport cost per tonne as a function of type and size of vessel for each of the routes, with the assumption that there is no draft restriction on any of the routes. The following conclusions can be drawn, based only on round-trip transport cost:

- Bulk carriers are competitive with barges on the shorter routes; on the longer routes they are definitely preferred.

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Table 5.4-13

ROUND-TRIP TRANSPORT COST PER ROUTE BY TYPE OF VESSEL

Type of Vessel	Nominal Carrying Capacity (DWT)	Round-Trip Transport Cost (US$/tonne)[a]						
		Route A[b] 25 NM	Route B 50 NM	Route C 100 NM	Route D 150 NM	Route E 400 NM	Route F 750 NM	Route G 1,100 NM
Barge	2,000	2.08	2.57	3.56	4.56	9.54[c]	16.49	23.46
	5,000	1.93	2.33	3.13	3.93	7.94	13.54	19.15
	10,000	1.63	1.89	2.40	2.91	5.46	9.03	12.60
Mini-bulk carrier	6,000	1.88	2.15	2.70	3.23	5.95	9.75	13.56
Bulk carrier	10,000	1.69	1.87	2.22	2.59	4.38	6.88	9.37
	20,000	1.55	1.69	1.98	2.25	3.65	5.62	7.58
	30,000	1.71	1.82	2.05	2.28	3.43	5.05	6.65
	40,000	1.84	1.94	2.14	2.33	3.32	4.72	6.10

(a) Excluding loading and unloading cost
(b) NM = nautical mile; one-way distance
(c) Heavy line indicates costs above US$8 per tonne

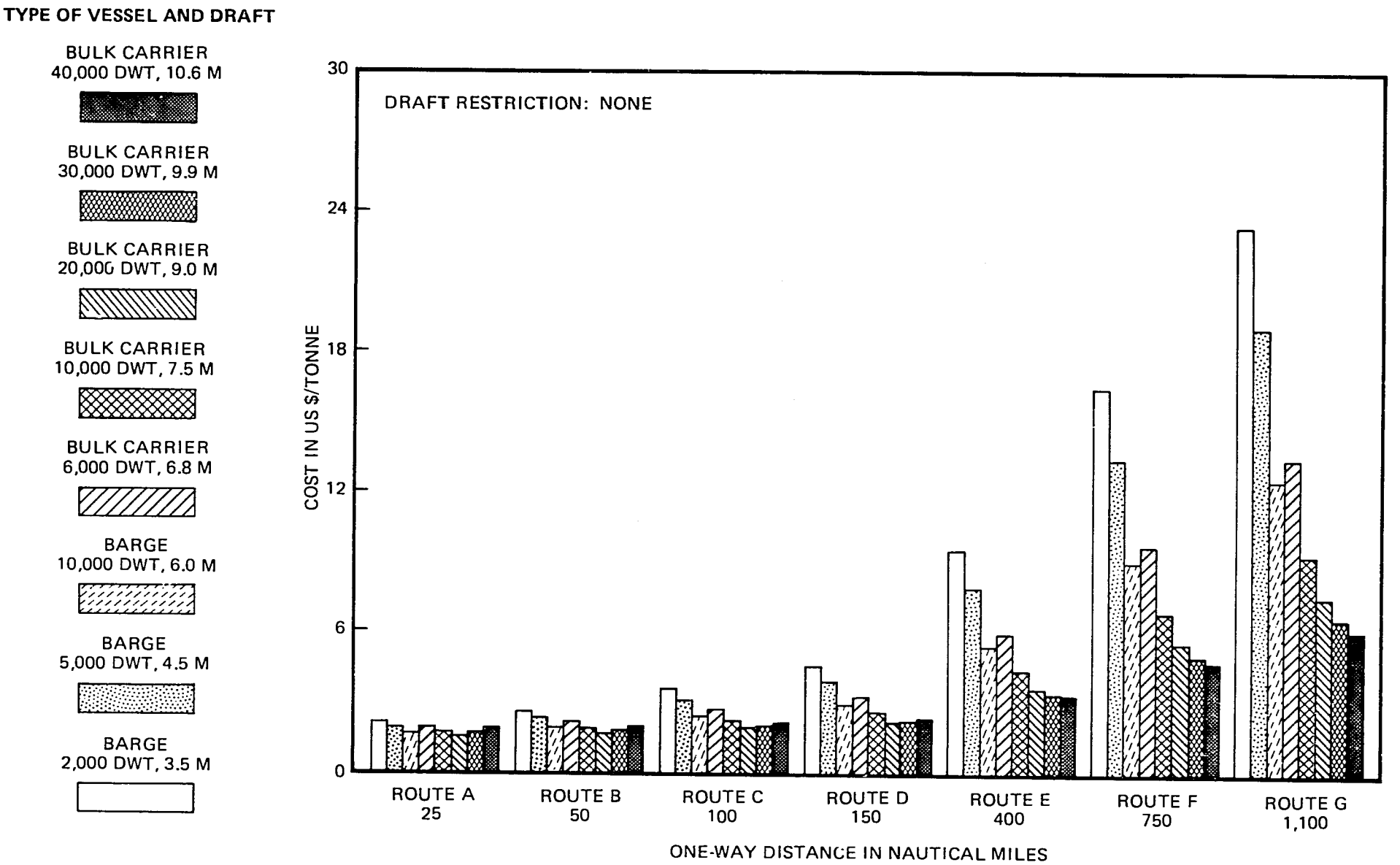

Figure 5.4-3 ROUND-TRIP TRANSPORT COST EXCLUDING LOADING AND UNLOADING COSTS (COST PER TONNE AS A FUNCTION OF VESSEL TYPE, DISTANCE, AND DRAFT RESTRICTIONS)

- If barges are to be selected based on draft restrictions, the largest possible size is preferred.

- If only bulk carriers are considered, so-called "handy-sized" vessels of 20,000 to 30,000 DWT are preferred on the shorter routes, while on the longer routes the largest size considered (40,000 DWT) is preferred.

- Round-trip transport cost is more sensitive to the size of barges than bulk carriers. Since the difference in round-trip transport cost between a 30,000 DWT and a 40,000 DWT bulk carrier is relatively minor for even the greatest distance, a 40,000 DWT bulk carrier is probably the largest vessel that should be considered.

- Finally, using US$8 per tonne as an arbitrary cutoff point, Table 5.4-13 illustrates that:

  - Barges of 2,000 DWT should not be used in inter-island traffic

  - Barges of 5,000 and 10,000 DWT, and mini-bulk carriers of 6,000 DWT, should only be used in coastal transport and on the shorter inter-island routes

  - Bulk carriers of 10,000 DWT and larger are preferred for inter-island transport

These conclusions depend on the assumptions made in calculating round-trip transport cost, on not considering the cost of loading and unloading, and on assuming no draft restrictions. To illustrate the effect of including loading and unloading cost, the round-trip transport cost for each vessel and route shown in Figure 5.4-4 includes approximate flat loading and unloading charges of US$2 per tonne for barges and US$3 per tonne for bulk carriers (approximately what can be expected for loading and unloading operations with a throughput of 5 MMTPY). This adds US$4 and US$6 to the round-trip transport cost for barges and bulk carriers, respectively. The difference between barges and bulk carriers is because loading and unloading of bulk carriers may require more complex facilities, particularly if different size vessels are to be handled. Based on Figure 5.4-4, it can be concluded that:

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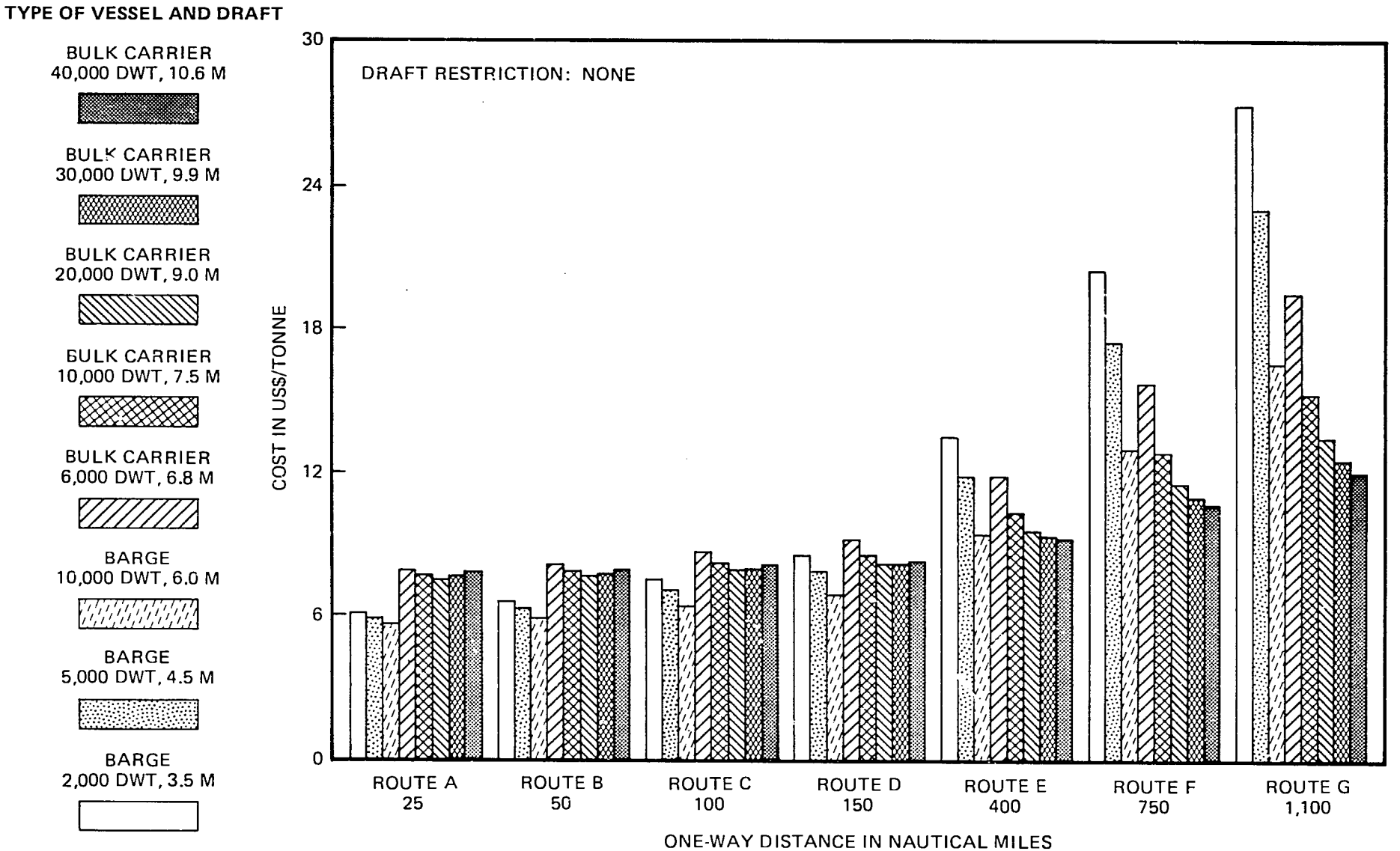

Figure 5.4-4 ROUND-TRIP TRANSPORT COST INCLUDING LOADING AND UNLOADING COSTS (COST PER TONNE AS A FUNCTION OF VESSEL TYPE, DISTANCE, AND DRAFT RESTRICTIONS)

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- If loading and unloading costs are to be included in the round-trip transport cost per tonne, the largest barge will have a competitive edge over bulk carriers on the short routes, and could be competitive even on a short inter-island route (Route E).

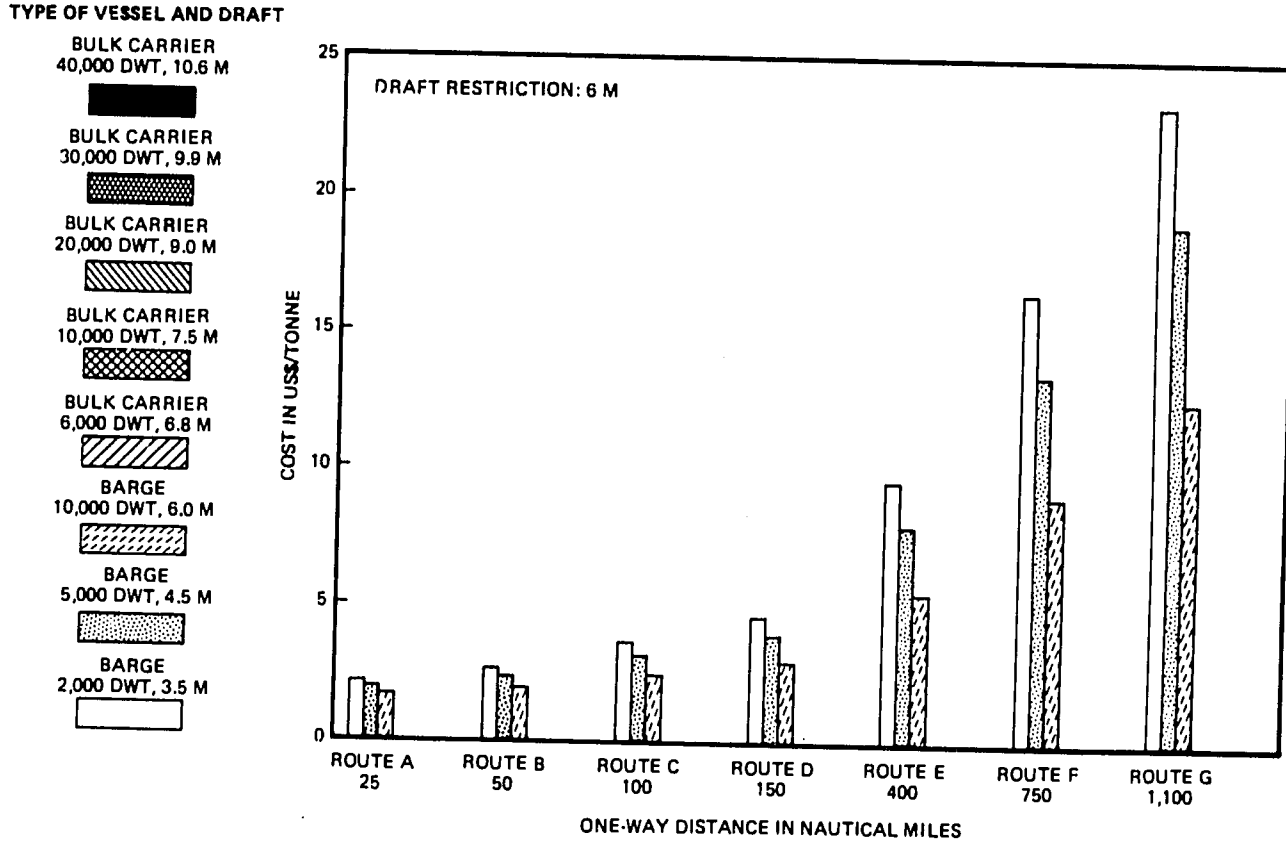
- On long-distance routes (Routes F and G), bulk carriers are still preferred. However, the difference in loading charges significantly erodes the competitive advantage of bulk carriers, compared to when loading and unloading charges are not part of the round-trip transport cost.

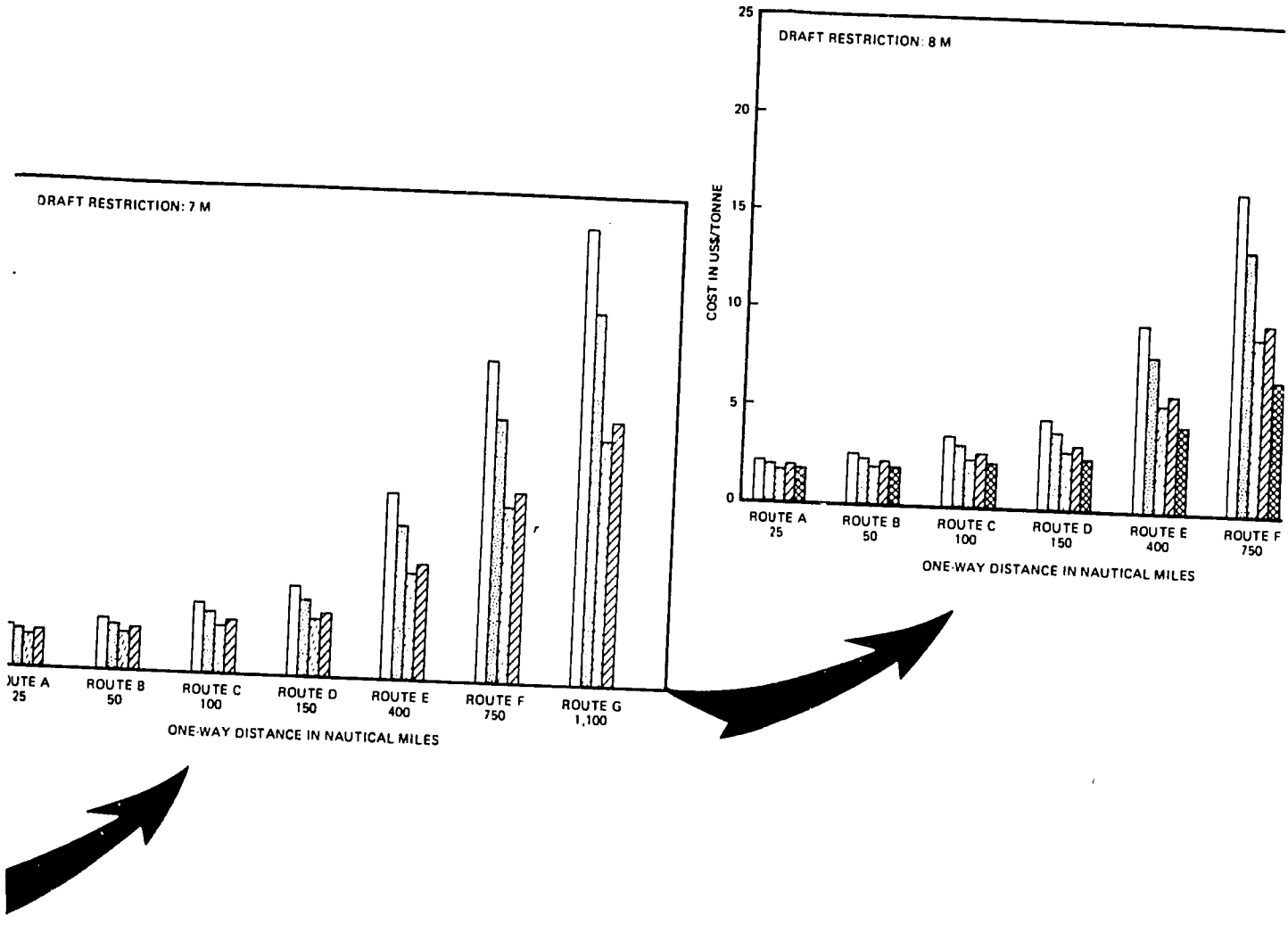
- These loading and unloading charges are reasonable approximations of the real costs. At throughput levels lower than 5 MMTPY, these charges will probably be higher. Comparing these charges with the round-trip transport costs in Table 5.4-13, it is clear that in virtually all cases the cost of loading and unloading is far larger than the round-trip cost per tonne shown in Table 5.4-13. This fact points to two important issues:

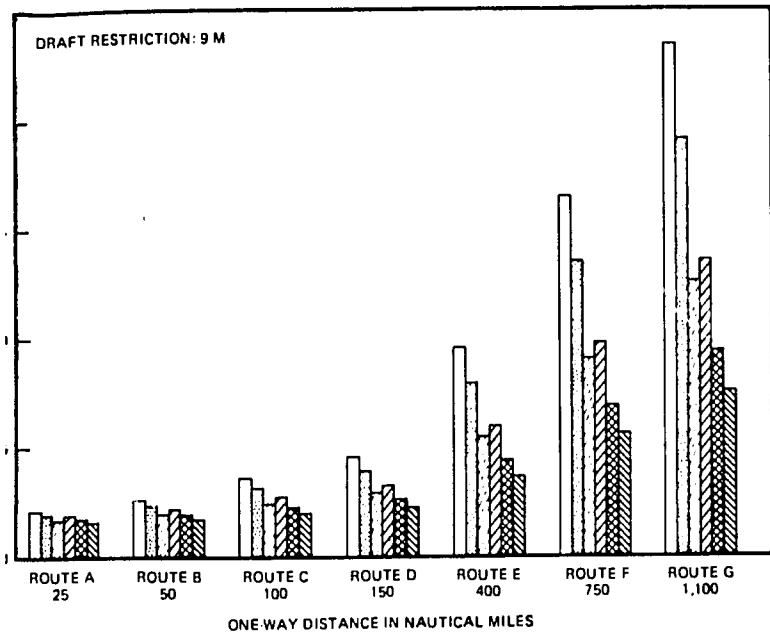
  - To minimize overall transport cost, including loading and unloading costs (regardless of who pays), selection of appropriate facilities to minimize costs is critical to an economically efficient domestic transport system.

  - In developing transport tariffs it will be important to determine who pays for the loading and unloading charges since they generally will be the most significant cost.

Finally, it should be noted with respect to draft restrictions, that a particular type and size of vessel (such as a 10,000 DWT barge) may often be selected not because it provides the lowest possible round-trip cost per tonne, but because it would be the cheapest vessel of those that meet the draft restrictions on the route. This observation is obvious, but merits special note in the case of Kalimantan coal transport, where draft restrictions figure prominently. Figure 5.4-5 graphically illustrates this situation by imposing several draft restrictions, and showing that particular vessels cannot always be used.


TYPE OF VESSEL AND DRAFT
BULK CARRIER 40,000 DWT, 10.6 M
BULK CARRIER 30,000 DWT, 9.9 M
BULK CARRIER 20,000 DWT, 9.0 M
BULK CARRIER 10,000 DWT, 7.5 M
BULK CARRIER 6,000 DWT, 6.8 M
BARGE 10,000 DWT, 6.0 M
BARGE 5,000 DWT, 4.5 M
BARGE 2,000 DWT, 3.5 M
DRAFT RESTRICTION: 6 M
COST IN US$/TONNE
0
5
10
15
20
25
ROUTE A 25
ROUTE B 50
ROUTE C 100
ROUTE D 150
ROUTE E 400
ROUTE F 750
ROUTE G 1,100
ONE-WAY DISTANCE IN NAUTICAL MILES


DRAFT RESTRICTION: 7 M
ROUTE A 25
ROUTE B 50
ROUTE C 100
ROUTE D 150
ROUTE E 400
ROUTE F 750
ROUTE G 1,100
ONE-WAY DISTANCE IN NAUTICAL MILES
DRAFT RESTRICTION: 8 M
COST IN US$/TONNE
0
5
10
15
20
25
ROUTE A 25
ROUTE B 50
ROUTE C 100
ROUTE D 150
ROUTE E 400
ROUTE F 750
ONE-WAY DISTANCE IN NAUTICAL MILES



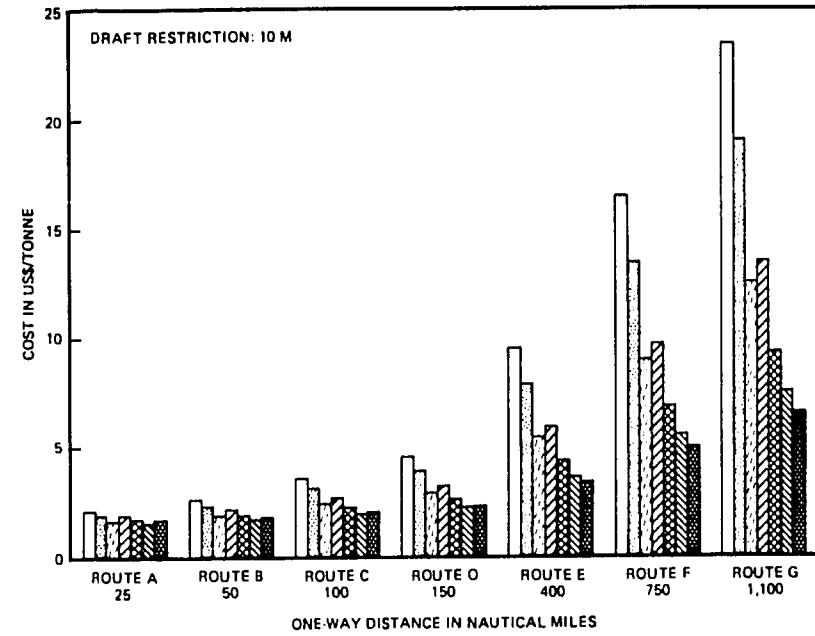


Figure 5.4-5 EFFECT OF DRAFT RESTRICTIONS ON ROUND TRIP TRANSPORT COST PER TONNE

Annual Transport Cost Per Tonne. The annual transport cost per tonne has been determined by requiring that a certain annual transport requirement be met on each route. The level of requirements considered are as follows:

- Level 1: 0.5 MMTPY
- Level 2: 1.0 MMTPY
- Level 3: 2.0 MMTPY
- Level 4: 5.0 MMTPY
- Level 5: "Unlimited Demand"

Most of the production areas in Kalimantan, particularly during Phase I, will be operating at the lower throughput levels (i.e., Levels 1, 2, and 3). Only the Senakin area is currently projected to reach Level 4. Level 5, called "unlimited demand," is included because this case corresponds to the situation in which the estimate for annual transport cost is about the same as the estimate for round-trip transport cost. For very large throughputs on a route, the influence of the discrete nature of the fleet becomes negligible.

As explained in Subsection 5.4.1, the annual transport cost is the cost of a fleet of vessels of the same type and size that is just large enough to meet the annual transport requirement of a particular route. In calculating annual transport cost, the general rule is to assume that a ship is added to the fleet as soon as it is needed to meet annual transport requirements, even if it would only be used for a limited number of commission days. In real world situations, the allocation and scheduling of vessels will probably be handled differently. The rule tends to result in the fleets' average number of commission days being lower than the 340 days assumed, but practical experience shows a lower number is more accurate anyway. As a result, the annual transport cost is generally a better cost indicator than round-trip transport cost. Annual transport cost would be the basis for a transport company to develop transport tariffs.

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Calculation Results. Figure 5.4-6 shows selected results of the annual transport cost calculations. Namely, costs are illustrated for the shortest route (Route A) and the longest (Route G), and for three levels of annual requirements (1, 4, and 5). Generally, the three top sets of lines in the figure correspond to the longest route and the lower lines to the shortest route. Two sets of conclusions can be drawn. This first set is a refinement of conclusions stated earlier in the discussion of round-trip transport cost per tonne:

- Bulk carriers are competitive with barges on the shorter routes only if annual transport requirements are large (5 MMTPY or more) because bulk carriers would be underused at small throughput levels. This is shown by the sharply increasing line for Route A at the 0.5 MMTPY level.

- On long routes bulk carriers are preferred over barges at any throughput level.

- If barges are selected based on draft restrictions, the largest possible size is strongly preferred for long routes, regardless of throughput. When the route is short there is a slight preference for the largest size, but only if annual throughputs are also large. If throughput is small (0.5 MMTPY) a smaller size barge (5,000 DWT) is preferred.

- If only bulk carriers are considered, so-called "handy-sized" vessels of 20,000 to 30,000 DWT are preferred on the shorter routes when throughput is high (Levels 4 and 5). When throughput is low (Level 1) the smallest mini-bulk carrier would be preferred on shorter routes, and "handy-sized" vessels would be preferred on longer routes.

- The line associated with Route G and Level 1 shows a situation in which a 20,000 DWT bulk carrier is clearly superior. When throughputs are increasing, larger vessels are preferred. However, Figure 5.4-6 shows that beyond 40,000 DWT the savings in annual transport cost will be minor.

Regarding the effect of annual transport requirements on cost, it can be concluded that:

- With increasing throughput on a particular route, annual transport cost per tonne consistently decreases because the increased requirements generally result in a higher average number of fleet commission days.

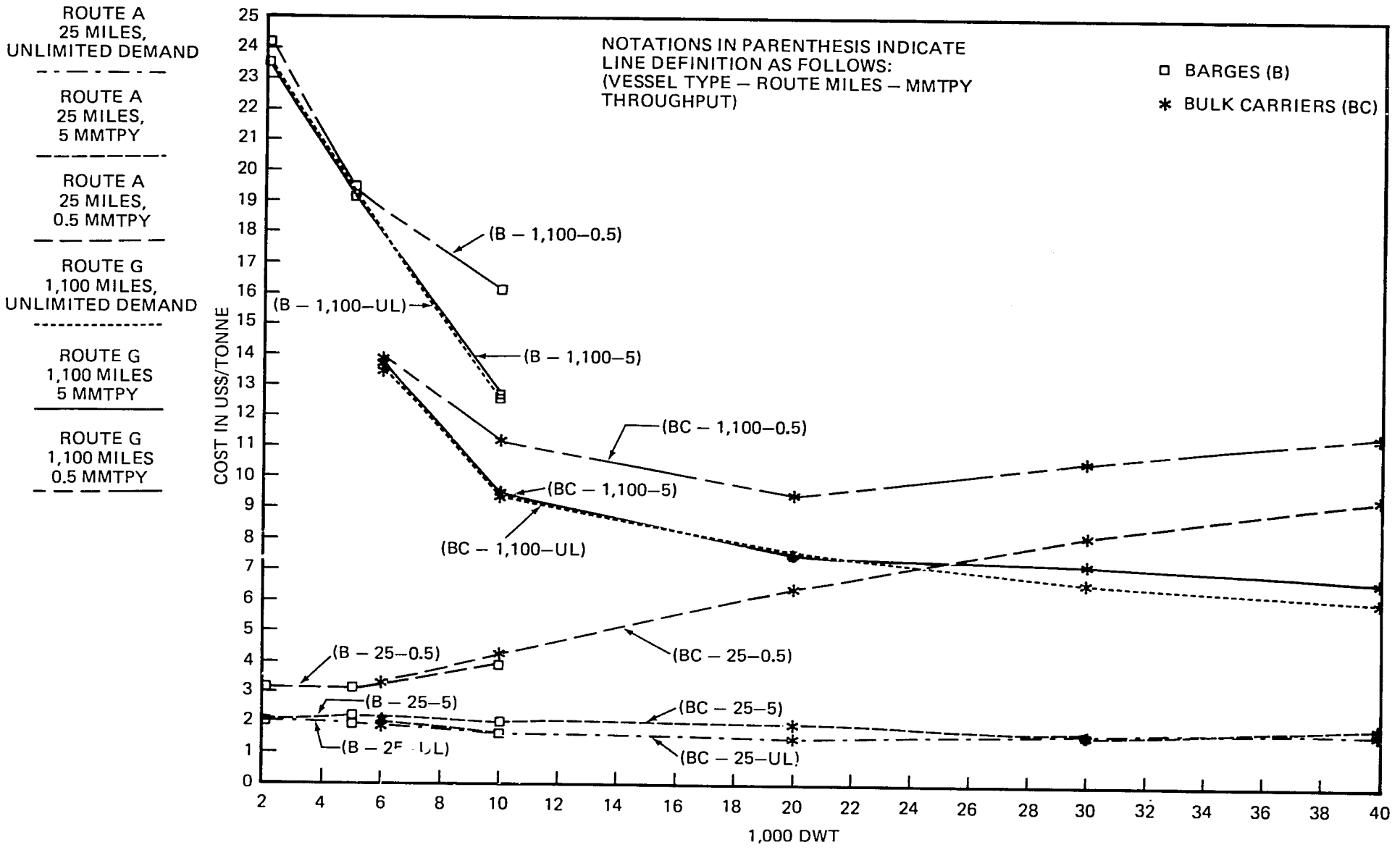

Figure 5.4-6 ANNUAL TRANSPORT COST FOR DIFFERENT COMBINATIONS OF THROUGHPUT AND DISTANCE (EXCLUSIVE OF LOADING AND UNLOADING COST, AND AS A FUNCTION OF SIZE OF BARGES AND BULK CARRIERS)

- Savings in annual transport cost per tonne are most significant up to a level of 5 MMTPY. As shown in Figure 5.4-6, beyond 5 MMTPY there is virtually no opportunity for further savings from increased throughput.

Table 5.4-14 and Figure 5.4-7 identify the preferred type and size of vessel, and the associated annual transport cost for all combinations of routes and annual throughput levels considered. The shorter coastal routes (A, B, C, and D), have been limited to vessels with a draft not exceeding 7 meters, corresponding to a system where coal is collected from various areas in Kalimantan and transported to a terminal in Kalimantan with sufficient draft to accommodate vessels up to 40,000 DWT. The medium- to long-distance systems correspond to transport from the terminal in Kalimantan to destinations on Java and Sulawesi.

Table 5.4-14 and Figure 5.4-7 essentially confirm the conclusions stated earlier. The preferred type and size of vessels to be used for a short-distance coastal transport system are:

- 5,000 DWT barges on Routes A and B at throughput levels of 0.5 MMTPY
- 6,000 DWT mini-bulk carriers on Route C for throughput levels up to 2 MMTPY, and on Route B for throughput levels up to 1 MMTPY
- 10,000 DWT barges on Routes A and B when throughput levels are greater than 0.5 MMTPY, on Route C when throughput levels are greater than 2 MMTPY, and on Route D when throughput levels are greater than 1 MMTPY

For medium- to long-distance transport systems with no draft restrictions, the type and sizes of vessels to be used are:

- 10,000 DWT bulk carriers on Route E at throughput levels of 0.5 MMTPY
- 20,000 DWT bulk carriers on Route E at throughput levels of 1 and 2 MMTPY, and Routes F and G when throughput levels are 0.5 MMTPY

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Table 5.4-14

PREFERRED TYPE AND SIZE OF VESSEL AND ASSOCIATED ANNUAL SEA TRANSPORT COST (US$/tonne)[a]

Annual Amount to be Transported \ Route One-Way Distance in Nautical Miles	A	B	C	D
	25	50	100	150
0.5 MMTPY	Barge 5,000 DWT $3.07	Barge 5,000 DWT $3.25	BC[b] 6,000 DWT $3.59	BC 6,000 DWT $3.78
1.0 MMTPY	Barge 10,000 DWT $1.98	Barge 10,000 DWT $2.10	BC 6,000 DWT $3.59	BC 6,000 DWT $3.78
2.0 MMTPY	Barge 10,000 DWT $1.98	Barge 10,000 DWT $2.10	BC 6,000 DWT $2.79	Barge 10,000 DWT $3.48
5.0 MMTPY	Barge 10,000 DWT $1.98	Barge 10,000 DWT $2.10	Barge 10,000 DWT $2.69	Barge 10,000 DWT $2.92
"Unlimited demand"	Barge 10,000 DWT $1.63	Barge 10,000 DWT $1.89	Barge 10,000 DWT $2.40	Barge 10,000 DWT $2.91
	SHORT DISTANCE TRANSPORT SHALLOW WATER (DRAFT LESS THAN 7 m)			

Annual Amount to be Transported \ Route One-Way Distance in Nautical Miles	E	F	G
	400	750	1,100
0.5 MMTPY	BC 10,000 DWT $5.20	BC 20,000 DWT $8.48	BC 20,000 DWT $9.46
1.0 MMTPY	BC 20,000 DWT $4.31	BC 30,000 DWT $5.74	BC 40,000 DWT $6.78
2.0 MMTPY	BC 20,000 DWT $4.31	BC 30,000 DWT $5.74	BC 40,000 DWT $6.78
5.0 MMTPY	BC 40,000 DWT $3.57	BC 40,000 DWT $5.18	BC 40,000 DWT $6.78
"Unlimited demand"	BC 40,000 DWT $3.32	BC 40,000 DWT $4.72	BC 40,000 DWT $6.10
	MEDIUM- TO LONG-DISTANCE TRANSPORT DEEP WATER (DRAFT MORE THAN 7 m)		

(a) For any route as a function of route distance and annual transport amount
(b) BC = Bulk carrier
Heavy lines separate different types and sizes of vessels

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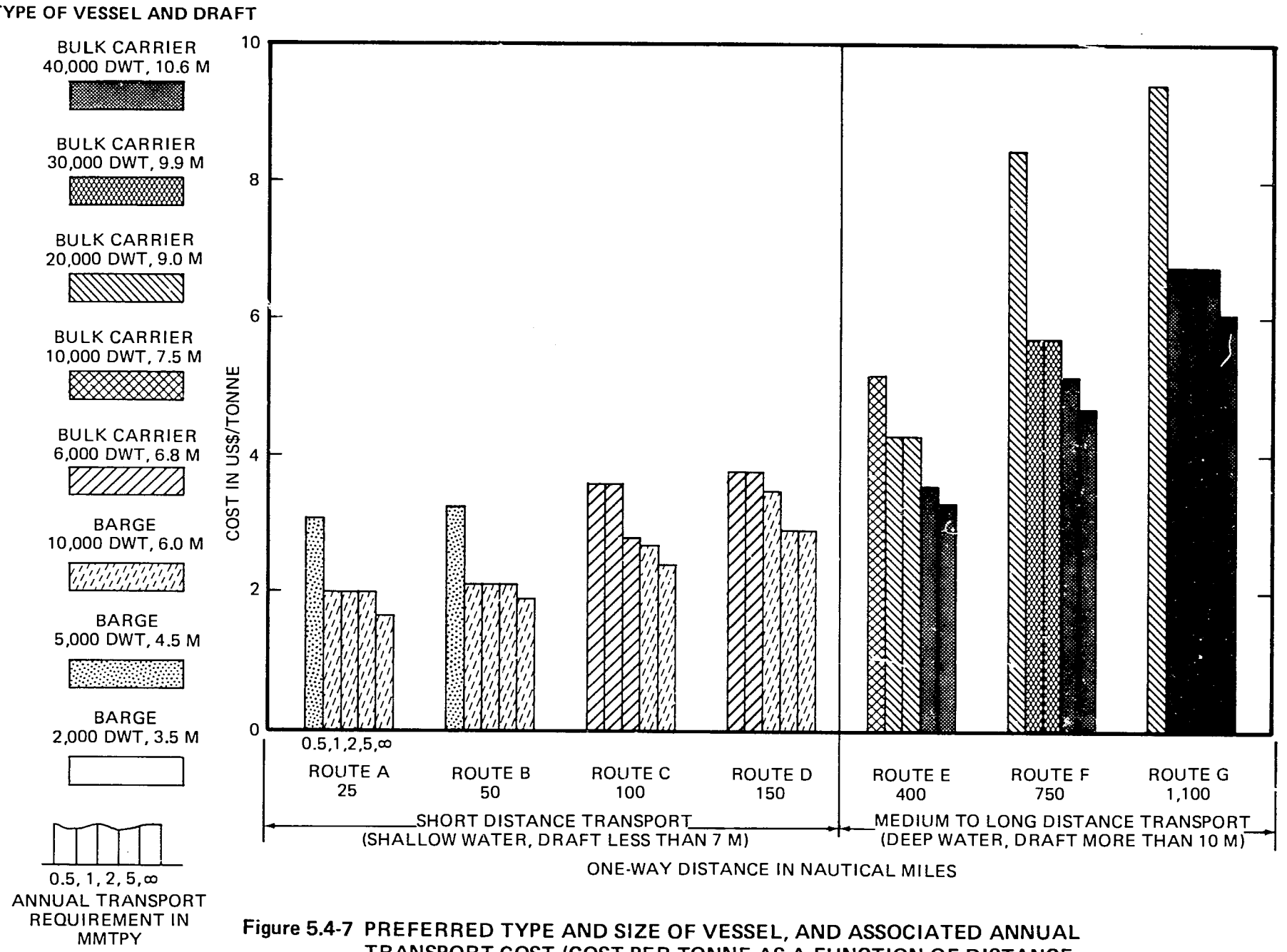

Figure 5.4-7 PREFERRED TYPE AND SIZE OF VESSEL, AND ASSOCIATED ANNUAL TRANSPORT COST (COST PER TONNE AS A FUNCTION OF DISTANCE AND ANNUAL TRANSPORT REQUIREMENT)

- 30,000 DWT bulk carriers on Route F at throughput levels of 1 to 2 MMTPY

- 40,000 DWT bulk carriers on Routes E and F when throughputs are greater than 2 MMTPY and on Route G when throughputs are greater than 0.5 MMTPY

Cumulative Savings. Table 5.4-15 identifies the cumulative savings in annual transport cost with increasing throughput on the various routes considered. To put this table in perspective, it should be noted that the annual transport cost for the case of unlimited demand is the same as the round-trip transport cost for the preferred type and size of vessel. Thus, the cumulative savings shown in Table 5.4-15 can also be related to the extra cost to be incurred over and above round-trip transport cost per tonne if throughput levels vary. For example, the round-trip transport cost for a 10,000 DWT barge on Route A is shown in Table 5.4-13 to be US$1.63 per tonne. If the annual transport requirements on this route were only 0.5 MMTPY, the preferred vessel would be a 5,000 DWT barge and the annual transport cost per tonne would be US$3.07, a difference of US$1.44 per tonne. Similarly, if the throughput were 1 MMTPY, the preferred vessel would be a 10,000 DWT barge and the extra cost would be US$1.44 per tonne less US$1.09 per tonne, or US$0.35. Comparing Tables 5.4-13 and 5.4-15, it follows that for the various routes, round-trip transport cost per tonne can understate the annual transport cost per tonne by the following maximum percentages:

- Route A: 88 percent
- Route B: 72 percent
- Route C: 50 percent
- Route D: 30 percent
- Route E: 57 percent
- Route F: 80 percent
- Route G: 55 percent

Table 5.4-15

CUMULATIVE SAVINGS IN ANNUAL TRANSPORT COST
(US$/tonne)[a]

Annual Amount to be Transported \ Route One-Way Distance in Nautical Miles	A	B	C	D
	25	50	100	150
0.5 MMTPY	Barge 5,000 DWT $____	Barge 5,000 DWT $____	BC[b] 6,000 DWT $____	BC 6,000 DWT $____
1.0 MMTPY	Barge 10,000 DWT $1.09	Barge 10,000 DWT $1.15	BC 6,000 DWT $____	BC 6,000 DWT $____
2.0 MMTPY	Barge 10,000 DWT $1.09	Barge 10,000 DWT $1.15	BC 6,000 DWT $0.80	Barge 10,000 DWT $0.30
5.0 MMTPY	Barge 10,000 DWT $1.09	Barge 10,000 DWT $1.15	Barge 10,000 DWT $0.90	Barge 10,000 DWT $0.86
"Unlimited demand"	Barge 10,000 DWT $1.44	Barge 10,000 DWT $1.36	Barge 10,000 DWT $1.19	Barge 10,000 DWT $0.87
	SHORT DISTANCE TRANSPORT SHALLOW WATER (DRAFT LESS THAN 7 m)			

Annual Amount to be transported \ Route One-Way Distance in Nautical Miles	E	F	G
	400	750	1,100
0.5 MMTPY	BC 10,000 DWT $____	BC 20,000 DWT $____	BC 20,000 DWT $____
1.0 MMTPY	BC 20,000 DWT $0.89	BC 30,000 DWT $2.74	BC 40,000 DWT $2.68
2.0 MMTPY	BC 20,000 DWT $0.89	BC 30,000 DWT $2.74	BC 40,000 DWT $2.68
5.0 MMTPY	BC 40,000 DWT $1.63	BC 40,000 DWT $3.30	BC 40,000 DWT $2.68
"Unlimited demand"	BC 40,000 DWT $1.88	BC 40,000 DWT $3.76	BC 40,000 DWT $3.36
	MEDIUM- TO LONG-DISTANCE TRANSPORT DEEP WATER (DRAFT MORE THAN 7 m)		

(a) As a function of increases in annual throughput
(b) BC = Bulk carrier

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5.5 FORMULATION OF ALTERNATIVE SEA TRANSPORT SYSTEMS

5.5 FORMULATION OF ALTERNATIVE SEA TRANSPORT SYSTEMS

This subsection discusses two generic alternatives to meet the transport requirements of the coal supply strategy shown in Table 5.3-1.

5.5.1 Basic Approach

Option 1 consists of direct inter-island shipping from the loading ports for the Kalimantan producing areas to the unloading ports for the customers on Java and Sulawesi.

Option 2 involves the transloading of coal in Kalimantan prior to transport to consumers. Option 2 can be considered a variation of Option 1 in the sense that after specification of a direct shipping system, those routes that could be replaced by coastal shipping to a transloading point followed by shipping to the final destination would be identified.

The following discussion reflects this approach and covers the following subjects:

- Option 1: routes and throughputs
- Selection of transshipment ports
- Option 2: routes and throughputs
- Vessel selection for Options 1 and 2
- Loading and unloading
- Fleet composition and vessel requirements

The shipping system specified for both options applies to the end years of Phases I, II, and III (i.e., 1988, 1991, and 1994). Thus fleet composition and vessel requirements identified are for those years.

5.5.2 Option 1: Routes and Throughputs

Table 5.5-1 shows the direct sea transport system for the years 1988, 1991, and 1994, which was derived from the coal supply strategy in

Table 5.5-1

ROUTES, AND LOADING AND UNLOADING PORTS
FOR DIRECT SHIPPING (OPTION 1)

Route Number	Route	Annual Transport Requirements (MMTPY) 1988	1991	1994
1	Linding - Cigading	1.00	1.00	1.00
2	Tanah Merah - Cigading	0.67	0.71	0.95
3	Tanah Merah - Gresik/Madura	0.93	1.09	1.09
4	Tanah Merah - Semarang	0.27	0.67	0.84
5	Tanah Merah - Cilacap	0.30	0.40	-
6	Tanah Merah - Biringkassi	0.19	-	-
7	Tanjung Batu - Paiton	0.69	1.82	4.56
8	Tanjung Bungalun - Biringkassi	-	0.30	0.36
9	Tenggarong - Cilacap	-	1.03	1.37
10	Lunsurannaga - Bitung (Menado)	-	0.08	0.34
11	Tanjung Bungalun - Cilacap	-	-	0.97
	TOTAL	4.05	7.10	11.48
	Loading Port			
	Linding	1.00	1.00	1.00
	Tanah Merah	2.36	2.87	2.88
	Tanjung Batu	0.69	1.82	4.56
	Tanjung Bungalun	-	0.30	1.33
	Tenggarong	-	1.03	1.37
	Lunsurannaga	-	0.08	0.34
	TOTAL	4.05	7.10	11.48
	Unloading Port			
	Cigading	1.67	1.71	1.95
	Gresik	0.48	0.64	0.64
	Madura	0.45	0.45	0.45
	Semarang	0.27	0.67	0.84
	Cilacap	0.30	1.43	2.34
	Biringkassi	0.19	0.30	0.36
	Paiton	0.69	1.82	4.56
	Bitung (Menado)	-	0.08	0.34
	TOTAL	4.05	7.10	11.48

Table 5.3-1. In 1988 the system would have seven routes, with three loading ports and seven unloading ports. From 1991 on there would be nine routes, with six loading ports and eight unloading ports.

Example of Route Selection Procedure. The Bindu-Betitit deposits in the Pasir area and the deposits in the Samarangau area have been allocated to meet most cement plants requirements (see Table 5.3-1). The common loading port for both areas is Tanah Merah on the Kuaro River. To meet transport requirements, five direct shipping routes would originate in Tanah Merah (see Table 5.5-1). For example, in 1988 coal would be carried on Route 2 to Cigading to meet the following requirements:

- 0.05 MMTPY; additional requirements for INDOCEMENT (Phase 1, 2, 3, 4, 6, 7, and 8) at Citeurup that could not be delivered out of Linding
- 0.25 MMTPY; requirements for Semen Cibinong at Narogong
- 0.17 MMTPY; for the INDOCEMENT plant at Palimanan near Cirebon
- 0.20 MMTPY; for the P. A. Abadi cement plant at Citeurup (also part of the INDOCEMENT group)

Total requirements of 0.67 MMTPY would be unloaded at Cigading for subsequent delivery to the various plants in Narogong, Citeurup, and Palimanan.

System Characteristics. Special points to consider are discussed below.

Sea Transport to Gresik and Madura. Coal supply to the cement plants at Gresik and on Madura would originate in Tanah Merah and involve virtually the same distance. Therefore, there is only one route (Route 3) on which ships would alternate between the unloading ports at Gresik and Bangkalan (on Madura). Total annual requirements on this route are the sum of the requirements for Gresik and Madura.

Switching of Loading Ports. The combination of limited production levels at various producing areas and the difference in time at which

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producing areas will come on stream means that certain consumers will have to be supplied from different areas at certain times. This is best illustrated in the case of supply to Semen Tonasa on Sulawesi, where Biringkassi is the unloading port. Initially, supply will come from Tanah Merah (Route 6), but during Phases II and III (when the Sangatta area is projected to come on stream), Tonasa will be supplied from Sangatta out of Tanjung Bungalun (Route 11).

Coal Supply from the Berau Area. As discussed in Subsection 5.4.3, it is envisioned that coal from the Berau area will be loaded at Lebanan on the Segah River. Coal will then be transported by small barges (up to 5,000 DWT) to Lunsurannaga on the Kalimantan coast, and transshiped into larger vessels. Since present data availability on river transport on the Berau River does not permit any further specification of the river transport system, it has been assumed that Lunsurannaga will be the major loading point for coal from the Berau area.

With respect to this assumption, it should be noted that the current projection for coal shipped out of the Berau area to northern Sulawesi is 340,000 tonnes per year in 1994 (Route 10 in Table 5.5-1). At such levels of throughput and given the distance involved (300 nautical miles), it may be more economical to ship directly from Lebanan to Sulawesi in 5,000 DWT barges, without transshipment at Lunsurannaga. However, the intention is to find additional markets for coal from the Berau area involving significantly larger throughputs and longer distances. In such cases, transshipment at Lunsurannaga would be an absolute necessity in order to minimize transport costs. Barge transport to at least Lunsurannaga would be a requirement in any scheme for developing the coal resources in the Berau area and should be considered part of the development cost, with a coal price established FOB at Lunsurannaga. Barge transport to Lunsurannaga is thus of no consequence to the entity responsible for transport of Kalimantan coal. As far as the latter is concerned, Berau coal is loaded at Lunsurannaga.

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Annual Throughput per Route. With the exception of coal supply to Paiton (Route 7), the throughput on most routes over the next ten years will be less or not much more than 1 MMTPY. As indicated in Subsection 5.4, these limited throughput levels will tend to limit the size of vessels used on any of the domestic routes.

Annual Throughput in Loading Ports. With the exception of Tanjung Batu, throughputs in most loading ports will be modest, ranging in 1994 from a low of 340,000 tonnes per year in Lunsurannaga to a high of 2.88 MMTPY at Tanah Merah. Considering stationary loading equipment is available with an average loading rate of 500 tonnes per hour, it follows that even at the maximum level of 2.88 MMTPY one loader could be sufficient, resulting in a berth occupancy of 66 percent. Generally, the relatively low annual throughputs in loading ports indicate that (at least during Phase I) there would be a tendency to favor slow (and thus inexpensive) loading equipment, and that the interest in dredging to allow larger vessels would most likely be limited.

Annual Throughput in Unloading Ports. Table 5.5-1 shows that on the basis of annual throughputs, the major ports will be Paiton, Cigading, and Cilacap. In 1994 they will handle at least 2 MMTPY, while all the other ports are projected to handle significantly less, ranging in 1994 from a low of 340,000 tonnes at Bitung to a high of 840,000 tonnes at Semarang. As explained in Subsection 5.4.3, these low throughput levels generally tend to favor the use of geared vessels to minimize unloading cost.

Using tonne-miles as an indicator, Phase I will see 50 percent of all transport requirements satisfied by the two routes to Cigading in west Java (see Table 5.5-2 and Figure 5.5-1). During Phases II and III, the importance of west Java will be overtaken by east Java (Paiton) and south central Java (Cilacap). The routes to south-central Java are particularly important, because, due to the distance involved, they account for 36 percent of all system transport requirements in 1994. This is despite the fact that south central Java will receive only about

Table 5.5-2

TRANSPORT REQUIREMENTS FOR OPTION 1
(tonne-miles)

Route Number	Route Name	One-Way Distance (nautical miles)	Annual Transport Requirements[a]					
			1988		1991		1994	
			TM	%	TM	%	TM	%
1	Linding - Cigading	700	700	29	700	15	700	9
2	Tanah Merah - Cigading	775	519	21	550	12	736	10
3	Tanah Merah - Gresik/Madura	450	419	17	491	10	491	7
4	Tanah Merah - Semarang	570	154	6	382	8	479	7
5	Tanah Merah - Cilacap	1,000	300	12	400	8	-	-
6	Tanah Merah - Biringkasi	300	57	2	-	-	-	-
7	Tanjung Batu - Paiton	450	311	13	819	17	2,052	28
8	Tanjung Bungalun - Biringkasi	450	-	-	135	3	162	2
9	Tenggarong - Cilacap	1,165	-	-	1,200	26	1,596	21
10	Lunsuran - Bitung (Menado)	300	-	-	24	1	102	1
11	Tanjung Bungalun - Cilacap	1,180	-	-	-	-	1,145	15
	TOTAL		2,460	100	4,701	100	7,463	100

(a) million tonne-miles and percent of total

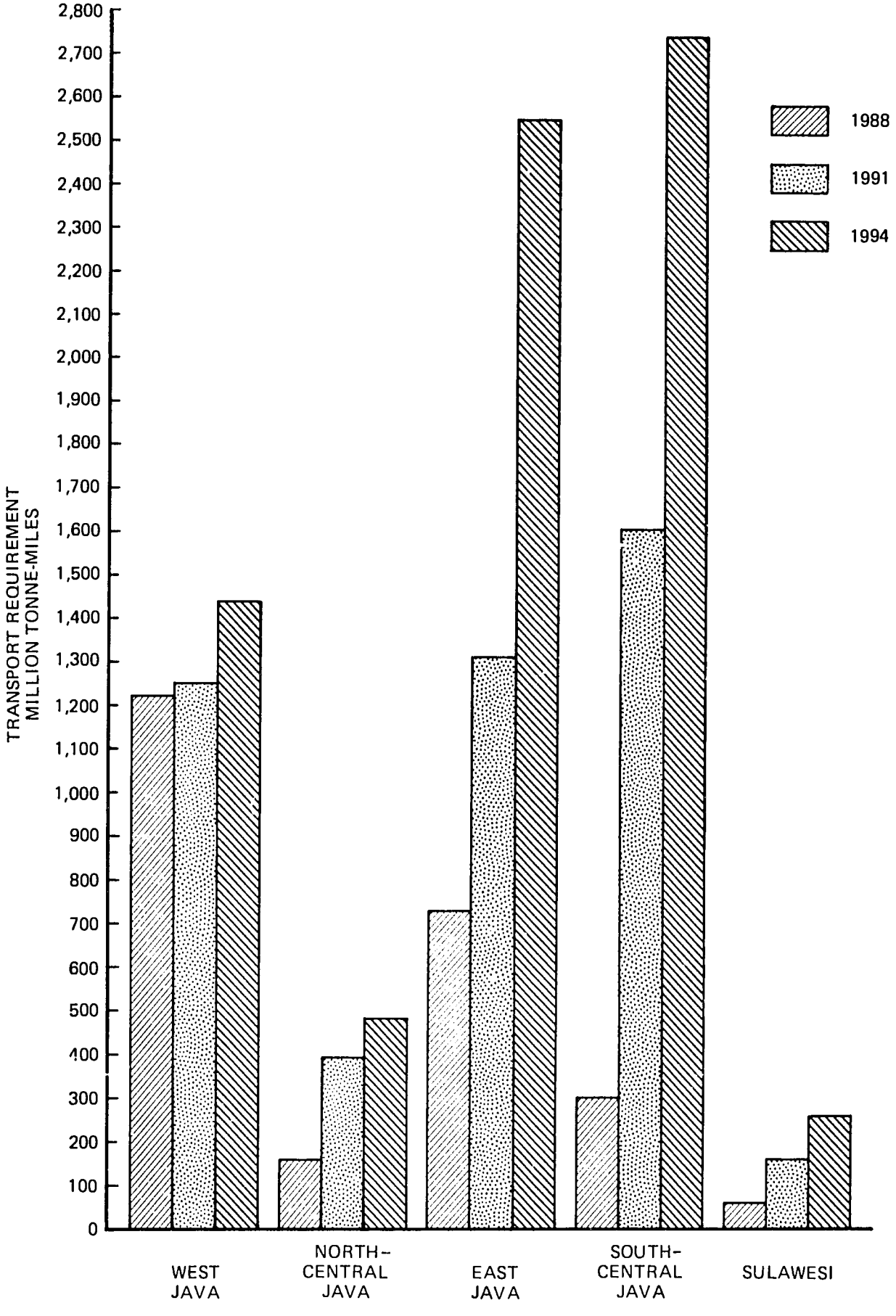

Figure 5.5-1 TRANSPORT REQUIREMENTS FOR OPTION 1 (IN TONNE-MILES)

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20 percent of the total amount of coal transported in 1994. As a result, transport requirements to south central Java show the fastest projected growth rate and will figure most prominently in the total annual cost of operating the coal transport fleet. This is particularly important in view of the likely increase in coal demand beyond 1994 from additional coal-fired units on the south coast of Java.

5.5.3 Selection of Transshipment Ports

Coal could be transported from a loading port to a transshipment port in Kalimantan that could receive larger vessels than the loading port. Cost savings over direct shipping would be achieved because the subsequent inter-island transport in larger vessels could result in a reduced cost per tonne-mile between loading and unloading port.

Review of the six loading ports in Kalimantan shows the relative proximity of four loading ports in east Kalimantan to each other (Linding, Tanah Merah, Tenggarong, and Tanjung Bungalun). These four ports are less than 150 nautical miles from the major port of Balikpapan, which, with a draft of 12 meters, would allow access for 40,000 DWT bulk carriers.

The remaining two loading ports (Tanjung Batu and Lunsurannaga) are a different situation. Tanjung Batu is located in south Kalimantan and coal loaded there is destined for Paiton, 450 nautical miles to the south. It appears unlikely that cost savings could be obtained by first shipping coal north to Balikpapan and then south to Paiton, because that would add 400 miles to the trip. However, because of draft restrictions at Tanjung Batu, it is possible to consider a transshipment center close to Tanjung Batu that would allow deep draft vessels. As indicated in Section 3, P.T. Arutmin has explored the possibility of using a terminal on Pulau Laut near Kotabaru for this purpose.

Lunsurannaga in northeast Kalimantan is the most northern loading point and is the loading port for coal going to northern Sulawesi. Similar to the

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Tanjung Batu case, the direct route between Lunsurannaga and northern Sulawesi appears to be the most economical shipping route.

Based on the above reasoning, two possible transshipment ports have been selected: (1) Balikpapan for coal from the Samarangau, Pasir, Mahakam, and Sangatta areas; and (2) Kotabaru for coal from the Senakin area. Furthermore, and at least during the planning phases considered in this report, it is assumed that coal from the Berau area would be shipped directly out of Lunsurannaga to northern Sulawesi.

5.5.4 Option 2: Routes and Throughputs

Using Balikpapan and Kotabaru as transshipment ports, Table 5.5-3 shows the various coastal and inter-island routes of Option 2. If cost savings could be expected, direct shipping routes in Option 1 would be split into coastal routes and inter-island routes. In addition, the following should be noted about Option 2:

- Phase I: During Phase I, Option 1 and Option 2 are identical. Thus, until 1988 there will be only direct shipping of Kalimantan coal. This accounts for the fact that it will take time (at least two years) to plan and construct a transshipment terminal, and throughput will not yet have grown sufficiently to justify a transshipment terminal.

- Transshipment terminal in Balikpapan. Toward the end of Phase I, total transport requirements should be sufficient to warrant the start of a terminal in Balikpapan to operate during Phase II. As shown in Table 5.5-3, throughput at this terminal would be 4.23 MMTPY in 1991 and 5.38 MMTPY in 1994, making an effective transshipment operation possible.

- Transshipment terminal at Kotabaru. Only during Phase III would the operation of a transshipment terminal at Kotabaru prove a viable proposition, because the level of domestic transport out of Tanjung Batu would be too low during Phases I and II. In 1994, 4.56 million tonnes are projected to be shipped though Kotabaru to Paiton, a level that could justify the expenditure for the terminal. If coal for export were transported out of Tanjung Batu or any other area within the Arutmin concession, a transfer terminal in Kotabaru may prove to be justified at an earlier date.

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Table 5.5-3

OPTION 2: ROUTES FOR COASTAL AND INTER-ISLAND SHIPPING

Route Number	Route	Annual Transport Requirements (MMTPY) 1988	1991	1994
Coastal Routes				
I	Linding - Balikpapan	-	1.00	1.00
II	Tanah Merah - Balikpapan	-	2.20	2.04
III	Tanjung Bungalun - Balikpapan	-	-	0.97
IV	Tenggarong - Balikpapan	-	1.03	1.37
V	Tanjung Batu - Kotabaru	-	-	4.56
	Total through Balikpapan	-	4.23	5.38
	Total through Kotabaru	-	-	4.56
	TOTAL		4.23	9.94
Inter-Island/Direct Routes				
1	Linding - Cigading	1.00	-	-
2	Tanah Merah - Cigading	0.67	-	-
3	Tanah Merah - Gresik/Madura	0.93	-	-
4	Tanah Merah - Semarang	0.27	0.67	0.84
5	Tanah Merah - Cilacap	0.30	-	-
6	Tanah Merah - Biringkassi	0.19	-	-
7	Tanjung Batu - Paiton	0.69	1.82	-
8A	Tanjung Bungalun - Biringkassi	-	0.30	0.36
10	Lunsurannaga - Bitung (Menado)	-	0.08	0.34
	TOTAL	4.05	2.87	1.54
Inter-Island/From Balikpapan				
12	Balikpapan - Cigading	-	1.71	1.95
13	Balikpapan - Gresik/Madura	-	1.09	1.09
14	Balikpapan - Cilacap	-	1.43	2.34
	TOTAL	-	4.23	5.38
Inter-Island/From Kotabaru				
15	Kotabaru - Paiton	-	-	4.56
	GRAND TOTAL (Inter-island)	4.05	7.10	11.48

- Direct shipping routes in Option 2. In addition to direct coal transport from Lunsurannaga to Bitung two other direct routes from Option 1 may be retained in Option 2: Tanah Merah to Semarang, and Tanjung Bungalun to Biringkassi. In both cases there is no apparent justification to consider transshipment. The unloading port at Semarang has a draft of 7 meters (see Subsection 5.4.3), and as a result is not accessible by large vessels from Balikpapan. No significant improvement over direct shipping out of Tanjung Bungalun can be expected since there are no draft restrictions there. Biringkassi has a 9 meter draft, and Biringkassi is a short distance from Tanjung Bungalun.

Option 2 results in a relatively simple shipping system. During Phase II this system would have three coastal routes, with two additional coastal routes during Phase III. There would be seven inter-island routes during Phase I. When transshipment starts during Phase II, while most of the routes would change, the number of inter-island routes would not change, staying at seven. Generally, the level of throughput on each of the routes under Option 2 would be essentially the same as for Option 1.

To determine the relative merits of Option 2 versus Option 1, it is necessary to calculate round-trip transport cost and annual transport cost for both options. In order to do this, the next subsections further specify the types of vessels selected for each option, and loading and unloading assumptions. Subsection 5.6 provides the results of the comparison between Options 1 and 2.

5.5.5 Vessel Selection for Options 1 and 2

Selection Criteria. As explained in Subsection 5.4, the type and size of vessel to be selected on any particular route is a function of four parameters:

- Limiting draft at the loading harbor
- Limiting draft at the unloading harbor
- Route distance
- Annual transport requirements on the route

The main criterion for choosing the type and size of vessel is lowest annual transport cost per tonne while meeting the annual transport requirements.

While simple application of the above criterion would provide the lowest cost type and size of vessel, the company operating the inter-island fleet would naturally attempt to standardize its fleet and use as few different types and sizes of vessels as possible. Not only would this additional criterion add to the flexibility of the fleet, but more important, it facilitates repair and maintenance procedures and generally results in lower operating cost.

Finally, in the selection procedures applied here, a further simplification has been introduced. Vessels are to be selected that would most economically transport the annual tonnage from loading port over an average distance trip. The average distance has been determined by dividing total transport requirements in tonne-miles originating from the loading port by the total annual amount to be loaded.

Table 5.5-4 provides information on all routes considered under Options 1 and 2 with respect to distance of the routes, limiting drafts of loading and unloading ports, the maximum size barge or bulk carrier that could be used on the route (assuming no dredging of loading ports and using the relationship shown in Figure 5.4-2), and the type and size of vessel selected for each route.

Vessel Selection Rationale for Option 1. Option 1 includes Routes 1 through 11. Average distances under Option 1 are:

- From Linding, 700 miles
- From Tanah Merah, about 600 miles
- From Tanjung Batu, 450 miles
- From Tanjung Bungalun, 450-982 miles
- From Tenggarong, 1,165 miles
- From Lunsurannaga, 300 miles

Table 5.5-4

VESSEL SELECTION AND ROUTES FOR OPTIONS 1 AND 2

Route Number	Route Name	One-Way Distance (nautical miles)	Limiting Draft (meters)			Maximum Vessel Size (DWT)		Vessel Selection[a]
			Loading Port	Unloading Port	Route	Barge	Bulk Carrier	
Coastal Routes								
I	Linding - Balikpapan	80	6	12	6	10,000	4,000	10,000 B
II	Tanah Merah - Balikpapan	60	6.5	12	6.5	12,000	5,000	10,000 B
III	Tanjung Bungalun - Balikpapan	135	13	12	12	50,000	60,000	10,000 B
IV	Tenggarong - Balikpapan	115	7	12	7	14,000	6,500	10,000 B
V	Tanjung Batu - Kotabaru	32	8	12	8	20,000	10,000	10,000 B
Inter-Island Routes								
1	Linding - Cigading	700	6	15	6	10,000	4,000	10,000 B
2	Tanah Merah - Cigading	775	6.5	15	6.5	12,000	5,000	10,000 B
3	Tanah Merah - Gresik/Madura	450	6.5	11	6.5	12,000	5,000	10,000 B
4	Tanah Merah - Semarang	570	6.5	7	6.5	12,000	5,000	10,000 B
5	Tanah Merah - Cilacap	1,000	6.5	12	6.5	12,000	5,000	10,000 B
6	Tanah Merah - Biringkassi	300	6.5	9	6.5	12,000	5,000	10,000 B
7	Tanjung Batu - Paiton	450	8	15	8	20,000	10,000	10,000 BC
8	Tanjung Bungalun - Biringkassi	450	13	9	9	28,000	20,000	20,000 BC
8A	Tanjung Bungalun - Biringkassi	450	13	9	9	28,000	20,000	10,000 B
9	Tenggarong - Cilacap	1,165	7	12	7	14,000	6,500	10,000 B
10	Lunsurannaga - Bitung (Menado)	300	8	15	8	20,000	10,000	10,000 BC
11	Tanjung Bungalun - Cilacap	1,180	13	12	12	50,000	60,000	20,000 BC
12	Balikpapan - Cigading	810	12	15	12	50,000	60,000	40,000 BC
13	Balikpapan - Gresik/Madura	490	12	11	11	50,000	48,000	40,000 BC
14	Balikpapan - Cilacap	1,050	12	12	12	50,000	60,000	40,000 BC
15	Kotabaru - Paiton	410	12	15	12	50,000	60,000	40,000 BC

(a) B = barge, BC = bulk carrier

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As shown in Table 5.5-4, the choice on most routes under Option 1 would be between 10,000 to 20,000 DWT barges and mini-bulk carriers of 4,500 to 6,500 DWT -- except for routes 7, 8, 10, and 11, where larger ships are possible. The following explains the vessel selections, which were based in part on the general conclusions stated in Subsection 5.4.4.

- Route 1. With throughput staying at 1 MMTPY and a distance of 700 miles, a 10,000 DWT barge would result in lower annual cost per tonne than a 4,000 DWT mini-bulk carrier.

- Routes 2, 3, 4, 5, and 6. The slightly shorter average distance of these routes (about 600 miles) and the total throughput of 2.89 MMTPY increases the advantage of a barge over a mini-bulk carrier. To keep types and sizes of vessels in the fleet to a minimum, a 10,000 DWT barge was selected.

- Route 7. The projected throughput increase and the distance involved call for the largest possible bulk carrier, which (without dredging) would be 10,000 DWT.

- Routes 8 and 11. Draft restrictions are not severe, but total throughputs will stay relatively small (0.30 MMTPY in 1991 and 1.33 MMTPY in 1994). During Phase II a smaller vessel would be best, but throughput and average distance during Phase III justifies a 20,000 DWT bulk carrier. Therefore, a 20,000 DWT bulk carrier was selected to start operations during Phase II.

- Route 9. Throughput is projected to increase to 1.37 MMTPY in 1994, and trips will be 1,165 miles. Figure 5.5-2, based on information developed in Subsection 5.4.4, shows that a mini-bulk carrier of 6,500 DWT would have approximately the same cost as a 10,000 DWT barge on this route. A 14,000 DWT barge would have a competitive advantage over the 6,500 mini-bulk carrier. To keep types and sizes of vessels in the fleet to a minimum, a 10,000 DWT barge was also selected for Route 9.

- Route 10. Throughput and distance would justify either a 10,000 DWT barge or a 10,000 DWT bulk carrier. A 10,000 DWT bulk carrier was selected because it would be more economical if throughput were to be larger than projected, and thus provides more flexibility. A larger barge has not been considered because it would be difficult to use on any other route. Since transport will only start during Phase II, the same vessels used on Route 7 could meet the early small transport requirements of this route.

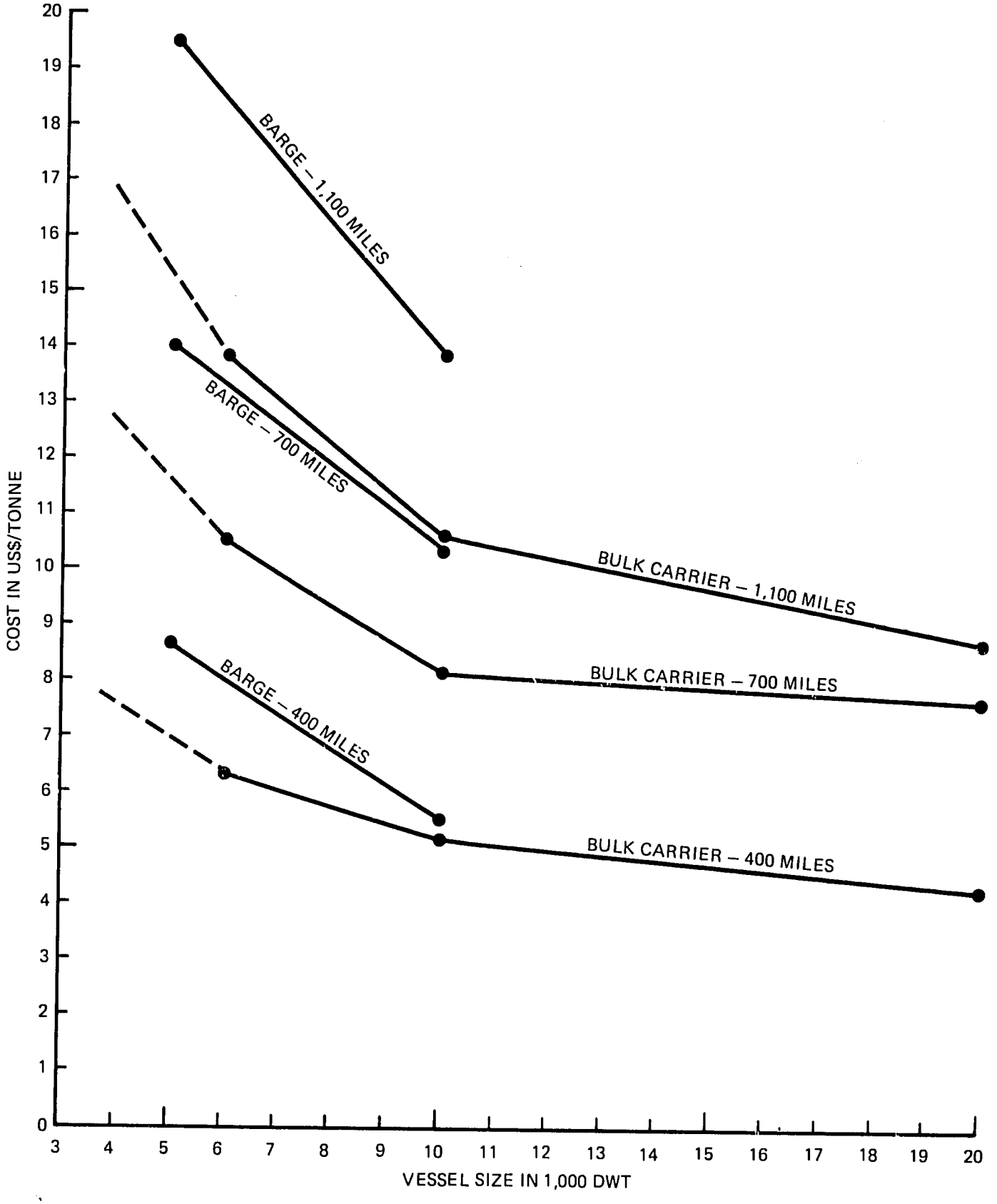

Figure 5.5-2 ANNUAL TRANSPORT COST FOR A LEVEL THROUGHPUT OF 1.5 MILLION TONNES PER YEAR (COST PER TONNE AS A FUNCTION OF VESSEL SIZE AND TYPE, AND ROUTE DISTANCE)

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Based on the above, the Option 1 fleet is as follows. During Phase I, 10,000 DWT barges would be used on all routes, except Route 7, where a 10,000 DWT bulk carrier would be used. This fleet would expand during Phases II and III to meet increased transport requirements, with a 20,000 DWT bulk carrier added to operate out of Tanjung Bungalun. This fleet is not necessarily the optimum fleet. Variations are still possible, but the fleet outlined above should result in an annual fleet operating cost that cannot be significantly lowered.

Vessel Selection Rationale for Option 2. As discussed earlier, the options differ only during Phases II and III. Thus, at the start of Phase II there will be a fleet of 10,000 DWT barges and tugs available as shuttles between loading ports and transshipment terminals. Although on some coastal routes larger vessels could be used, the fact that the 10,000 DWT barges would be available precludes any other selection.

The shorter distances involved in coastal transport would enable more efficient use of the tugs. While barges are loading and unloading, tugs could transport empty barges between the transshipment terminal and loading port. This type of shuttle operation is less likely under Option 1, because empty barges would sit idle for too long a period before another tug with a full barge would arrive. Therefore, the tug and barge would operate as a "fixed" combination under Option 1.

Under Option 2, new routes would be established between the transshipment terminals at Balikpapan and Kotabaru and the ports of Cigading, Gresik/Madura, Cilacap, and Paiton (Routes 12, 13, 14, and 15). Throughputs at Balikpapan and Kotabaru, the distances involved, and the lack of serious draft restrictions calls for large (40,000 DWT) bulk carriers on these four routes.

There would be no need to operate a 20,000 DWT bulk carrier between Tanjung Bungalun and Biringkassi under Option 2, so one of the available 10,000 DWT barges was selected. In Tables 5.5-3 and 5.5-4, this is called Route 8A. The other direct shipping routes retained (Routes 4 and 10) would continue to use the same vessels as under Option 1.

5.5.6 Loading and Unloading

Table 5.5-5 shows the assumptions made about the loading and unloading facilities at each of the ports. The general basis for these assumptions is contained in the discussion on loading and unloading in Subsection 5.4.2. Specifications of the type and size of vessels to be used under Options 1 and 2 resulted in the type and capacity selection of loading and unloading equipment shown in Table 5.5-5.

5.5.7 Fleet Composition and Vessel Requirements

Complete definitions of the two shipping options in the previous subsections and the methodology discussed in Subsection 5.4.1 allow for calculation of the number of vessels required under both options. Detailed results of these calculations, such as round-trip time per vessel per route and the required number of vessels per route, are in Appendix C. Table 5.5-6 shows the overall result of these calculations in terms of the fleet composition under each option. Under Option 1, a total of seventeen 10,000 DWT barge-tug combinations, eight 10,000 DWT bulk carriers, and two 20,000 DWT bulk carriers would be used in 1994 to transport 11.48 million tonnes of coal.

Under Option 2, the fleet would have the same composition in 1988 as under Option 1. During Phases II and III, the fleet composition would change as a result of the coastal shuttle operation, and fewer tugs and barges would be required during Phase II than during Phase I. Increased transport requirements during Phase III would call for more barges again in 1994. However, only five tugs would be needed in 1994. To meet the transport requirements at Tanjung Batu during Phase II, three 10,000 DWT bulk carriers would be used, but as soon as transshipment starts at Kotabaru, only one would have to be retained in the fleet. By 1994 six 40,000 DWT bulk carriers would be used to transport 9.94 million tonnes from the transshipment terminals at Balikpapan and Kotabaru over four routes. The remaining 1.54 million tonnes would be shipped directly out of Kalimantan loading ports to Semarang, Biringkassi, and Bitung. If Option 2 proves to be an attractive plan, this reduction in requirements for certain vessels could easily be accommodated by a combination of

Table 5.5-5

LOADING AND UNLOADING FACILITIES ASSUMPTIONS FOR ALL PORTS

Loading Port	Type of Vessels To Be Loaded[a]	Type of Loading Equipment	Design Capacity (TPH)	Average Capacity (TPH)
Linding	10,000 B	stationary	1,000	500
Tanah Merah	10,000 B	stationary	1,000	500
Tanjung Batu	10,000 B/10,000 BC	traveling	1,000	700
Tanjung Bungalun	10,000 B/20,000 BC	traveling	1,000	700
Tenggarong	10,000 B	stationary	1,000	500
Lunsurannaga	10,000 BC	traveling	1,000	700
Balikpapan	40,000 BC	traveling	1,500	1,050
Kotabaru	40,000 BC	traveling	1,500	1,050

Unloading Port	Unloading Barges			Unloading Bulk Carriers		
	Type of Unloading Equipment	Design Capacity (TPH)	Average Capacity (TPH)	Type of Unloading Equipment[a]	Design Capacity (TPH)	Average Capacity (TPH)
Cigading	traveling	2 x 500	500	traveling (existing)	2 x 750	750
Gresik	stationary	2 x 500	250	geared vessel; 40,000 BC	-	1,000
Madura	stationary	2 x 500	250	geared vessel; 40,000 BC	-	1,000
Semarang	stationary	2 x 500	250	not applicable	-	-
Cilacap	traveling	2 x 500	500	traveling	2 x 750	750
Biringkassi	stationary	2 x 500	250	geared vessel; 20,000 BC	-	750
Paiton	not applicable	-	-	traveling (planned)	2 x 1,000	1,000
Bitung (Menado)	not applicable	-	-	geared vessel; 10,000 BC	-	500
Balikpapan	traveling	2 x 500	500	not applicable	-	-
Kotabaru	traveling	2 x 500	500	not applicable	-	-

(a) B = barge, BC = bulk carrier; in deadweight tonnes (DWT)

Table 5.5-6

FLEET COMPOSITION AT THE END OF PHASES I, II, AND III
FOR OPTIONS 1 AND 2

Vessels	Number of Vessels		
	1988	1991	1994
Option 1: Direct Shipping			
10,000 DWT barges	10	16	17
Tugs	10	16	17
10,000 DWT bulk carriers	1	3	8
20,000 DWT bulk carriers	-	1	2
Option 2: Transshipment			
10,000 DWT barges	10	7	12
Tugs	10	4	5
10,000 DWT bulk carriers	1	3	1
40,000 DWT bulk carriers	-	3	6

chartering and buying vessels. For example, rather than acquiring ten barge-tug combinations during Phase I, six could be chartered until such time as they were no longer needed, while the four barge-tug combinations to be used during all phases could be purchased.

5.6 EVALUATION OF ALTERNATIVE SEA TRANSPORT SYSTEMS

5.6 EVALUATION OF ALTERNATIVE SEA TRANSPORT SYSTEMS

This subsection evaluates the two alternative shipping systems formulated in the previous subsection (Options 1 and 2). To this end, this subsection addresses:

- Transport costs for Option 1 and 2
- Potential cost savings of Option 2 over Option 1
- Additional benefits associated with transshipment terminals at Balikpapan and Kotabaru

It is important to emphasize the separation of the above three subjects. Transport costs are an important parameter for judging the viability of the development and use of Kalimantan coal resources. As discussed in Subsection 5.2, transport costs would have to be below a certain level (about US$8/tonne) in order to remain competitive with Australian imports (assuming the same FOB price and coal quality).

The second subject addresses the desirability of establishing specific onshore transshipment terminals at Balikpapan and Kotabaru. This is only one of the possible forms of transshipment. For example, coal from the Pasir and Samarangau areas could also be transshipped closer to Tanah Merah using a floating transshipment terminal, but this option has not been considered in this report.

Finally, the third subject is separate in the sense that a transshipment terminal should first and foremost be evaluated on the basis of realistic cost savings to the transport company. If other benefits exist they simply will add to the viability of establishing such terminals. For example, a terminal at Balikpapan could also be used to receive imported coal in large vessels for subsequent distribution to other ports in the ASEAN region. However, the perspective taken in this report is that such a proposition should be further pursued only if the terminal could prove to be economically attractive based on the transport requirements of a domestic coal transport system.

5.6.1 Transport Costs for Options 1 and 2

Using the methodology and assumptions discussed in Subsection 5.4.1, round-trip transport costs for all routes are shown in Table 5.6-1. Because vessels from a particular loading port are expected to be used on several routes from that port, no attempt was made to calculate annual transport cost per tonne. Appropriate fleet scheduling should minimize idle time for these vessels and ensure they are being used as close to 340 days as possible. However, as discussed in Subsection 5.4.4, it should be realized that the round-trip transport cost shown in Table 5.6-1 is the low end of the actual transport cost that will be experienced by the transport company.

Barge Transport vs Bulk Carrier Transport. With respect to cost per tonne-mile, Table 5.6-1 confirms the conclusion that barge transport is generally more expensive than transport with bulk carriers. For example, by comparing the cost per tonne-mile of most Option 1 routes with the main inter-island routes in Option 2 (Routes 12, 13, 14, and 15), it can be seen that the cost per tonne-mile for barges could be almost twice that of bulk carriers.

Option 1 Direct Shipping Cost. Using a very broad generalization, it can be said that under Option 1 Kalimantan coal could be shipped to Sulawesi for around US$4 per tonne, to east Java for around US$4.50 to US$6 per tonne, to north-central Java (Semarang) for around US$7.50 per tonne, to west Java for around US$8.50 to US$9.50 per tonne, and to south-central Java for US$8 to US$13 per tonne. These generalizations are not intended to accurately state the costs, but they do illustrate the relative cost of transporting Kalimantan coal to various areas using Option 1.

In particular, it can be concluded that any additional charges levied by port authorities or other agencies on barge transport to west and south central Java may result in the cost of barge transport alone being as much as 25 to 35 percent of the delivered price of coal to these areas. In view of the fact that the unloading ports of Cigading and Cilacap in

Table 5.6-1

ROUND-TRIP TRANSPORT COST FOR ALL ROUTES OF OPTIONS 1 AND 2

Route Number	Route	One-Way Distance (nautical miles)	Selected Vessel[a]	Round-Trip Transport Cost	
				US$/Tonne	US$/Tonne-Mile x 10^{-3}
Coastal Shipping Routes					
I	Linding - Balikpapan	80	10,000 B	1.15	14.4
II	Tanah Merah - Balikpapan	60	10,000 B	0.95	15.8
III	Tanjung Bungalun - Balikpapan	135	10,000 B	1.71	12.7
IV	Tenggarong - Balikpapan	115	10,000 B	1.54	13.4
V	Tanjung Batu - Kotabaru	32	10,000 B	0.66	20.6
Inter-island Shipping Routes					
1	Linding - Cigading	700	10,000 B	8.42	12.0
2	Tanah Merah - Cigading	775	10,000 B	9.20	11.9
3	Tanah Merah - Gresik/Madura	450	10,000 B	6.37	14.2
4	Tanah Merah - Semarang	570	10,000 B	7.54	13.2
5	Tanah Merah - Cilacap	1,000	10,000 B	11.45	11.5
6	Tanah Merah - Biringkassi	300	10,000 B	4.80	16.0
7	Tanjung Batu - Paiton	450	10,000 BC	4.31	9.6
8	Tanjung Bungalun - Biringkassi	450	20,000 BC	3.93	8.7
8A	Tanjung Bungalun - Biringkassi	450	10,000 B	6.26	13.9
9	Tenggarong - Cilacap	1,165	10,000 B	13.12	11.3
10	Lunsurannaga - Bitung (Menado)	300	10,000 BC	3.55	11.8
11	Tanjung Bungalun - Cilacap	1,180	20,000 BC	8.08	6.8
12	Balikpapan - Cigading	810	40,000 BC	4.80	5.9
13	Balikpapan - Gresik/Madura	490	40,000 BC	3.33	6.8
14	Balikpapan - Cilacap	1,050	40,000 BC	5.73	5.5
15	Kotabaru - Paiton	410	40,000 BC	3.05	7.4

(a) B = barge; BC = bulk carrier

west Java and south-central Java do not present severe draft restrictions (so larger vessels from other coal supply areas could enter), barge transport of Kalimantan coal to these areas could be a deterrent to the use of Kalimantan coal. Although barge transportation costs to Sulawesi, east Java, and north-central Java do not necessarily present a problem, reductions would help increase the attractiveness of Kalimantan coal.

Round-trip Transport Cost Under Option 2. Three routes (4, 6, and 10) would be the same in Option 1 as Option 2. Option 2 round-trip transport costs would differ from Option 1 only on those direct shipping routes where either a different vessel is specified, or routes where coal would be transshipped at Balikpapan or Kotabaru. The route from Tanjung Bungalun to Biringkassi would remain as a direct shipping route in Option 2, but instead of using a 20,000 DWT bulk carrier 10,000 DWT barges would be used. This would be done to maximize fleet efficiency, but would raise the tranport cost per tonne on this route from US$3.93 to US$6.26 (see Routes 8 and 8A in Table 5.5-6).

Transshipment in Option 2 would affect only Routes 1, 2, 3, 5, 7, 9, and 11. Table 5.6-2 shows how transshipment would reduce the transport cost for those routes. For example, direct shipping in 10,000 DWT barges from Linding to Cigading (Route 1) would result in a round-trip transport cost of US$8.42/tonne. Under Option 2, coal first would be shipped from Linding, transloaded at Balikpapan (Route I), and subsequently shipped in 40,000 DWT bulk carriers to Cigading (Route 12). The resulting round-trip transport cost for Option 2 would be US$5.95/tonne, a reduction of US$2.47/tonne.

As mentioned earlier, cost reductions at this point are not intended to address the issue of whether a transshipment terminal at Balikpapan or Kotabaru is economically justified or not. Thus no consideration is given at this point to the cost of transshipment itself. With this caveat, Table 5.6-2 allows several general conclusions on the cost reduction made possible by transshipment:

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Table 5.6-2

COMPARISON OF ROUND-TRIP TRANSPORT COST FOR OPTION 1
ROUTES CHANGED UNDER OPTION 2

Option 1: Direct Shipping			Option 2: Transloading in Kalimantan										Round-trip Cost Reduction Under Option 2	
	Round-trip Cost		Coastal Transport				Inter-island Transport				Combined Transport			
					Round-trip Cost				Round-trip Cost		Round-trip Cost			
Route Number	US$/ Tonne	US$/ Tonne-mile x 10^{-3}	Route Number	One-Way Distance (nautical miles)	US$/ Tonne	US$/ Tonne-mile x 10^{-3}	Route Number	One-Way Distance (nautical miles)	US$/ Tonne	US$/ Tonne-mile x 10^{-3}	US$/ Tonne	US$/ Tonne-mile x 10^{-3}	Cost/ Tonne (percent)	Cost/ Tonne-mile (percent)
1	8.42	12.0	I	80	1.15	14.4	12	810	4.80	5.9	5.95	6.7	29	44
2	9.20	11.9	II	60	0.95	15.8	12	810	4.80	5.9	5.75	6.6	38	45
3	6.37	14.2	II	60	0.95	15.8	13	490	3.33	6.8	4.28	7.8	33	45
5	11.45	11.5	II	60	0.95	15.8	14	1,050	5.73	5.5	6.68	6.1	42	47
7	4.31	9.6	V	32	0.66	20.6	15	410	3.05	7.4	3.71	8.4	14	13
9	13.12	11.3	IV	115	1.54	13.4	14	1,050	5.73	5.5	7.27	6.3	45	44
11	8.08	6.8	III	135	1.71	12.7	14	1,050	5.73	5.5	7.44	6.3	8	7

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- Transshipment into 40,000 DWT bulk carriers between east Kalimantan and Java, when compared to direct shipping in 10,000 DWT barges, could result in an average reduction of 37 percent in the round-trip transport cost per tonne, and 45 percent per tonne-mile.

- Transshipment into 40,000 DWT bulk carriers for transport from southeast Kalimantan to Paiton, when compared with direct shipping in 10,000 DWT bulk carriers, could result in an average reduction of around 13 to 14 percent in transport cost per tonne and tonne-mile.

- Transshipment into 40,000 DWT bulk carriers between Tanjung Bungalun and Cilacap, when compared to direct shipping in 20,000 DWT bulk carriers, could result in an average reduction of 7 to 8 percent in transport cost per tonne and tonne-mile.

To further illustrate the above conclusions, Figure 5.6-1 is an example of shipping alternatives from Tanah Merah to Java. Alternative 1 involves transshipment at Balikpapan, Alternative 2 involves direct shipping, and Alternative 3 involves transshipment at a floating terminal in deep water as close as possible to Tanah Merah. The implication of the above conclusions is that the round-trip transport costs of Alternatives 1 and 3 (exclusive of the cost of transshipment) are expected to be 30 to 40 percent below the cost of Alternative 2.

Finally, Table 5.6-2 shows that coastal barging generally would result in the highest cost per tonne-mile. However, when combined with the much longer inter-island routes in 40,000 DWT bulk carriers, overall savings from transshipment will result.

Annual Transport Cost. The round-trip transport costs per route of Table 5.6-2 have been used to approximate the annual cost of operating the fleets called for by Options 1 and 2. The results are shown in Tables 5.6-3 and 5.6-4. The company responsible for Kalimantan coal transport at the end of Phase I would incur a total cost of approximately US$30 million to transport a total of 4.05 million tonnes. This implies that the average tariff for sea transport alone would have to be at least

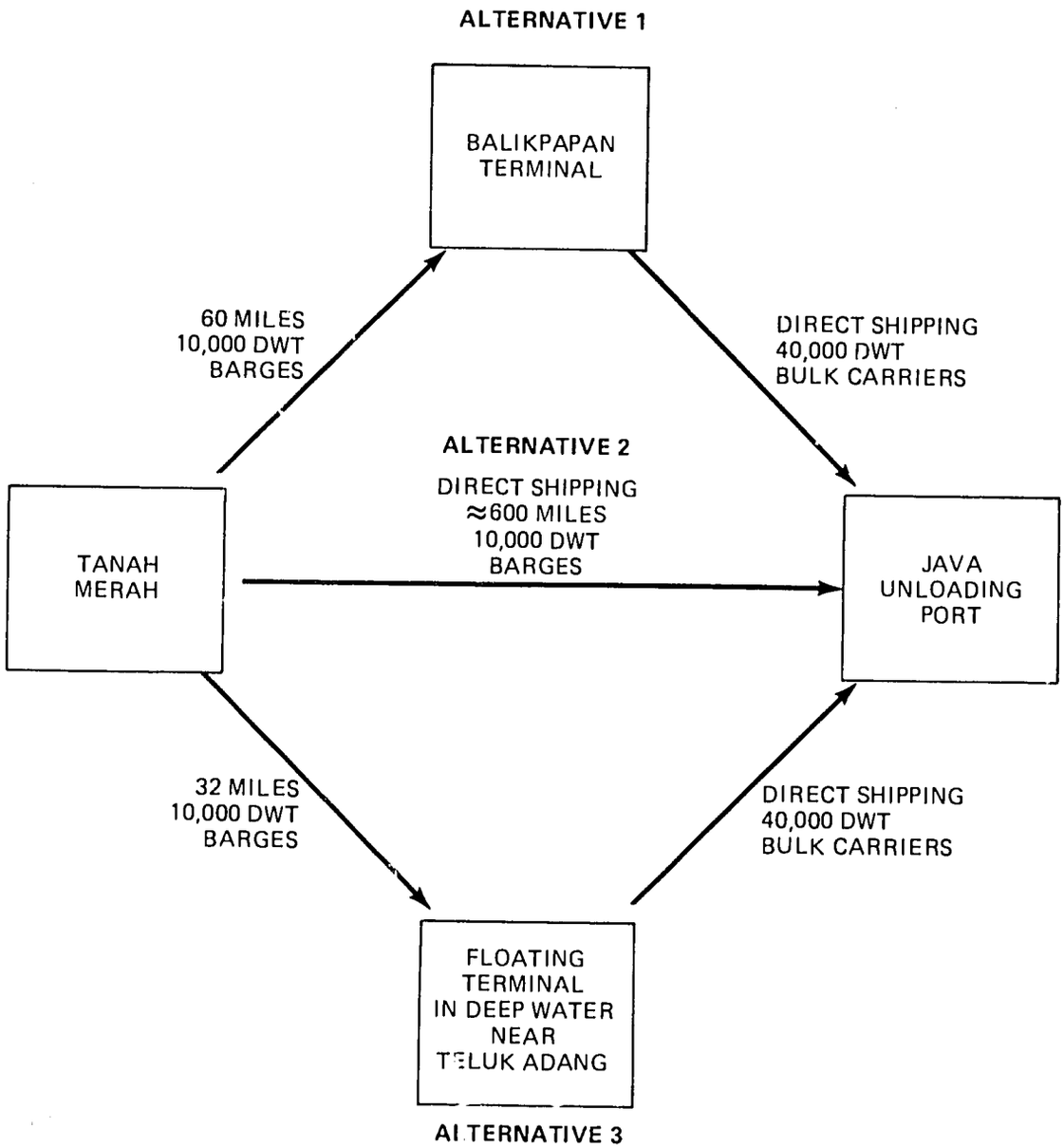

Figure 5.6-1 ALTERNATIVES FOR SHIPPING FROM TANAH MERAH TO JAVA

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Table 5.6-3

OPTION 1: TOTAL ANNUAL TRANSPORT COST

Route Number	Route Name	Annual Transport Cost (million US$/year)		
		1988	1991	1994
1	Linding - Cigading	8.42	8.42	8.42
2	Tanah Merah - Cigading	6.16	6.53	8.74
3	Tanah Merah - Gresik/Madura	5.92	6.94	6.94
4	Tanah Merah - Semarang	2.04	5.05	6.33
5	Tanah Merah - Cilacap	3.44	4.58	-
6	Tanah Merah - Biringkassi	0.91	-	-
7	Tanjung Batu - Paiton	2.97	7.84	19.65
8	Tanjung Bungalun - Biringkassi	-	1.18	1.41
9	Tenggarong - Cilacap	-	13.51	17.97
10	Lunsurannaga - Bitung (Menado)	-	0.28	1.21
11	Tanjung Bungalun - Cilacap	-	-	7.84
	TOTAL	29.86	54.33	78.51

about US$7.50/tonne to recover costs. During Phases II and III, respectively, total annual cost would increase to around US$40 million to US$55 million, and US$60 million to US$79 million, depending on the shipping system implemented. During the same period, total annual transport requirements would increase from 4.05 MMTPY in 1988, to 7.10 MMTPY in 1991, and 11.48 MMTPY in 1994. In order to recover cost, the transport company would have to establish average tariffs of at least US$5.62 to US$7.65 per tonne during Phase II and US$5.22 to US$6.84 during Phase III. The lower estimate applies to Option 2, the higher to Option 1.

Table 5.6-4

OPTION 2: TOTAL ANNUAL TRANSPORT COST

Route Number	Route Name	Annual Transport Cost (million US$/year) 1988	1991	1994
	Coastal Shipping Routes			
I	Linding - Balikpapan	-	1.15	1.15
II	Tanah Merah - Balikpapan	-	2.09	1.94
III	Tanjung Bungalun - Balikpapan	-	-	1.66
IV	Tenggarong - Balikpapan	-	1.59	2.11
V	Tanjung Batu - Kotabaru	-	-	3.01
	Total through Balikpapan	-	4.83	6.86
	Total through Kotabaru	-	-	3.01
	TOTAL		4.83	9.87
	Inter-Island/Direct Shipping Routes			
1	Linding - Cigading	8.42	-	-
2	Tanah Merah - Cigading	6.16	-	-
3	Tanah Merah - Gresik/Madura	5.92	-	-
4	Tanah Merah - Semarang	2.04	5.05	6.33
5	Tanah Merah - Cilacap	3.44	-	-
6	Tanah Merah - Biringkassi	0.91	-	-
7	Tanjung Batu - Paiton	2.97	7.84	-
8A	Tanjung Bungalun - Biringkassi	-	1.88	2.25
10	Lunsurannaga - Bitung (Menado)	-	0.28	1.21
	TOTAL	29.86	15.05	9.79
	Inter-Island/From Balikpapan			
12	Balikpapan - Cigading	-	8.21	9.36
13	Balikpapan - Gresik/Madura	-	3.63	3.63
14	Balikpapan - Cilacap	-	8.19	13.41
	TOTAL	-	20.03	26.40
	Inter-Island/From Kotabaru			
15	Kotabaru - Paiton	-	-	13.91
	GRAND TOTAL	29.86	39.91	59.97

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Fleet Capital Intensity. The fleet composition and vessel requirements for Options 1 and 2 identified in Subsection 5.5.7, together with the new building costs of each vessel, provide a measure of the amount of capital that would be tied up in the fleets required (see Table 5.6-5). Preliminarily, it can be concluded that Option 2 would provide a less capital-intensive solution to transporting coal from Kalimantan to domestic destinations. This conclusion is based on using new building cost as contrasted to the market price of vessels, and no consideration is given to specific chartering and financing arrangements. As a result, Table 5.6-5 cannot be interpreted as an estimate of the investments required to implement either Options 1 or 2, but it does indicate that less capital would be tied up in the Option 2 fleet, favoring the transshipment option vis-a-vis the direct shipping option. Such a conclusion would have to be verified on the basis of specific cash flow calculations.

5.6.2 Potential Cost Savings of Option 2 over Option 1

The purpose of the following discussion is to focus specifically on a comparison between Options 1 and 2 as formulated in Subsection 5.5. The detailed data on potential cost savings from Option 2 were presented in the previous subsection (Tables 5.6-1 through 5.6-4). Table 5.6-6 summarizes this data with specific emphasis on cost savings. Table 5.6-7 shows cost savings associated with the establishment of transshipment terminals at Balikpapan and Kotabaru. In summary, the results are:

- Annual cost savings. Option 2 would save the transport company US$14.42 million in 1991 and US$18.54 million in 1994.

- Annual cost savings per tonne. Option 2 would save the transport company US$2.03 per tonne in 1991, declining to US$1.62 per tonne in 1994.

- Savings due to Balikpapan transshipment. Transshipment in Balikpapan would save the transport company US$15.12 million in 1991 and US$16.65 million in 1994. With a throughput of 4.23 MMTPY in 1991 increasing to 5.38 MMTPY in 1994, this translates into a savings of US$3.57 per tonne in 1991 and US$3.09 per tonne in 1994.

Table 5.6-5

CAPITAL TIED UP IN THE OPTION 1 AND 2 FLEETS[a]
(million US$)

Major Cost Elements	1988	1991	1994
Option 1			
10,000 DWT barges and tugs	92.0	147.2	156.4
10,000 DWT bulk carriers	10.0	30.0	80.0
20,000 DWT bulk carriers	-	15.5	31.0
TOTAL	102.0	192.7	267.4
Option 2			
10,000 DWT barges			
Tugs	65.0	26.0	32.5
Barges	27.0	18.9	32.4
10,000 DWT bulk carriers	10.0	30.0	10.0
40,000 DWT bulk carriers	-	69.0	138.0
TOTAL	102.0	143.9	212.9

(a) Capital tied up is based on the new building costs discussed in Subsection 5.4.1, and does not necessarily equate to the actual investment required

- Savings due to Kotabaru transshipment. Transshipment in Kotabaru would save the transport company US$2.73 million in 1994, which, at a throughput level of 4.56 MMTPY, translates into a savings of US$0.60 per tonne.

- Savings per route through Balikpapan. (See Table 5.6-7) Routing through Balikpapan would result in varying cost savings per route, ranging from a low of US$0.64 per tonne for coal from Tanjung Bungalun to Cilacap, to a high of US$5.85 per tonne for coal from Tenggarong to Cilacap.

The above results refer strictly to transport savings. To determine whether a transshipment terminal at either Balikpapan or at Kotabaru is economically viable, the cost of transshipment or a "terminal charge" must be taken into account. If the terminal charge per tonne is less than the projected savings per tonne, construction of a terminal is a viable proposition.

Table 5.6-6

SUMMARY OF OPTION 2 COST SAVINGS

Major Cost Elements	1988	1991	1994
Total annual transport cost (million US$)			
Option 1	29.86	54.33	78.51
Option 2	29.86	39.91	59.97
Savings from transshipment	-	14.42	18.54
Average annual transport cost (US$/tonne)			
Option 1	7.37	7.65	6.84
Option 2	7.37	5.62	5.22
Savings from transshipment	-	2.03	1.62
Composition of savings (million US$)			
Total annual cost for Option 1	-	54.33	78.51
Savings from transfer in Balikpapan	-	(15.12)	(16.65)
Savings from transfer in Kotabaru	-	-	(2.73)
Extra cost of using barge on Route 8A	-	0.70	0.84
Total annual cost for Option 2		39.91	59.97
Savings in Balikpapan			
Total savings from transfer (million US$)	-	15.12	16.65
Throughput (MMTPY)	-	4.23	5.38
Savings (US$/tonne)	-	3.57	3.09
Savings in Kotabaru			
Total savings from transfer (million US$)	-	-	2.73
Throughput (MMTPY)	-	-	4.56
Savings (US$/tonne)	-	-	0.60

Determining the transshipment charge for a terminal at either Balikpapan or Kotabaru requires a feasibility study to determine the cost associated with construction, operation, and maintenance. Such investigation is outside the scope of this current study. Therefore, the approach taken here is to analyze the results of the feasibility study for the Batam coal transshipment terminal and use these data as a benchmark for arriving at preliminary conclusions (Reference 5-1).

Analysis of the Batam Coal Centre. The proposal for the Batam coal terminal is similar, although not the same, as a shore-based terminal at

Table 5.6-7

SAVINGS FROM TRANSSHIPMENT AT BALIKPAPAN AND KOTABARU

Route Number	Route Name	Annual Transport Requirements (MMTPY)		Option 1		Option 2		Savings from Transshipment		
		1991	1994	Route Number	Round-Trip Transport Cost (US$/tonne)	Route Numbers	Round-Trip Transport Cost (US$/tonne)	Savings in Round-Trip Cost (US$/tonne)	Savings in Annual Cost (million US$/year) 1991	Savings in Annual Cost (million US$/year) 1994
	Balikpapan Routes									
1	Linding - Cigading	1.00	1.00	1	8.42	I, 12	5.95	2.47	2.47	2.47
2	Tanah Merah - Cigading	0.71	0.95	2	9.20	II, 12	5.75	3.45	2.45	3.28
3	Tanah Merah - Gresik/Madura	1.09	1.09	3	6.37	II, 13	4.28	2.09	2.27	2.27
4	Tanah Merah - Cilacap	0.40	-	5	11.45	II, 14	6.68	4.77	1.91	-
9	Tenggarong - Cilacap	1.03	1.37	9	13.12	IV, 14	7.27	5.85	6.02	8.01
11	Tanjung Bungalun - Cilacap	-	0.97	11	8.08	III, 14	7.44	0.64	-	0.62
	TOTAL	4.23	5.38						15.12	16.65
	Kotabaru Route									
7	Tanjung Batu - Paiton	1.82	4.56	7	4.31	V, 15	3.71	0.60	-	2.73
	GRAND TOTAL	6.05	9.94						15.12	19.38

either Balikpapan or Kotabaru, and can be used as a basis for formulating assumptions on transshipment charges. The design calls for throughput to reach a level of about 2 MMTPY in 1985, increasing to 5 MMTPY after 1990. Construction cost, interest during construction, and initial working capital is estimated at US$88.977 million (1983). To determine the charge system for the terminal, Reference 5-1 recommends that the Batam Coal Centre structure its handling charges on a cost recovery basis. More specifically, it is suggested the charges be based on full annual recovery of:

- Variable Cost
  - Power supply
  - Water supply
  - Consumables
- Fixed Cost
  - Wages and salaries
  - Repairs and maintenance
  - Medical expenses
  - Insurance
  - Township
  - Rent and rates
- Interest expense
- Tax expense
- Capital recovery
- Dividend payments

Furthermore, in the financial analysis for the Batam Coal Centre the following key assumptions were made:

- Initial capital cost financed with 70/30 debt equity ratio (70 percent funded by external lenders at commercial rates and 30 percent by shareholders)

- A capital recovery factor of 10 percent (10 yearly installments)

- Dividends payable to shareholders declared out of after-tax profits, structured to equate with a 10 percent return on equity

With the above financial structure and assumptions, Table 5.6-8 presents the results of the financial analysis for the Batam Coal Centre in terms of annual cost to be recovered and required terminal charge based on projected throughput. The following can be concluded about the Batam Coal Centre:

- Over a twenty year period the average throughput of the terminal is about 4 MMTPY, average annual cost is about US$15 million and the average handling charge is about US$3.75 per tonne.

- The financing assumptions of the Batam Coal Centre are such that a private company operating the terminal most likely would not consider the proposal viable because the 10 percent return on equity is not regarded as a normal commercially acceptable return on investment. Increasing this return and shortening the period of capital recovery would undoubtedly increase the average handling charge to US$5 or US$6 per tonne.

- From a government perspective, the proposal could be acceptable if and only if there would be other benefits to the national interest to offset the financially marginal attractiveness of the project. Reference 5-1 states in this regard:

  > The economic analysis of this project is predicated upon the assumption that investors' (shareholders') objective is not one of profit maximization. Due to the strategic and national importance of this project to Indonesia, the profit component has been kept to a minimum.

<u>Economic Viability of Shorebased Transshipment at Balikpapan and Kotabaru</u>. Based on the above discussion, the following assumptions were made regarding terminal charges for a transshipment terminal with a throughput of 5 MMTPY:

- A charge of US$3 to US$4 per tonne would be sufficient to recover initial capital, operations, and maintenance costs

- A charge of at least US$5 to US$6 per tonne is necessary to ensure a commercially acceptable rate of return on investment by private investors

Table 5.6-8

FINANCIAL ANALYSIS RESULTS FOR BATAM COAL CENTRE

Year	Projected Throughput (MMTPY)	Total Annual Cost to Be Recovered(1) (million US$)	Required Terminal Handling Charge(2) (US$/tonne)
1986	1.825	14.053	7.70
1987	3.145	20.537	6.53
1988	3.295	18.946	5.75
1989	3.495	19.257	5.51
1990	4.240	18.359	4.33
1991	4.240	18.147	4.28
1992	4.240	19.165	4.52
1993	4.240	19.250	4.54
1994	4.240	18.910	4.46
1995	4.240	17.257	4.07
1996	4.240	11.533	2.72
1997	4.240	11.575	2.73
1998	4.240	10.982	2.59
1999	4.240	11.109	2.62
2000	4.240	11.363	2.68
2001	4.240	11.872	2.80
2002	4.240	11.109	2.62
2003	4.240	11.194	2.64
2004	4.240	11.236	2.65
2005	4.240	11.236	2.65
TWENTY YEAR AVERAGE	3.98	14.85	3.73

Source: Ref. 5-1

(1) Terminal is operated on the principal that the charging system be based on full annual recovery of variable costs, fixed costs, interest expense, tax expense, capital recovery (recovery factor 10 percent), and dividend payment (paid out of after-tax profits and equating to a 10 percent return on equity). Construction cost, interest during construction, and initial working capital is estimated at US$88.977 million (1983) and funded with a 70/30 debt equity ratio.

(2) Terminal handling charge is determined by dividing total annual cost to be received by the projected annual throughput.

With these assumptions on terminal charges, the transport savings (mentioned earlier in this section) can now be put in perspective.

It is unlikely that a transshipment terminal at Kotabaru for domestic coal transport would be a viable operation. Potential cost savings are far too small as compared to the cost of establishing the terminal. Despite the projected high throughput level of 4.56 MMTPY in 1994, savings of US$0.60 per tonne would not begin to cover the minimum charge of US$3 to US$4 per tonne.

The situation in Balikpapan is different from Kotabaru. A government company delivering coal from Kalimantan to customers on Java could potentially benefit (or at least break even) by establishing a terminal at Balikpapan, because savings could be greater than the minimum charge of US$3 to US$4 per tonne needed to recover the cost of operating the terminal.

If other benefits to the country could be identified from developing the terminal (discussed in the next subsection), it is particularly attractive to the government to further investigate such a project. This conclusion is drastically altered if instead of a government company, a private company would be responsible for transport and transshipment of Kalimantan coal to customers on Java. The potential cost savings of transshipping at Balikpapan, estimated at US$3.57 per tonne in 1991 and decreasing to US$3.09 per tonne in 1994, are not sufficient to make a terminal at Balikpapan an attractive investment.

In the above discussion it was assumed that transport on all routes and transshipment would be the sole responsibility of one entity. In addition, it was concluded that only for a government-owned company could a terminal at Balikpapan possibly make sense. This one company would collect the coal, transport it to the transshipment terminal, and ship it from the terminal to destinations in Java. Only under such arrangements would a terminal at Balikpapan be a viable proposition that is beneficial to the country.

Other arrangements could significantly alter this situation. For example, if transshipment at Balikpapan were handled by a separate government company responsible only for the terminal, charging, say, US$3 for every tonne transshipped, and if another government transport company arranged transport on a route-by-route basis, benefits of transshipment would be more difficult to obtain. In such a case, the consumer would have to pay the cost of coastal barging to the terminal, a charge of US$3 per tonne for transshipment, and the cost of inter-island shipping from the terminal to their own unloading port. Review of Table 5.6-7 indicates that under such arrangements direct shipping on Routes 1, 3, and 11 would be preferred to transshipment because it would cost less to the consumer to ship directly than to use the transshipment terminal.

If separate companies were used, throughput at Balikpapan would thus fall from 4.23 MMTPY to 2.14 MMTPY in 1991, and from 5.38 MMTPY to 2.32 MMTPY in 1994. This would seriously jeopardize the economic viability of the terminal operation, because at reduced throughputs the cost per tonne for transshipment would have to be increased to recover minimum cost. This, in turn, may jeopardize potential cost savings to consumers that would prefer transshipment. The end result would be no terminal at Balikpapan, and a direct shipping system that would be more expensive to the country as a whole.

5.6.3 Additional Benefits from Transshipment

Subsection 5.6.2 dealt only with potential cost savings associated with transshipment in the specific context of comparing Options 1 and 2 as previously formulated. However, additional benefits could be obtained from establishing a transshipment terminal at Balikpapan or Kotabaru that is owned and operated by the government. In this case, the institutional arrangements for organizing transport and transshipment of coal would be as important as the physical transshipment facilities.

Additional study is required to ascertain the importance of the following benefits.

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Central Marketing and Distribution Point. Supported by a transshipment center, the transport company could actively engage in promoting and marketing Kalimantan coal. The company could buy FOB from the various producers, store coal at their own facilities if needed, and subsequently sell and transport coal to domestic consumers. This would relieve individual producers from having to market and sell their coal domestically. Emphasis on marketing and aggressive promotion of domestically produced coal is considered highly desirable in the current situation, where there is no proven "track record" that domestic coal can be produced and transported at internationally competitive prices. As mentioned in Subsection 5.2, the emergence of a major domestic market for coal is a key problem now that it has been proven that significant coal development in Kalimantan can take place.

Opportunity to Engage in Exports/Imports. At times when Kalimantan production exceeds domestic consumption, the company that operates the transshipment and storage facilities at Balikpapan could engage in export of coal. Coal also could be imported in large vessels if domestic production should be insufficient to meet domestic market needs. Facilities at Balikpapan or Kotabaru would allow for loading and unloading of large vessels, a necessary requirement for entering the export/import trade and establishing the country as a coal exporter. In addition, collection of coal from various areas would result in a significant volume of coal trade. It would be difficult to enter the coal trade without significant volume (other than occasional spot sales), because the big producers (Australia, China, U.S., and others) merely squeeze out the smaller ones. Only with significant throughput and volume would it be possible to achieve the economies of scale necessary to attain a competitive position in the international market.

Opportunity to Provide Blending and Coal Preparation. Specific and constant coal quality is a key requirement of many coal customers. In particular, stringent quality control is desirable for the use of coal in cement plants to prevent problems experienced due to irregularities in the coal, uneven sized coal, dust, spontaneous combustion, and

excessively large variations in heating value and moisture content. A central terminal could provide the necessary facilities for meeting a range of quality requirements. Screening, crushing, and blending could be carried out to match individual customer specifications.

The Batangas terminal in the Philippines provides a good example of the type of operation envisioned. At Batangas, coal from various areas (including imports) is processed for subsequent distribution to cement plants in the Philippines (References 5-10 and 5-11). Central coal preparation facilities would eliminate the need for even the simplest preparation facilities at the various coal producing areas.

Service to Private Coal Producers. Currently, four private coal companies operate concessions in the Mahakam area. Their production is largely exported to Japan, Taiwan, and Korea. At present, this coal is transported using mini-bulk carriers of around 6,500 DWT. A central terminal at Balikpapan would allow this coal to be transported in larger vessels, increasing the competitive advantage of the product. This will be especially important when the new bridge across the Mahakam River precludes the use of mini-bulk carriers and only barges can be used for transport.

Security of Supply. Collection and storage of coal at a central point in Kalimantan could prevent supply interruption to individual customers and act as a buffer in case coal production in individual areas was interrupted.

Regional Development. Finally, a major transshipment terminal with coal storage, blending, and preparation facilities could be a significant factor in the development of Kalimantan. Such facilities, combined with the operation of a coastal barging system and an inter-island shipping system, would provide significant employment opportunities and contribute to regional income. In addition, such facilities could be the catalyst to the development of other coal-related industries in the Balikpapan area, further stimulating regional development.

5.7 CONCLUSIONS AND RECOMMENDATIONS

5.7 CONCLUSIONS AND RECOMMENDATIONS

These conclusions and recommendations are presented in relation to the major issues addressed in this section. It should be specifically noted that only the domestic sea transport of Kalimantan coal was considered in this section. No consideration was given to sea transport requirements for exporting Kalimantan coal.

5.7.1 Competitive Advantage of Kalimantan Coal (Subsection 5.2)

- For the sake of a comparison, it was assumed that Australian coal could be shipped to deep draft harbors on Java (Cigading, Paiton, and Cilacap) for approximately US$8 per tonne.

- It should be possible to transport Kalimantan coal to Java and Sulawesi for less than US$8 per tonne.

- At US$8 per tonne for transport, the competitive advantage of Kalimantan coal is relatively small.

- The utmost effort should be devoted to developing a sea transport system that will guarantee the lowest possible transport cost to retain and enhance the development potential of Kalimantan coal.

5.7.2 Phased System Development (Subsection 5.3)

- Development of the transport system must coincide with development of the market for Kalimantan coal. Market development can be characterized by the number and size of sales contracts between producers and consumers. Until the market is established, uncertainty regarding the market will exist.

- The following phased development of the transport system should be considered:

  - Phase I: startup phase (present-1988)

  - Phase II: transient phase (1988-1991)

  - Phase III: steady state phase (1991-on)

- Investments in the transport system should reflect basic market uncertainties. Thus, during Phase I, the emphasis should be on initiating coal transport at the lowest possible cost and with minimal capital investments, until larger capital outlays can be justified by existing sales contracts (Phases II and III).

5.7.3 Loading and Unloading Facilities (Subsection 5.4.2)

- Loading and unloading costs are a key factor in the development of a cost-effective domestic transport system, regardless of who pays for them. With small distances and relatively low throughputs, loading and unloading costs are as large or larger an issue as sea transport cost.

- Preliminarily, it can be concluded that projected throughput at Type I and II ports (see Table 5.7-1) do not justify shore-based facilities for bulk carriers. These ports should be serviced by geared vessels.

- A study should be undertaken to verify the above conclusion and the use of self-unloading vessels should be examined. The study should be limited in scope to bulk carriers up to 40,000 DWT and the throughput levels indicated in Table 5.7-1.

Table 5.7-1

PROJECTED THROUGHPUT LEVELS FOR UNLOADING PORTS

Port Type	Annual Throughput (TPY)	Port Names
I	350,000 - 450,000	Bitung (Menado) Biringkassi (Tonasa) Madura Cement Harbor
II	650,000 - 850,000	Gresik Semarang
III	1,500,000 - 2,000,000	Cigading
IV	2,000,000 - 6,000,000	Cilacap Paiton

5.7.4 Draft Restrictions (Subsection 5.4.3)

c Draft restrictions at these potential loading ports in Kalimantan are a major impediment to a low-cost sea transport system:

- Tanjung Batu on Teluk Klumpang
- Linding on the Apar Kecil River
- Tanah Merah on the Kuaro River
- Tenggarong on the Mahakam River
- Lebanan on the Segah River

o The Sangatta area is the only potential coal producing area with relatively easy access to deep water along the Kalimantan coast, near Tanjung Bungalun.

o Draft restrictions at coal unloading ports on Java and Sulawesi are generally less restricting, and sufficiently large vessels (20,000 DWT and up) should be able to enter the ports of:

- Cigading in west Java
- Cilacap in south-central Java
- Paiton in east Java
- Gresik in east Java
- New cement harbor on Madura
- Biringkasi on Sulawesi
- Bitung on Sulawesi

o Semarang in north-central Java is the only unloading port with serious draft restrictions.

o Exclusively shallow draft wide-beam vessels should be used for domestic coal transport. For Indonesian draft conditions, such vessels appear to present the cheapest alternative to dredging.

o A prefeasibility study also should be conducted for all potential loading ports to determine the approximate cost of initial and annual dredging (as a function of vessel size). The study should focus on a comparison of dredging cost and potential savings in transport

cost per tonne for domestic routes between 400 and 1,100 nautical miles, in vessels up to 40,000 DWT, and with throughput levels of several million tonnes per year.

- Current port facilities at Semarang should not be used for coal unloading. Instead, a special harbor facility should be developed near Semarang. Even at such a facility, current indications are that the maximum draft would be 7 meters.

5.7.5 Vessel Selection (Subsection 5.4.4)

Note: The following conclusions are a direct result of transport cost assumptions in Subsection 5.4.1 and apply to the relatively limited throughput levels of the proposed domestic transport system.

- On inter-island routes (400 - 1,100 miles), bulk carriers are preferred over barges. On short coastal routes (25 - 150 miles), barges are preferred.

- If barges are selected for inter-island transport because of draft restrictions, the largest possible size is preferred regardless of throughput or annual transport requirements per route.

- The size of barges for coastal transport depends on annual throughput per route. At low levels of 0.5 MMTPY per route, smaller barges are preferred (i.e., 5,000 DWT).

- "Handy-sized" bulk carriers of 20,000 to 30,000 DWT are preferred for inter-island transport at relatively low throughput levels (0.5 MMTPY). When throughput increases, the preference is for larger vessels of 40,000 DWT. Beyond 40,000 DWT, savings in annual transport cost per tonne would be minor and a 40,000 DWT bulk carrier could be considered the maximum size vessel to be used in domestic coal transport. Mini-bulk carriers (less than 10,000 DWT) would be attractive for short distances at low throughput levels.

5.7.6 Alternative Transport Systems (Subsection 5.5)

- Domestic transport of coal could be done either with a direct shipping system (Option 1), or with transshipment of coal in Kalimantan to large bulk carriers (Option 2).

- Balikpapan and Kotabaru provide suitable locations for shore-based transshipment terminals. Transshipment could also be accomplished with floating terminals located near coal producing areas. Only coal from the Pasir, Samarangau, Mahakam, and Sangatta would be transshipped at Balikpapan, while Kotabaru would serve as a transshipment point to the Senakin area only.

- Both options are assumed to be the same during Phase I because development of the domestic market and transshipment facilities would require time.

- Both options would have simple systems. During Phase I there would be three loading ports and seven unloading ports. During Phases II and III there would be six loading ports and eight unloading ports. Under Option 1 there would be seven routes in Phase I and nine routes during Phases II and III. During Phases II and III under Option 2 there would be seven inter-island routes and a maximum of five coastal routes.

- At the end of Phase I, the transport system would carry 4.05 MMTPY. This would increase to 7.10 MMTPY by the end of Phase II, and 11.48 MMTPY by the end of Phase III. In terms of annual transport requirements expressed in tonne-miles, transport between Kalimantan and south-central Java is most significant, and in 1994 would account for 36 percent of all transport requirements in the system.

- Without dredging, a direct shipping system would consist mostly of 10,0000 DWT barges, in addition to small bulk carriers. Fleet composition would be as shown in Table 5.7-2 at the end of each phase.

- A transshipment system would consist of 10,000 DWT barges and larger bulk carriers. Terminal operation in Balikpapan would start during Phase II, and in Kotabaru during Phase III. Fleet composition at the end of each phase would be as shown in Table 5.7-3.

- Coastal barge operation would result in a more efficient use of tugs and barges, reducing the required number of tugs.

Table 5.7-2

FLEET COMPOSITION: DIRECT SHIPPING
(Option 1)

Vessel Type	1988	1991	1994
10,000 DWT barge and tug combinations	10	16	17
10,000 DWT bulk carriers	1	3	8
20,000 DWT bulk carriers	-	1	2

Table 5.7-3

FLEET COMPOSITION: TRANSSHIPMENT
(Option 2)

Vessel Type	1988	1991	1994
10,000 DWT barges			
tugs	10	4	5
barges	10	7	12
10,000 DWT bulk carriers	1	3	1
40,000 DWT bulk carriers	-	3	6

5.7.7 Cost of Direct Shipping (Subsection 5.6.1)

- The round-trip transport cost in a direct shipping system in which dredging was not considered was estimated as follows:

  - Sulawesi: US$4/tonne
  - East Java: US$4.50 to US$6/tonne
  - North-central Java (Semarang): US$7.50/tonne
  - West Java: US$8.50 to US$9.50/tonne
  - South-central Java: US$8 to US&13.00/tonne

  By and large, the higher numbers reflect direct shipping in 10,000 DWT barges.

- Based on the above estimates and using US$8 per tonne as the cut-off point, barge transport to west Java and south-central Java is a potential deterrent to the use of Kalimantan coal in those areas.

- Coal for west Java and south central Java should only be carried in bulk carriers so as to achieve the lowest possible transport cost. West Java will be a major consumer during Phase I, with 1.67 MMTPY destined for Cigading in 1988. During this phase only three loading ports are projected to be in operation: Linding, Tanah Merah, and Tanjung Batu. As soon as possible a study should be undertaken to determine how the consumers in Java could be supplied with coal from Kalimantan during Phase I in view of quality and other requirements, and in view of having to achieve minimum transport cost by using bulk carriers.

5.7.8 Transshipment (Subsections 5.6.1 and 5.6.2)

- Exclusive of the cost of transshipment itself, transshipment to large vessels for domestic transport reduces round-trip transport cost per tonne.

- Transshipment into 40,000 DWT bulk carriers, when compared to direct shipping in 10,000 DWT barges, results in transport cost reductions averaging 37 to 45 percent. Compared to direct shipping in 10,000 DWT and 20,000 DWT bulk carriers, these reductions are, on average, 13 to 14 percent and 7 to 8 percent, respectively

- Exclusive of the cost of transshipment itself, the total annual cost for all system transport requirements can be reduced by approximately US$15 to US$20 million during Phases II and III with transshipment. This reduction reflects the reduction in cost to the country as a whole.

5.7.9 Economic Feasibility of Onshore Transshipment Terminals (Subsection 5.6.2)

- Annual transport cost savings resulting from transshipment (exclusive of transshipment cost) are estimated at approximately US$15 million per year for Balikpapan and US$2.7 million for Kotabaru. Annual throughput at both would be approximately 5 MMTPY.

- Assuming a minimum transshipment charge of US$3 to US$4 per tonne, a terminal at Balikpapan could be attractive from a national perspective. Annual savings would at

least be sufficient to recover the cost of constructing, operating, and maintaining the terminal. Thus, a government owned company charged with the responsibility to transport Kalimantan coal to customers on Java may select Option 2 if it can be shown that by doing so, other benefits, important to the country as a whole, are also captured.

- Assuming a transshipment charge of US$5 to US$6 per tonne, i.e., a charge needed to ensure a commercially acceptable rate of return on investment by a private company, a terminal at Balikpapan will most likely not be economically attractive. Thus, a private company charged with the responsibility to transport Kalimantan coal to customers on Java will prefer a direct shipping system (Option 1) over transshipment (Option 2), even if such system would be more expensive to the country as a whole.

- Establishing a terminal at Kotabaru for domestic coal transport would not be an attractive solution because the transshipment cost would far outweigh the potential savings, regardless of who owns the terminal.

5.7.10 Establishing a Transshipment Terminal at Balikpapan (Subsections 5.6.2 and 5.6.3)

- To capture the potential national economic benefits of a transshipment terminal at Balikpapan, one government company must not only be responsible for transport, but also for establishing and operating the terminal. The distributive nature of potential benefits (i.e., annual cost savings of varying quantities on different routes) would make it much more difficult to realize these benefits under another institutional arrangement.

- While national economic benefits associated with a terminal at Balikpapan may be marginal, additional benefits exist that could be significant. The government company operating the terminal could:

  - Function as a central marketing and distribution agent, coordinating and promoting the marketing and use of Kalimantan coal for domestic use

  - Engage in imports and/or exports

  - Engage in blending and coal preparation

  - Provide a service to private coal companies

- Secure a supply of Kalimantan coal for domestic consumers

- Contribute to regional development of Kalimantan

o Establishing a terminal at Balikpapan could be a deciding factor in development of Kalimantan coal resources, especially in view of projected low production levels in individual areas. Future production levels not only influence decisions by contractors to proceed with the development of concessions, but also their decisions on the amount of capital investment allocated to harbor and transport facilities to ship coal to domestic destinations. The competitive advantage of Kalimantan coal is lessened if such facilities would not provide the lowest cost for sea transport.

5.7.11 Feasibility Study for Kalimantan Transshipment Terminal

Based on the above conclusions it is recommended that a preliminary feasibility study be undertaken as soon as possible to further investigate the technical and economic feasibility of establishing a transshipment terminal in Kalimantan. The scope of this study should include these major tasks:

o Verification of projected coal production levels at all coal producing areas in Kalimantan, including those private contractors operating for PN Tambang Batubara and other private companies operating in Kalimantan.

o Verification and market analysis of the potential uses of Kalimantan coal, including domestic and export markets.

o Identification of possible sites for a transshipment terminal, including, but not limited to, the area around Balikpapan.

o Formulation of a shipping network (routes) and a system for transport of coal in the absence of a transshipment terminal in Kalimantan.

o Formulation of a shipping network and system for the transshipment of Kalimantan coal to domestic and foreign destinations. Consideration should be given to both onshore and offshore transshipment facilities.

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- Detailed formulation of the objectives for and requirements of a transshipment facility in Kalimantan, with due consideration to aspects such as storage and blending facilities, coal preparation, ability to service export/import trade vessels, etc.

- Preliminary design and order of magnitude cost estimates for construction, operation, and management of a transshipment terminal in Kalimantan.

- Institutional/implementation analysis to identify the appropriate arrangements and procedures for operating both a direct shipping and transshipment system, for setting transport tariffs, and other aspects influencing final transport costs (such as port and other charges).

- Financial and economic analysis of costs and benefits to the government, including, but not limited to, national economic benefits.

- Evaluation and selection of the most appropriate transport system for Kalimantan coal in view of all relevant considerations, including results of the financial and economic analysis and any other factors that will influence the development and use of Kalimantan coal.

- Development of an implementation plan for engineering, design, and construction of a transshipment terminal, including scopes of work, cost estimates, and schedules.

5.8 REFERENCES

5.8 REFERENCES

5-1 Batam Island Coal Centre, Feasibility Study, Team Batam Coal Centre and BHP Engineering, Jakarta, May 1983.

5-2 East Java Steam Power Plant, Feasibility Study, Volume 5, Site Selection Report, Electrowatt Engineering Services Ltd. Zurich in cooperation with Nippon Koei Co., Ltd., Tokyo and P.T. Amythas and Associates, Jakarta, July 1982.

5-3 The Developing Countries and International Shipping, World Bank Staff Working Paper No. 502, November 1981, Washington, D.C.

5-4 Indonesian Shipping Directory 1982 - 1983, Marindo Press, Jakarta.

5-5 Netherlands Maritime Institute, Integrated Sea Transport Study, Part IV, Shipping and Ports, Directorate General of Sea Communications, August 1982.

5-6 Penelitian Pembuatan Desain Sistim Perhubungan Nasional, Tahap 1, Volume II, P.T. Indulexco, Departemen Perhubungan, Juli 1983.

5-7 Williamson, G.A., The Principal Dimensions and Operating Draughts of Bulk Carriers, 1975.

5-8 Standard Ship Designs, Volume 1, Dry Cargo Vessels, 9,500 - 250,000 DWT, Fairplay International Records and Statistics, 1980.

5-9 Standard Ship Designs, Volume 2, Dry Cargo Vessels, 455 - 9,500 DWT, Fairplay International Records and Statistics, 1980.

5-10 Slater R.A., Coal Terminal Design - What Price Flexibility?, International Bulk Journal, August 1983.

5-11 Hargreaves, D., Philippines - National Coal Authority Outlines its Programme, International Bulk Journal, August 1983.

Section 6

LAND TRANSPORT

This section contains the following subsections:

- o 6.1 Introduction
- o 6.2 Land Transport Alternatives
- o 6.3 Land Transport of Kalimantan Coal
- o 6.4 Land Transport on Java and Sulawesi
- o 6.5 Conclusions and Recommendations
- o 6.6 References

6.1 INTRODUCTION

6.1 INTRODUCTION

This section analyzes land transport of Kalimantan coal prior to and after sea transport. More specifically this section:

- Provides a general review of land transport modes
- Identifies land transport requirements for the various coal producing areas on Kalimantan discussed in Section 3
- Identifies land transport requirements on Java and Sulawesi based on information provided in Section 4
- Evaluates land transport options for Kalimantan, Java, and Sulawesi
- Assesses equipment requirements (trucks and other rolling stock) for land transport
- Identifies key issues and problems in land transport of coal that should be pursued in follow-on feasibility studies

The coal chain that begins with Kalimantan producers and ends with consumers on Java and Sulawesi requires two land transport steps:

- Transport on Kalimantan from new mines to coal loading ports
- Transport on Java and Sulawesi from coal unloading ports to cement and power plant locations

Land transport of coal to future power plant locations on Kalimantan (i.e., Banjarmasin, Balikpapan, and Loakulu) is not discussed because quantities involved are small; therefore the major Kalimantan land transport issue is transport to the coast for subsequent sea transport. In addition, the power plant locations on Kalimantan have only been tentatively identified. Further study by PLN is required. Such studies will have to analyze land transport of coal vis-a-vis minemouth power generation and transport of electricity. If the latter proves to be less costly, no land transport of coal to power plants on Kalimantan would be involved at all.

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The choice of how to transport coal over land would generally be related to the plans for all other stages in the coal transport chain. For example, one could opt for a more expensive land transport system if savings in subsequent sea transport more than make up the difference in cost by using larger vessels. Although generally true, this observation has limited value in the case of Kalimantan coal transport. As discussed in Section 3, and with the possible exception of the Samarangau area, the limited production levels and vessel loading points for most future mine sites leads to a situation where sea and land transport options are few and land transport is therefore essentially independent of sea transport. As a result, the key issue in Kalimantan is to select the least costly land transport option regardless of how sea transport is accomplished. A key parameter to ensure smooth and efficient operation of the overall coal transport chain is the amount of coal storage at the loading point. Similarly, for consumer's facilities located on or very near the coast and the unloading point, the choice of how to transport coal from the unloading point to the facilities is independent of other elements of the transport chain.

For consumers located inland on Java, there is generally more interdependency between different elements of the coal transport chain. In particular, if there is a choice in the location of the unloading point for a customer facility, land transport options have to be considered. This is illustrated in Figure 6.1-1. If an unloading port is selected close to the customer's facility, truck transport may be the preferred mode; if an unloading port is farther away from the customer's facility but has an existing railroad, transport by rail may be preferred.

Land transport in this section will generally be discussed independent of other elements of the coal chain for reasons given above. In cases where there are possible interdependencies, they will be noted on a case-by-case basis, such as the case of land transport on Java. Subsection 6.2 discusses in general terms the land transport alternatives that are most

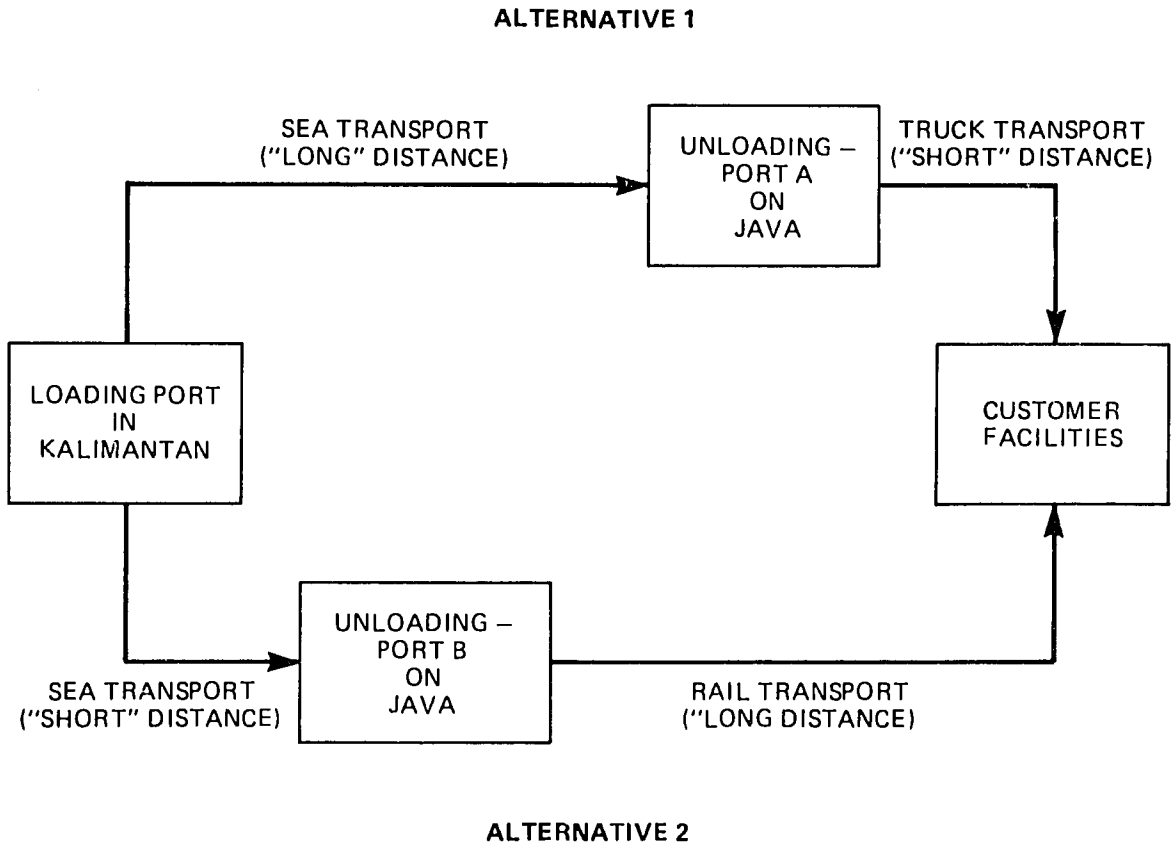

Figure 6.1-1 CONCEPTUAL ILLUSTRATION OF INTERDEPENDENCIES IN THE COAL TRANSPCRT CHAIN

suitable for Kalimantan coal transport. Subsections 6.3 and 6.4 focus on the transport situation on Kalimantan, and on Java and Sulawesi, respectively. Finally, Subsection 6.5 summarizes conclusions and recommendations regarding land transport.

6.2 LAND TRANSPORT ALTERNATIVES

6.2 LAND TRANSPORT ALTERNATIVES

Generally, land transport of coal can be achieved by:

- Truck
- Conveyor
- Railroad
- Slurry pipeline
- Aerial tramway

Each of these transport modes has advantages and disadvantages, and conditions under which it is most suitable (see References 6-1 and 6-2). Trucks and conveyors are generally used for short distances and relatively modest loads (up to several million tonnes per year); rail and slurry pipelines are frequently the competing modes for large tonnage, long-distance transport; aerial tramways are used in special circumstances, with otherwise impassable terrain (very steep grades, ravines, etc.). Of all the transport modes, transport of coal by rail and slurry pipeline is frequently the most complex, requiring large capital outlays and extensive planning efforts.

6.2.1 Trucks and Conveyors

Trucks and conveyors are generally selected in cases where transport distances are less than 40 to 50 km and throughputs are on the order of 1 to 10 million tonnes per year. Trucks and conveyors are used for in-mine transport, transport from mine to loading port, and transport from unloading port to a customer's facility. Trucks for in-mine transport can range from small (10 to 15 tonnes) to very large (off-highway, carrying 50 to 150 tonnes). Similarly, conveyor systems can be designed to accommodate a broad range of capacities and are either moveable or fixed systems.

The choice between trucks or conveyors depends on a large number of parameters and every situation is to a large extent unique. The most important parameters are:

- Terrain and routing
- Soil stability and type of road
- Weather conditions and type of road
- Power costs
- Fuel costs
- Labor costs
- Availability of trained personnel for conveyor maintenance and repair
- Availability of conveyor components and replacement parts
- Reliability
- Labor force stability
- Cost of infrastructure (housing for laborers, etc.)
- Inflation
- Project life
- Phased development and future expansion
- Availability of materials for road construction
- Financing arrangements

The following selective statements illustrate how some of the above parameters enter into the evaluation of site-specific alternatives:

- If the terrain is such that numerous rivers have to be crossed and bridges are required, conveyors have a competitive edge because lighter structures can be used.
- If an area is prone to frequent and heavy rains causing damage to roads, conveyors may prove to be more reliable.
- Trucks can be phased into the development of a particular area. Conveyors generally are designed and constructed for the ultimate output of a particular area.

- High fuel and high labor costs generally favor conveyors. However, the availability of power or the cost of providing power must be considered with conveyors. Conveyors can generate power if the net drop in elevation between two points is at least 2.5 percent of the total conveyor length.

- If housing is expensive, conveyors have a competitive edge because fewer personnel are required.

- Financial considerations play an important role. To preserve capital at the outset of a project, trucks can be leased for, say, the first five years until a positive cash flow is developed, even if trucking is a more "expensive" system than belt conveyors. There can be a tax advantage in leasing trucks, which is lost by using belt conveyors. In addition, if trucks can be built domestically but conveyor systems have to be imported, foreign exchange is saved by using trucks.

As can be seen, each comparison between trucks and conveyors is unique. However, with this caveat in mind, comparison of existing systems shows that conveyor systems are generally most economic in the range of 4 to 10 MMTPY. Trucking is generally more economic in the 1 to 3 MMTPY. Above 3 MMTPY, trucking generally becomes very expensive.

6.2.2 Rail and Slurry Pipeline

Railroads. Rail transport of coal is common in south and west Sumatra, where coal has been transported by rail to coastal loading ports since the early 1900s. So far, rail has been the most frequently used transport mode for coal. As a general rule, rail can be competitive with trucking or conveyors at throughputs as low as 2 MMTPY and distances of at least 50 km, but the point at which rail becomes competitive is highly dependent on site-specific conditions. For example, factors such as road congestion and existing rights-of-way systems for rail (as exist in Sumatra and Java) can make rail competitive at low throughputs. However, the general rule should roughly apply to other areas where there are currently no rail systems, with rail becoming the prime choice with larger throughputs (5 to 10 MMTPY).

The most important innovation in rail transport of coal has been the introduction of unit trains. Using the unit train is a management technique that allows dedication of equipment and efficient planning through a long-term contractual commitment of the producer and consumer. A unit train consists of a dedicated set of equipment loaded at the point of origin, unloaded at only one destination, and shuttling back and forth on a predetermined schedule. The key to the success of unit trains (and of rail transport) lies in the following:

- Integration of the entire material handling system
- Floodloading while the train is moving very slowly
- Continuous 24-hour movement of trains
- Rapid unloading by rotary dumping of cars, or, less frequently, through bottom doors while the cars move over a trestle or long pit

At present, using a unit train is required to keep the cost of rail transport down to a minimum and retain a competitive advantage over other modes.

Slurry Systems. Slurry transport is a well-developed technology for large tonnage, long-distance transport. Slurry systems have been used worldwide for transporting a wide range of minerals including iron concentrate, limestone, copper concentrate, phosphate, and coal. More than 25 slurry systems have been installed over terrain ranging from flat marshland to rough mountains, with throughputs up to 12 MMTPY.

The longest slurry pipeline system installed to date is the Black Mesa Coal pipeline in the southwestern U.S., which transports 5 MMTPY over a distance of 455 km. This system has been operating since 1970 and is very reliable. Because of the success of the system, a number of large coal systems are now being planned throughout the world with throughputs ranging up to 30 MMTPY and transport distances up to 2,500 km.

Figure 6.2-1 shows a typical coal slurry pipeline system. It has three main components:

- Slurry preparation facilities
- Pipeline and pump stations
- Dewatering facilities

Slurry Preparation. The slurry preparation facilities crush the coal to the fine size consistency (practically all minus 1 mm) required for long-distance transport. This is usually accomplished by a two-stage crushing process with water added during the second stage. The result is a coal-water mixture of roughly 50 percent coal and 50 percent water.

Pipeline and Pump Stations. An all-welded steel pipeline without lining is used for long-distance pipe systems. The pump stations, containing multiple high-pressure positive displacement pumps, are located about 75 to 150 km apart. Once the pipe diameter and wall thickness have been selected, the maximum rate of coal movement or throughput of the system is effectively fixed. Because of minimum velocity and slurry concentration considerations, a slurry pipeline system has limited turndown -- that is, it cannot operate on a continuous basis at much less than about 70 percent of the maximum throughput. Lower throughput rates are possible, but only by using a batch operation (pumping slugs of slurry followed by slugs of water on an intermittent basis). Most slurry systems require some batching, particularly during the early years of operations, when mine facilities have not reached full capacity. However, an extended batching period is undesirable because of the cost of water and pumping.

Dewatering. Dewatering facilities make up the final component (see Figure 6.2-2). Typically, a two-stage system using some form of mechanical separation by centrifuges or filters is followed by thermal drying. The final product normally has a surface moisture of about 9 to 10 percent, which allows the dewatered pipeline coal to be moved by conventional bulk handling techniques without dust generation. However, if desired, the slurry at the terminal could be loaded into a slurry

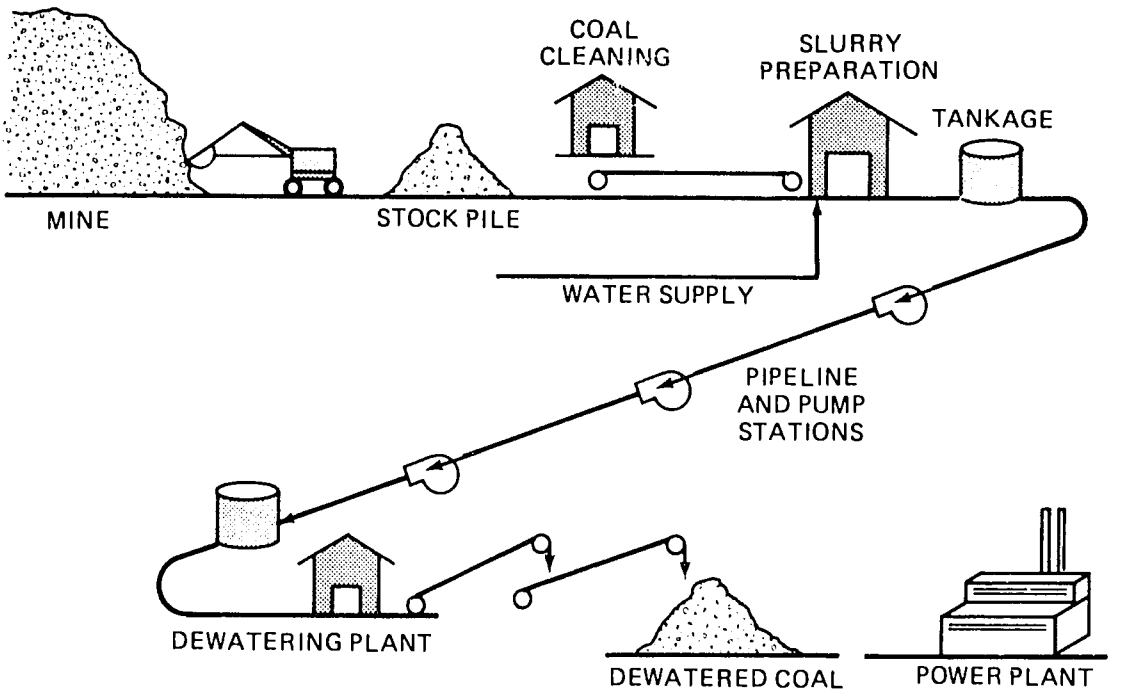

Figure 6.2-1 COAL SLURRY PIPELINE SYSTEM

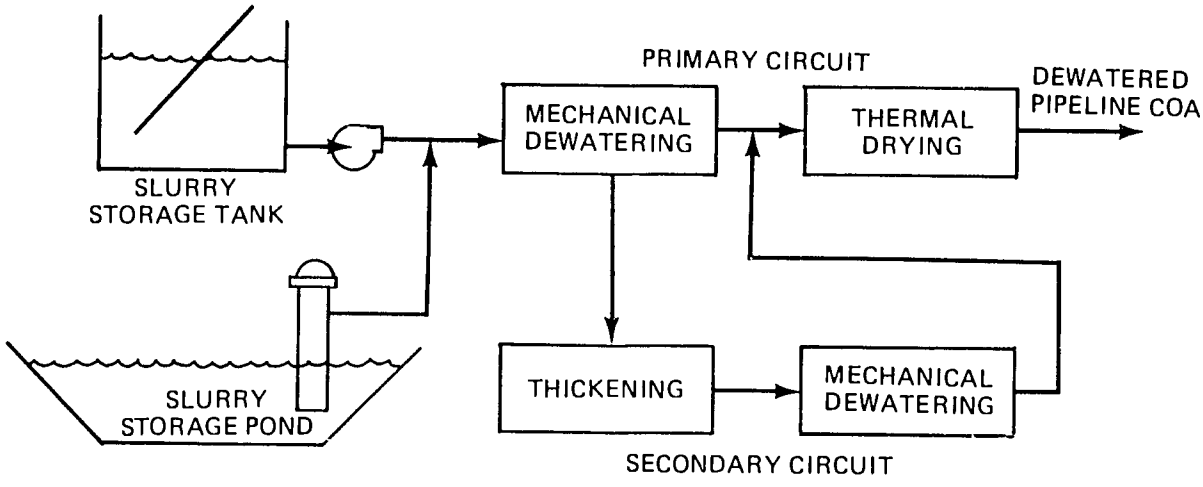

Figure 6.2-2 COAL SLURRY DEWATERING AND HANDLING

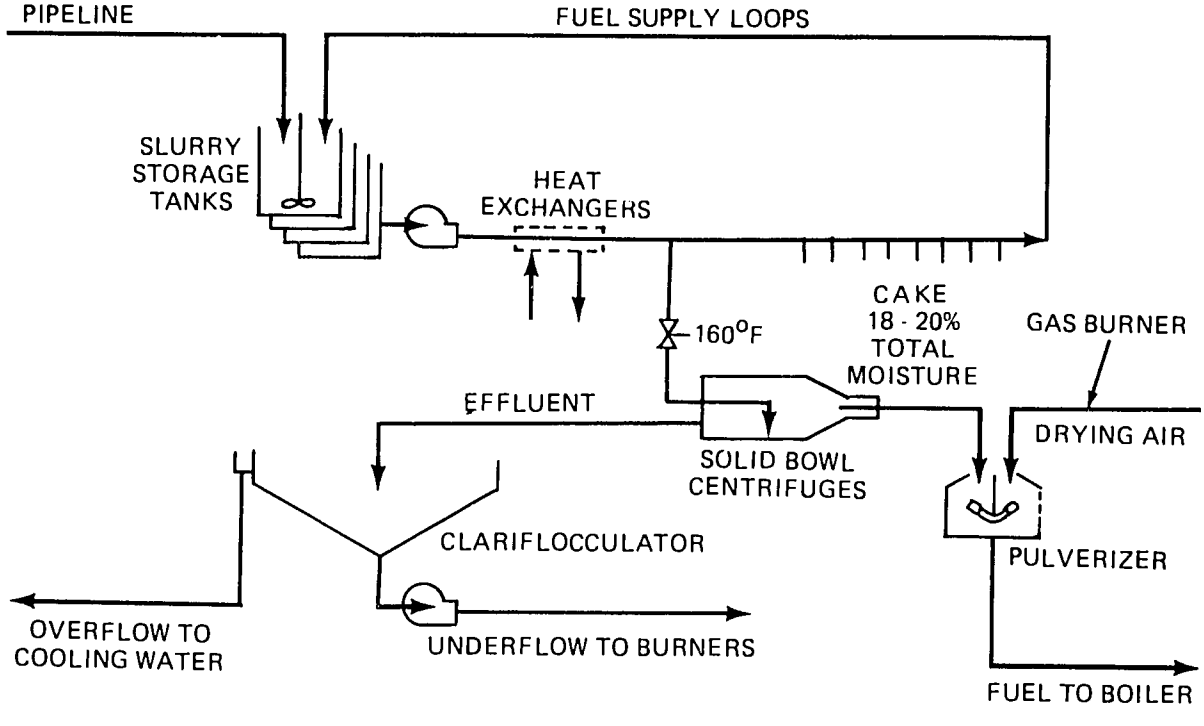

Figure 6.2-3 AN INTEGRATED COAL SLURRY – POWER PLANT FUEL SYSTEM

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tanker for further shipment, as received from the pipeline or concentrated after some water removal.

Coal transported by slurry pipeline to a power plant may not require the dewatering system to be separated from the power generation facilities (see Figure 6.2-3). Such a procedure is used at the Mohave Power Plant for the Black Mesa pipeline system. Like all pipeline systems, slurry pipelines demonstrate economies of scale and become more competitive as the pipe diameter and throughput increase. Likewise, the unit transport charge measured on a cents-per-ton kilometer basis, decreases as the distance increases since the preparation and dewatering charges are then spread over a larger distance. This explains the large current interest in high-throughput long-distance systems.

Slurry Systems in Indonesia. Compared to trucks, conveyors, and rail, slurry pipeline systems are clearly preferred only if throughputs are large and distances long (at least 5 MMTPY and 500 km, and frequently greater). These conditions virtually rule out this mode in most cases in Indonesia, particularly where special circumstances occur, such as an existing rail system as Java.

A circumstance that could call for a slurry system is the transport of coal to a large power plant, designed to burn a coal-water mixture and with no existing railroad. The key to viability of such a system is in the complete integration of all fuel supply elements, from mine to power plant. In general, however, the specific conditions in Indonesia (supply on Kalimantan and consumers on Java, generally limited throughputs on coal transport routes, and short distances) make it highly unlikely that slurry systems are an attractive domestic transport alternative. Such a conclusion is not absolute. In the case of a particular consumer and a dedicated coal source, a slurry system may prove to be the least costly and most reliable transport system.

6.2.3 Aerial Tramways

Aerial tramways are generally designed for very small throughputs and small distances over very difficult terrain, and they provide an

expensive solution when other alternatives fail. Tramway systems are not unknown in Indonesia. In the past, in-mine transport at the Ombillin mine in West Sumatra was accomplished by tramway, but at present, long-distance conveyors are used. A tramway system is used P.T. Semen Padang for the transport of limestone from the quarry to the cement plant.

Review of a large number of tramway systems for various materials throughout the world indicates an average throughput of about 50 to 60 tonnes per hour or an annual throughput of about several hundred thousand tonnes. The average distance of such systems is on the order of about 5 km. A recent Bechtel study for a tramway system, transporting 250,000 tonnes per year over 10 km of very rough terrain, resulted in a capital cost estimate of US$28 million and operating cost of US$1 million per year. Even under the most favorable financing conditions, such a system results in a transport charge of at least US$1 per tonne/km. Compared to truck transport charges of about US$0.15 to US$0.20 per tonne/km, it is clear that tramways are only to be considered as a last resort, when there are no other alternatives.

6.2.4 Conclusion: Comparison of Land Transport Modes

Cost comparisons without detailed analysis of particular systems are hazardous. Figures that compare competing transport systems for which an engineering definition is suspect or incomplete are, in the final analysis, a waste of time. Questions about the break-even distance between a rail and pipeline scheme, or truck and conveyor systems are better left unanswered until engineering definitions can provide some sound basis for the answers.

It is possible to list some of the specific advantages and disadvantages associated with each transport mode. This information can help provide insight into what can be done, yet it is not sufficient by itself. Table 6.2-1 provides such information on the type of transport systems discussed in this section.

Taking the above caveat fully into account, the following general conclusions can be drawn regarding land transport of coal:

- Trucks and conveyors are suitable for throughputs up to 10 MMTPY and distances of less than 50 km
- Trucks generally serve the lower throughputs of up to 2 MMTPY and conveyors become more economical at around 4 MMTPY
- Rail and slurry pipelines are the alternatives for high-tonnage long-distance transport
- If there is an existing rail system, rail transport is generally more competitive than slurry pipeline
- Slurry pipeline systems become an attractive alternative when throughputs are high (5 to 10 MMTPY) and distances are long (several hundred km). At lower throughputs and shorter distances, rail becomes more competitive
- Slurry systems can be attractive in "dedicated" supply systems, where, for example, one particular coal mine is used to supply a particular (still to be designed) power plant
- Rail systems have an advantage over slurry systems where there are many delivery points
- Aerial tramways are only to be selected where there are practically no other alternatives

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Table 6.2-1

GENERAL COMPARISON OF COAL LAND TRANSPORT ALTERNATIVES

Basic for Comparison	Coal Land Transport Alternatives				
	Truck	Conveyor	Truck/Conveyor Combination	(Unit) Train	Pipeline (Slurry)
Selection criteria	o Short haul o Low throughput o Moderate terrain	o Short haul o Large throughput o Difficult terrain	o Short haul o Large throughput o Difficult and moderate	o Long haul o Large throughput o Good terrain	o Long haul o Large throughput o Moderate to difficult terrain o Available water source o Good product dewater characteristics
Advantages	o Continuous operation o Quick response to changing needs o Permits extensive product distribution o Can cover grades as high as 20%	o Can economically climb grades as high as 32% o Requires relatively little power o Low labor requirements o Little interface with existing facilities (can be elevated) o Quiet operation except at transfer points o Continuous operation o Good salvage value o About 90% availability	o Continuous operation o Trucks on moderate grades (20%) and conveyor at difficult grades (32%) reduces operating costs o Little interface with existing facilities	o Low cost per tonne-km o High availability o Continuous operation o Train system can be used for other goods and services	o Low cost per tonne-km o High availability o Continous operation o Little or no environmental impact o Direct routing o Low labor requirements
Disadvantages	o About 85% productivity depending on weather and human elements o Good road maintenance essential	o Entire distribution halts if conveyor breaks o System normally carries only one type of product o Crusher sometimes required o Spreaders usually needed at end of conveyor system	o About 80% productivity o Entire distribution halts if conveyor breaks	o High capital cost o Windage loss - windbreaks, covered cars o Significant labor requirements to operate and maintain railroad	o High capital cost o Product dewatering required o Dedicated operation

6.3 LAND TRANSPORT OF KALIMANTAN COAL

6.3 LAND TRANSPORT OF KALIMANTAN COAL

6.3.1 Transport Requirements and Options

Land transport requirements for Kalimantan coal are based on information provided in Section 3 regarding coal production schedules, possible loading ports, and distances between mines and loading ports. The following assumptions were made to calculate the level of transport requirements at the end of Phases I, II, and III (1980, 1991, and 1994):

- The entire projected annual production for each mine is transported to the respective loading ports, identified in Section 3.
- Coal from the Samarangau area is loaded at the same site as the one used for P.T. Utah (see Subsection 6.3.2).
- Coal from the Tanjung area is transported by land to Banjarmasin. In the absence of information on transport possibilities using the Barito River, the only alternative is to use some form of land transport.

Based on the above assumptions, Table 6.3-1 and Figure 6.3-1 present total land transport requirements in tonne/km. Because of the nature of the above assumptions, the estimated requirements can be expected to provide an upper limit to the total land transport requirements that may have to be satisfied for the following reasons:

- Coal production levels may be lower to match domestic demands
- Some coal, used by local power plants, may not have to be transported by land
- Coal from the Tanjung area may only be transported by land for part of the total distance to Banjarmasin

Figure 6.3-1 shows how land transport requirements are distributed among the coal areas in various phases of development. As can be seen, and with the exception of the Tanjung area, the major requirements for land transport are from the South Kalimantan and Samarangau areas. In South Kalimantan, requirements are high because of comparatively high production levels, while in Samarangau the distance to the loading port is comparatively greater than most other areas.

Table 6.3-1

PROJECTED KALIMANTAN COAL PRODUCTION AND ASSOCIATED
MINE TO LOADING PORT LAND TRANSPORT REQUIREMENTS FOR 1990, 1991, AND 1994

Area	Mining Location	Distance to Loading Port (km)	Annual Production[a] (MMTPY)			Land Transport Requirements (MM tonne/km)		
			1988	1991	1994	1988	1991	1994
Senakin	Sangsang	25	1.00	1.00	1.00	25	25	25
Senakin	Sepapah	30	0.50	0.50	0.50	15	15	15
Senakin	East Senakin	30	0.50	3.00	4.00	15	90	120
Pasir	Petangis	15	1.00	1.00	1.00	15	15	15
Pasir	Bindu-Betitit	14	0.67	1.00	1.00	9	14	14
Samarangau	Samarangau	45[b]	1.70	2.00	2.00	77	90	90
Mahakam	Busang	10	-	1.50	2.00	-	15	20
Sangatta	West Pinang	20	-	1.50	2.00	-	30	40
Berau	Kelai	31	-	1.00	2.00	-	31	62
Tanjung	-	200[3]	-	0.50	1.50	-	100	300
		TOTAL	5.37	13.00	17.00	156	425	701

(a) See Table 3.9-4
(b) It was assumed that loading port is on Kuaro River (See Subsection 6.3.2)
(c) Land transport to Banjarmasin was assumed

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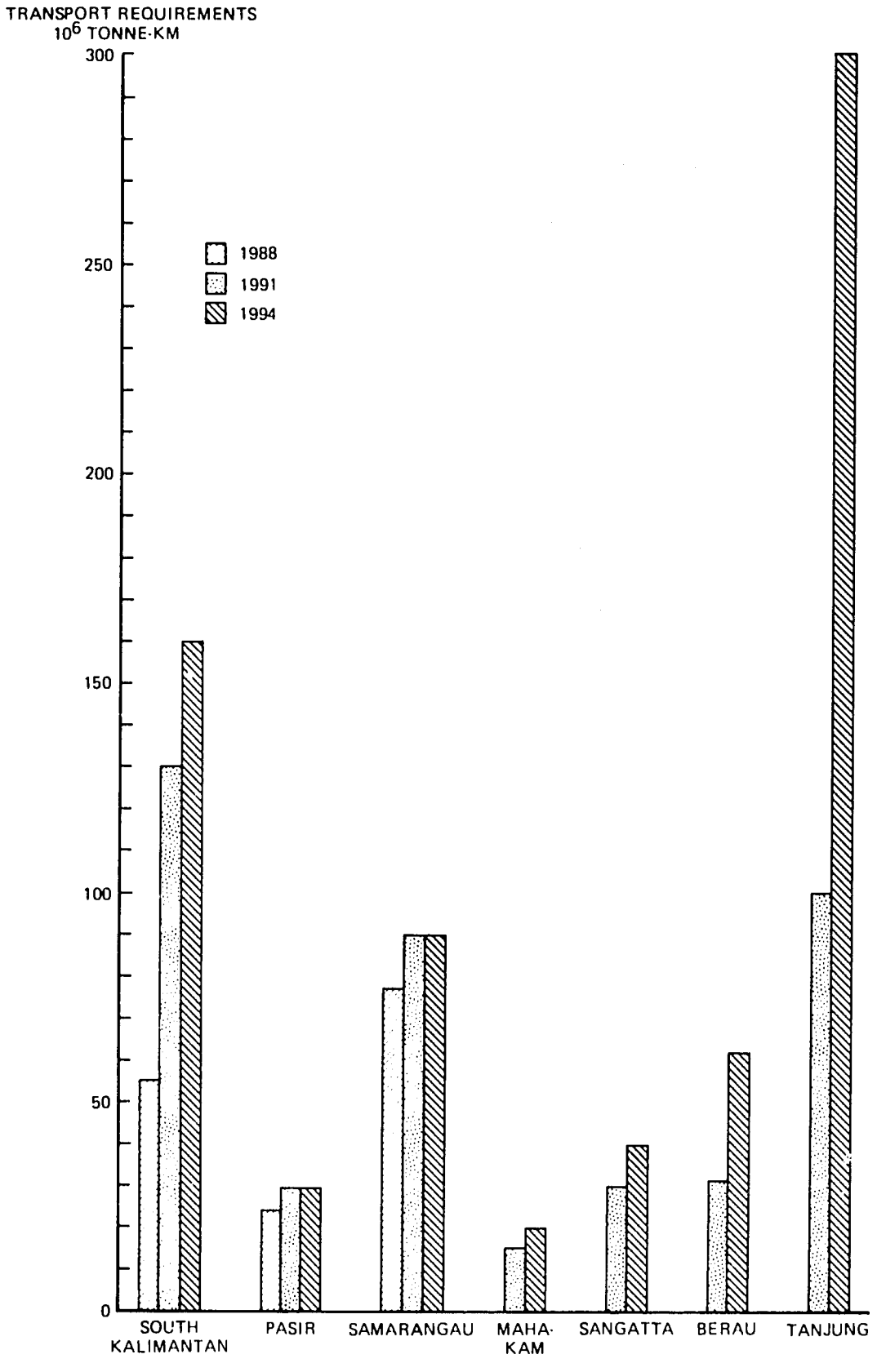

Figure 6.3-1 LAND TRANSPORT REQUIREMENTS BETWEEN COAL AREAS AND LOADING PORTS IN KALIMANTAN

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Based on the discussion of land transport of coal in Section 3 and Table 6.3-1, the key characteristics important to the selection of land transport modes for coal are:

- All production levels in 1994 are projected to be less than or equal to 2 MMTPY, with the exception of East Senakin.

- All mines are less than 45 km from a possible loading point, with the exception of the Tanjung area.

- Although no adequate transport infrastructure currently exists in any of the coal producing areas, there are no significant constraints to developing any of the land transport modes discussed earlier (i.e., there are no special conditions, such as an existing rail line, that would a priori favor a particular land transport mode).

In view of the general discussion of land transport modes in the previous subsection, the above characteristics lead to the following preliminary conclusions for all areas except the Tanjung area:

- Trucking. Of the various possible land transport options (trucking, conveyors, rail, coal slurry and aerial tramway), low production and short distances combine to favor trucking for all areas. Lack of an infrastructure will result in development of haul roads serving dual uses (movement of personnel, supplies, etc.) in addition to coal. Furthermore, the flexibility of trucking operations fits well with the phased development as currently foreseen.

- Conveyors. Next to trucking, conveyors may have to be considered as an option in certain areas. A conveyor system may be attractive in cases where new haul roads have to build to the loading port. In the Sangatta area, for example, trucking coal from the West Pinang area to Tanjung Bungalun could be more expensive than using a conveyor system. A conveyor may also be attractive in cases where the annual production level exceeds the range of economic operations of a trucking system. An example is the East Senakin area where the 1994 production of 4 MMTPY may justify a conveyor system. The elongated form of the deposit may require a moveable system to keep costs low. In all cases where conveyors are considered, the most critical issue will be the power requirements to drive the conveyor system, because a significant amount of electric power will be required. No electric power is currently available in any of the areas.

- Rail. Although it is impossible to rule out this option, it is very unlikely that coal will be transported by rail in Kalimantan. All areas currently under development are in remote areas of Kalimantan with little or no other development. As a result, a rail system would have to be justified by coal transport alone. Given the short distance and low throughputs this is unlikely.

- Slurry and Aerial Tramway. For all practical purposes, these two options can be eliminated from any further consideration. Transport characteristics as identified above clearly indicate that these are the "wrong tools to do the job."

As mentioned earlier, too little is known about transport of coal from the Tanjung area to the Kalimantan coast. Therefore, the above preliminary conclusions do not apply to this area and further study will be required.

6.3.2 Samarangau Area

As mentioned in Subsection 3.4.4, P.T. Kideco has several alternatives under study for transporting coal out of the area. In this case, the choice of land transport mode is closely related to the selection of the loading point for subsequent sea transport. Figure 6.3-2 summarizes the various transport options considered by P.T. Kideco. Either coal will be transported by land to Tanjung Sabilang for transport on 50,000 to 60,000 DWT bulk carriers, or coal will be transported to a site on the Kuaro River for transport on 10,000 DWT barges to its final destination or a transhipment center. Depending on the alternative selected, total land transport requirements in 1994 will be in the range of 90 to 200 million tonnes/km.

The difference is distance between Samarangau and the two possible unloading ports is a key issue in the evaluation of the two alternatives. The shorter distance (45 km) would most likely call for a trucking operation, but this is the maximum distance at which trucking is economic. Conveyor, the next best alternative, would be possible, although the limited throughput (2 MMTPY), as well as local terrain

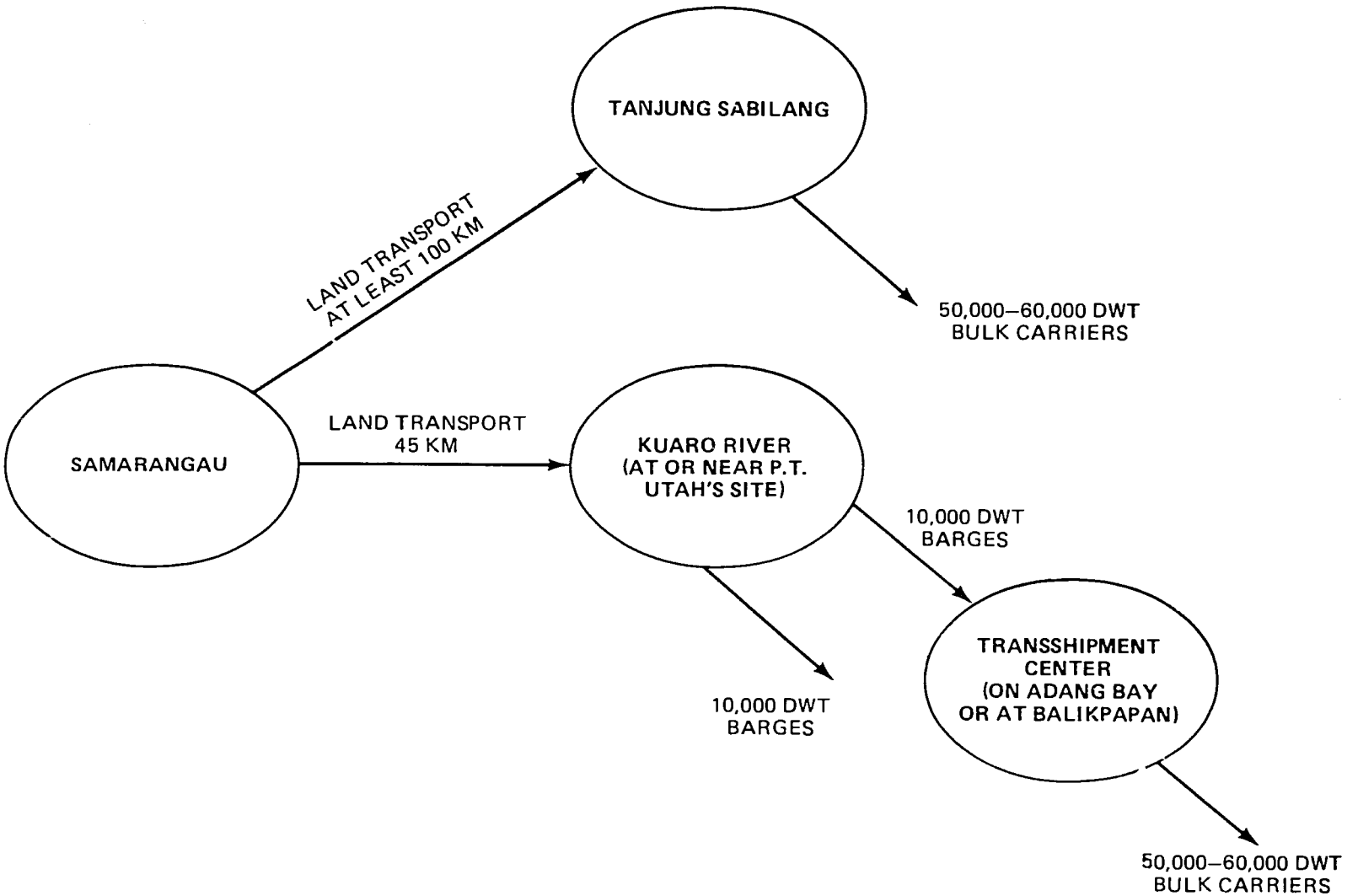


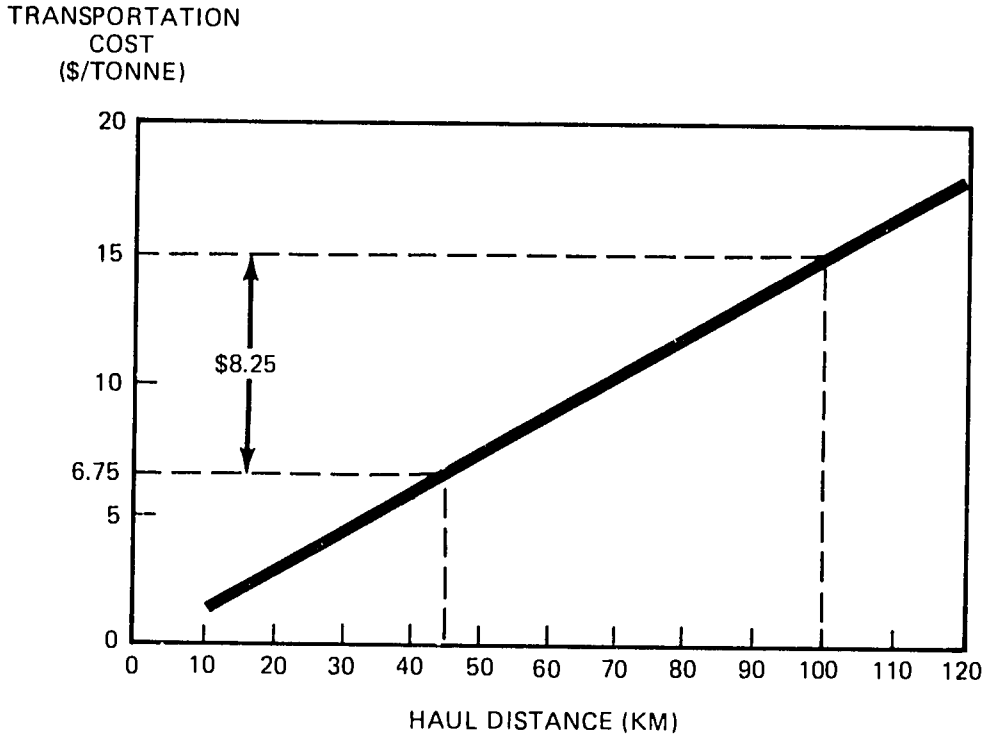
Figure 6.3-2 TRANSPORTATION OPTIONS FOR SAMARANGAU

conditions (passing the first set of foothills), could make this alternative less attractive.

In case of the longer distance (100 km) it would be even more difficult to find attractive alternatives to trucking. Although rail and conveyors are possible, both distances and throughput render these alternatives unlikely. The distance and throughput are too small for rail transport, while difficult local terrain conditions near the coast would cause high construction costs. On the other hand, the distance is large for a conveyor system and the throughput is small. As a result, trucking may be the only viable option to transport coal to either Tanjung Sabilang or to a loading point on the Kuaro River. Therefore, it is assumed that coal will be trucked to the loading port in each alternative.

To gauge the effect of the difference in distance on the alternatives, the cost per tonne-km of trucking is required. Discussion with a number of coal contractors indicates that if coal transport would be contracted out to local contractors operating 15 tonne trucks, the transport charge would most likely be in the range of US$0.15 to US$0.25 per tonne-km. This charge would cover the trucking system expenses (trucks, fuel, drivers, etc.) as well as road maintenance expenses. The charge does not include road construction costs. It assumes that roads suitable for 15 tonne trucks are already constructed, which is estimated to cost about US$50,000 to US$100,000 per km. Using the lower end of the range as the benchmark, Figure 6.3-3 shows the costs of trucking as a function of distance. It follows that the differential land transport cost is US$8.25 per tonne in favor of the alternative requiring only 45 km of trucking.

The cost of shipping in 10,000 DWT barges from the Kuaro River to Balikpapan has been estimated at US$0.95/tonne (see Table 5.6-1). If the transloading cost at Balikpapan is as high as US$6 per tonne, the total cost of transshipment using the 45 km alternative will be US$6.95, still well below the differential land transport cost between the two



BASED ON A COST OF $0.15/TONNE–KM
FOR TRUCK OPERATION AND ROAD MAINTENANCE.
ROAD CONSTRUCTION COST NOT INCLUDED.

Figure 6.3-3 KALIMANTAN TRUCK TRANSPORTATION COST

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alternatives. Thus, it appears that there is a strong economic motivation for using a loading point on the Kuaro River and limiting the truck transport distance to 45 km. In addition, if this preliminary conclusion is borne out by more detailed studies, the potential for operating a joint Kideco-Utah facility on the Kuaro River should be fully explored as soon as possible.

6.3.3 Vehicle Requirements for Kalimantan Coal Transport

So far trucking appears to be the most attractive land transport mode in most areas in Kalimantan, at least during the early phases of development. However, type and size of truck, as well as management of the trucking fleet still have to be decided. Several alternatives will need to be investigated. If special dedicated haulroads are constructed, "off-highway" trucks of 50 to 100 tonnes can be considered. The savings associated with using larger trucks will have to be weighed against the increased cost of road construction and maintenance. On the other hand, if existing public roads are used, the size of the truck is limited by the allowable axle-loading of the road. Fleet management is an important issue. Coal contractors may opt to operate their own fleet of trucks or they may decide to contract out the mine to loading port transport to local transport companies. At present, it is too early to determine the least costly trucking system.

To provide insight into the order of magnitude of requirements for trucking coal to loading ports, a calculation was made of the number of vehicles required under this set of very specific assumptions:

- All land transport during Phases I, II, and III is done by trucks, with the exception of the Tanjung area.
- Total projected production from each mine (see Table 6.2-1) is trucked to the respective loading port.
- A truck-trailer combination that can carry 30 tonnes and has an axle loading of less than or equal to 8 tonnes/axle is used. Generally, these trucks can use public roads without incurring additional road construction costs.

- The trucking fleet operates 24 hours per day (three shifts) for 300 days per year (excluding Sundays and holidays), or 7,200 hours per year.

- Truck availability due to maintenance and repair is 80 percent (5,760 hours per year).

- Average speed is 30 km per hour.

- The total time associated with loading, unloading, and waiting is 0.5 hour per round trip.

Based on the above assumptions, Table 6.3-2 shows the number of truck-trailer combinations required for each mining area in the years 1988, 1991, and 1994. Since the total operating life of a truck is about 20,000 hours, each truck has an operating life of about 3.5 years. Thus, if the mines operate for 30 years, trucks will have to be replaced nine times. Therefore, the total number of trucks required to sustain Kalimantan coal production is on the order of several thousand truck-trailer combinations over a period of 30 years, with an average requirement of about 50 to 100 truck trailer combinations per year.

Table 6.3-2

TRUCK REQUIREMENTS FOR KALIMANTAN LAND TRANSPORT

Area	Mining Location	Loading Port	Distance to Loading Port	Number of 15 Tonne Trucks		
				1988	1991	1994
Senakin	Sangsang	Tanjung Batu	25	13	13	13
Senakin	Sepapah	Tanjung Batu	30	7	7	7
Senakin	East Senakin	Tanjung Batu	30	7	43	58
Pasir	Petangis	Linding	15	9	9	9
Pasir	Bindu-Betitit	Tanah Merah	14	6	8	8
Samarangau	Samarangau	Tanah Merah	45	34	41	41
Mahakam	Busang	Tenggarong	10	-	10	14
Sangatta	West Pinang	Tanjung Bungalun	20	-	16	21
Berau	Kelai	Lebanan	31	-	15	30
			TOTAL	76	162	201

6.4 LAND TRANSPORT ON JAVA AND SULAWESI

6.4 LAND TRANSPORT ON JAVA AND SULAWESI

This subsection discusses how coal can be transported from the officially designated unloading ports on Java and Sulawesi (see Section 5) to the customer facilities. It reviews the land transport situation in:

- West Java
- South-central Java
- North-central Java
- East Java and Sulawesi

In certain cases, alternative low-cost transport schemes are identified.

6.4.1 Transport Requirements and Options

Table 6.4-1 presents land transport requirements for the years 1988, 1991, and 1994, based on the projected coal consumption levels discussed in Section 4, and the location of unloading ports and customer facilities on Java and Sulawesi. Transport distances in west Java, south-central, and north-central Java are in principle based on existing rail connections, and approximate road distances where no rail exists. In east Java and Sulawesi, transport distances are based on approximate road distances.

Figure 6.4-1 compares land transport requirements for the various areas served. The most striking observation is the comparatively high coal transport requirements in west Java compared to all other areas served. In addition, compared to land transport in Kalimantan and excluding land transport from the Tanjung area, requirements for coal transport in west Java up to the year 1994 will be much larger than the total transport requirements in all areas of Kalimantan combined (see Table 6.3-1 and Figure 6.3-1).

This observation, based on the location of the unloading port in west Java and the respective locations of customer facilities, is not surprising. However, it does point out that the major task of

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Table 6.4-1

PROJECTED COAL CONSUMPTION AND LAND TRANSPORTATION REQUIREMENTS FOR 1988, 1991, AND 1994 IN JAVA AND SULAWESI

Area	Unloading[a] Port	Coal Consuming Facility[b]			Manual Coal Requirement[d] (MMTPY)			Land Transport Requirement (MM tonne/km)		
		Type of Plant	Location	Distance From[c] Unloading Port (km)	1988	1991	1994	1988	1991	1994
West Java	Cigading	Cement	Narogong	201	0.25	0.25	0.28	50.3	50.3	56.3
			Citeurup	211	1.25	1.25	1.33	263.8	263.8	280.6
			Palimanan (Cirebon)	382	0.17	0.21	0.34	64.9	80.2	129.9
South-central Java	Cilacap	Cement	Cilacap	10	0.20	0.20	0.42	2.0	2.0	4.2
			Karang Talun	10	0.10	0.14	0.25	1.0	1.4	2.5
			Gombong	68	-	0.06	0.30	-	4.1	20.4
		Power	Near Cilacap	0	-	1.03	1.37	-	-	-
North-central Java	Semarang	Cement	Tanggung	74	0.17	0.25	0.42	12.6	18.5	31.1
			Purwodadi	68	0.10	0.42	0.42	6.8	28.6	28.6
East Java	Gresik	Cement	Gresik	1.5	0.48	0.64	0.64	0.7	1.0	1.0
	Madura Cement Harbor	Cement	Karang Pandan	30	0.45	0.45	0.45	13.5	13.5	13.5
	Paiton	Power	Paiton	0	0.69	1.82	4.56	-	-	-
Sulawesi	Biringkassi	Cement	Tonasa and Biringere	15	0.19	0.30	0.36	2.9	4.5	5.4
	Bitung	Cement	Near Menado	15	-	0.08	0.34	-	1.2	5.1
TOTAL					4.05	7.10	11.48	418.5	469.5	578.6

(a) Unloading port based on preliminary decisions from the government (Reference 6-3)
(b) See Table 4.2-1 for additional details
(c) Distances for west Java, south-central Java, and north-central Java based on existing rail connections (Reference 6-4); power plants are on the coast and require no land transport (i.e., Paiton and Cilacap); remaining distances are based on approximate road distance
(d) See Table 4.2-4

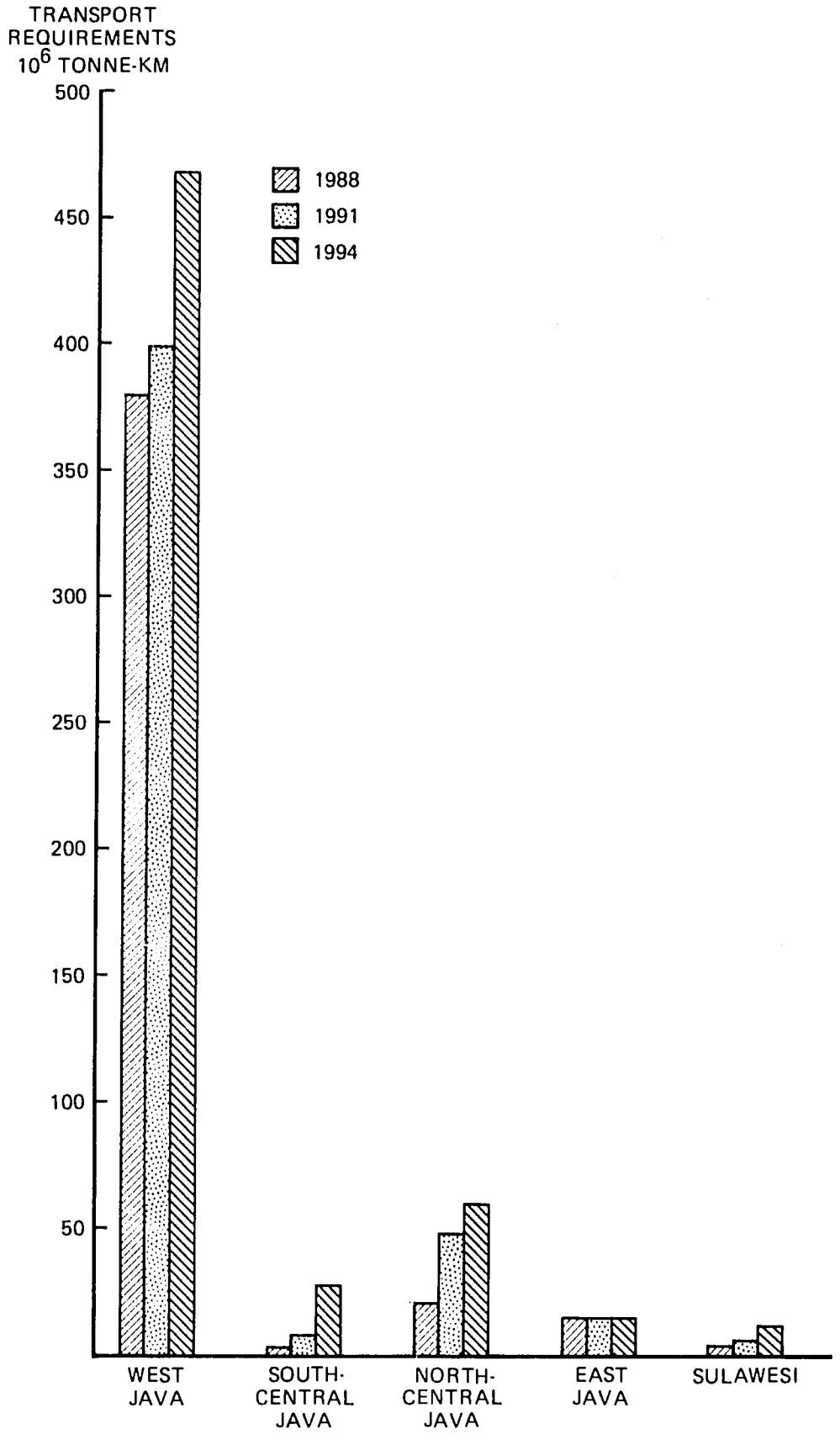

Figure 6.4-1 LAND TRANSPORT REQUIREMENTS BETWEEN UNLOADING PORTS AND CONSUMER FACILITIES ON JAVA AND SULAWESI

transporting Kalimantan coal over land takes place not on Kalimantan, but on Java and in particular in west Java. Land transport requirements to cement plants at Narogong and Citeurup alone represent 75, 67, and 58 percent of all land transport requirements in 1988, 1991, and 1994, respectively. In contrast, these two customer facilities represent in the same years 37, 21, and 14 percent of total coal demand.

As shown in Table 6.4-1, coal customers fall into two categories based on locations. One group is inland on Java, with transport distances of over 50 km. This group includes:

- Narogong (201 km)
- Citeurup (211 km)
- Palimanan (382 km)
- Gombong (68 km)
- Tanggung (74 km)
- Purwodadi (68 km)

The other group is on or within 30 km of the coast. This group includes the power plants at Paiton and Cilacap where no land transport is expected to be involved. The cement plant at Gresik is 1.5 km from the unloading point. Cement plants on Sulawesi (Tonasa and Menado) are at most 15 km from the unloading point, while the cement plant on Madura is projected to be within 30 km from the planned cement harbor. Based on the discussion on land transport modes in Subsection 6.1, it can be concluded that the only suitable transport modes to serve customers in the first group are rail and truck, while the only suitable alternatives to serve customers in the second group are truck and conveyor, with the possible exception of those locations where there is already an existing rail system between the unloading port and the customer's facility.

Unloading Ports. Figure 6.4-3 shows the officially designated coal unloading ports on Java and the existing railroad system. To serve customers in west Java, a port on the west coast will be selected. Generally, water depth along this part of the Java coast does not present

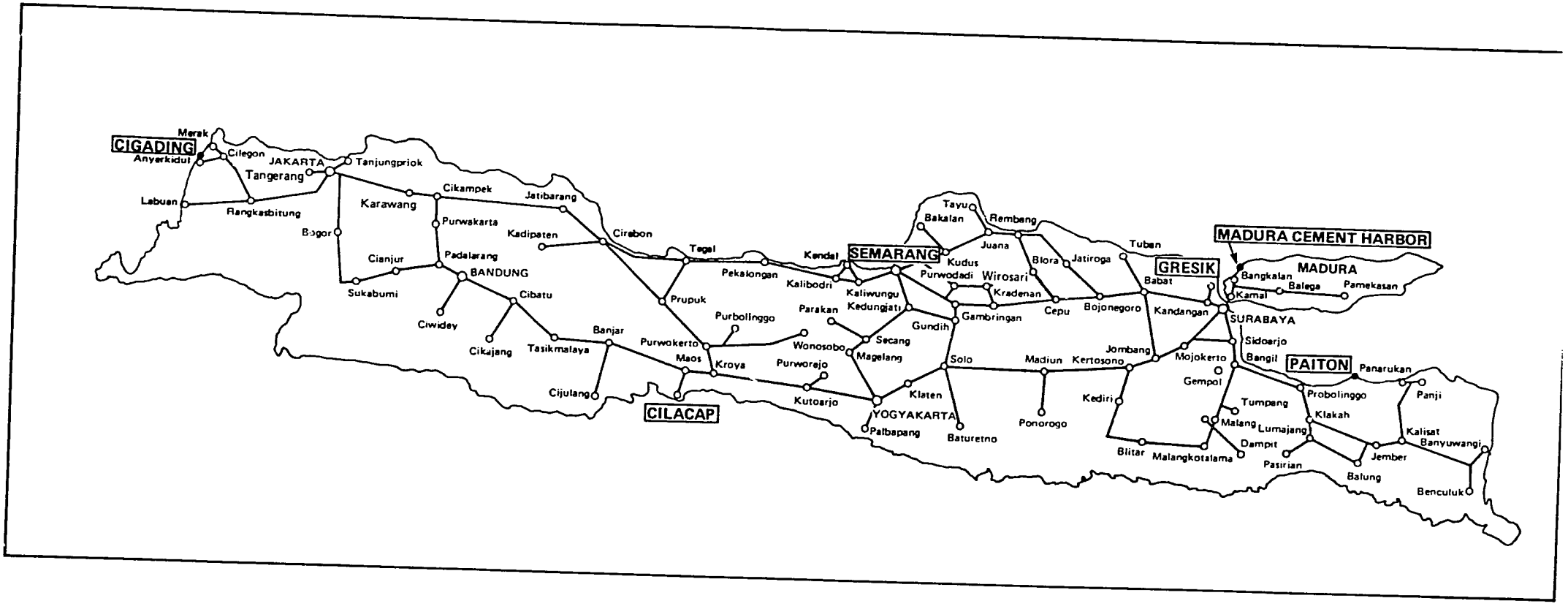

Figure 6.4-2 COAL UNLOADING PORTS AND THE JAVA RAILWAY SYSTEM

severe draft restrictions. The special harbor of Krakatau Steel, located at Cigading, has been identified for coal unloading. Alternatively, a new port facility adjacent to Krakatau Steel's harbor (under construction by the Department of Sea Communications) could accommodate coal. Although the latter was originally proposed as a general cargo port, development of a special coal unloading jetty and handling facilities has been considered.

To serve customers in south-central and north-central Java, Cilacap and Semarang, respectively, have been designated as unloading ports. As discussed in Section 5, Cilacap has an existing deep water port and presents no major draft restrictions. Semarang can only be reached through a relatively long and shallow approach channel, severely limiting vessel size.

Customers in east Java (cement plants at Gresik and on Madura, and the power plant at Paiton) are expected to be served through their own special-purpose port facilities, located next to or very close to the respective plants. A similar situation is expected for cement plants on Sulawesi.

Inland Locations. Many tradeoffs need to be assessed when selecting either truck or rail to serve inland locations on Java. Generally, the existing rail system is a priori a very attractive alternative. Because of the extremely high population density in Java, the premium placed on land for agricultural purposes (primarily rice growing), and the limited availability of land, transporting coal on existing roads should be discouraged wherever possible. Most roads are two-lane and at present are overcrowded with many different vehicles, including automobiles, horse-drawn carts, bicycles, large trucks, and pedestrians. The situation is dangerous and can only get worse as the population keeps increasing. Conservatively, it can be projected that by 1990, Java, which has a total land area of 132,200 km^2, will have at least 100 million people. Although new roads are being constructed, the extremely high cost associated with new construction necessitates that this be done only in urgent cases and certainly not only for hauling

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coal. This fact is illustrated by the current construction of 19 km of a four-lane Class I-type road between Surabaya and Gempol in east Java (see Figure 6.4-2). Based on discussions with personnel of the Kanwil Dep. Pekerjaan Umum, Dati I Java Timor, the costs (November 1980 Rupiah) as contracted have been as follows:

Road construction	14.4 billion Rupiah
Structures construction	10.8 billion Rupiah
Land acquisition	24.0 billion Rupiah
TOTAL	49.2 billion Rupiah

If price escalation from November 1980 to the present is included, the cost of construction increases from 25.2 billion Rupiah to at least 32.2 billion Rupiah, leading to a total cost of approximately 56.2 billion Rupiah, or about 3 billion Rupiah/km. Although this cost is for the construction of a four-lane Class-I-type road, it illustrates the comparatively high cost of building new roads in Java. In conclusion, using existing roads for coal transport makes an already difficult situation worse, while construction of special purpose roads is clearly out of the question. On the other hand, Java has an existing rail system (see Figure 6.4-2).

The rail system on Java is narrow gauge (1.067 m), and the total route length is 4,112 km. There are 2,790 km of main line in the system with maximum axle loading of 14 tonnes/axle, and 1,322 km of branch line with maximum axle loading of 9 tonnes/axle. Generally, the main line system is kept in reasonable condition, while in many cases branch lines have been closed and have fallen into disrepair. By and large, the total system including equipment has not been properly maintained over the last 40 to 50 years for severe lack of funds. Although the state of the system is poor, the right-of-ways that still exist provide a system of thoroughfares throughout crowded Java. Because of this, the rail system is key to economically moving large quantities of coal in Java.

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Coastal Locations. Transporting coal to facilities at or near to the coast presents a different situation. The best way to illustrate this is to consider two specific cases: the cement plant at Gresik, and the power plant at Paiton.

Figure 6.4-3 is a schematic of the layout of roads and port facilities at Gresik. A special-purpose port facility, owned and operated by P.T. Semen Gresik, is only 1.5 km from the cement plant. Depth at the jetty is about 11 meters and 30,000 DWT ships have used the port to unload equipment while the cement plant was under construction. At present, no unloading facilities are available on the jetty and incoming raw materials are trucked to the cement plant. In the case of coal, a similar trucking system could be used, or alternatively a simple conveyor system could be developed. The simplest solution would be to have a receiving hopper on the jetty and a 1.5 to 3 km belt conveyor to the coal preparation plant at the factory site. As discussed in Section 5, throughput of coal at Gresik is small, making it more difficult to economically justify shore-based unloading equipment. Instead coal would be unloaded using the ship's own gear and dumped directly into the hopper.

Although the distance from the respective loading ports to cement plants on Madura and Sulawesi is larger than in Gresik, coal transport could be handled in a similar way with trucks and conveyors as the main options. In the case of cement plants near Cilacap, a number of other options exist, which are discussed in Subsection 6.4.3.

Figure 6.4-4 shows the conceptual layout of coal unloading facilities at the power plant at Paiton. This drawing was taken from the first site selection study (Reference 6-8) and does not reflect a final design configuration. In particular, the final form of the jetty and coal handling system will most likely be modified to accommodate the actual type and size of vessel that will transport coal to the power plant. In general, however, Figure 6.4-4 is useful to illustrate that no land transport of coal is involved, other than the transport of coal within the limits of the power plant site. Although the latter is a complex system, it is entirely within the scope of the power plant design and as

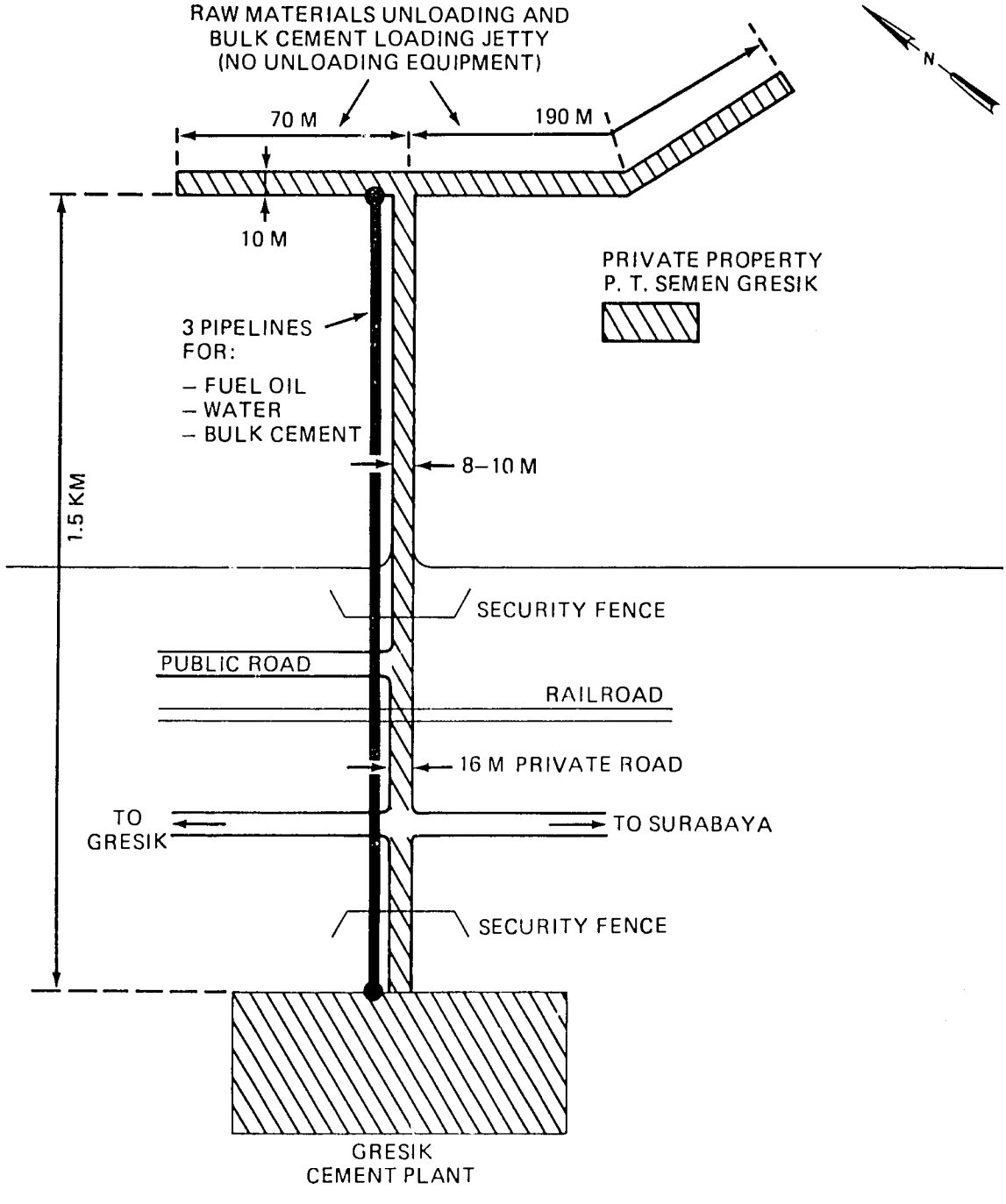

Figure 6.4-3 SCHEMATIC LAYOUT OF LAND TRANSPORT AT P. T. SEMEN GRESIK

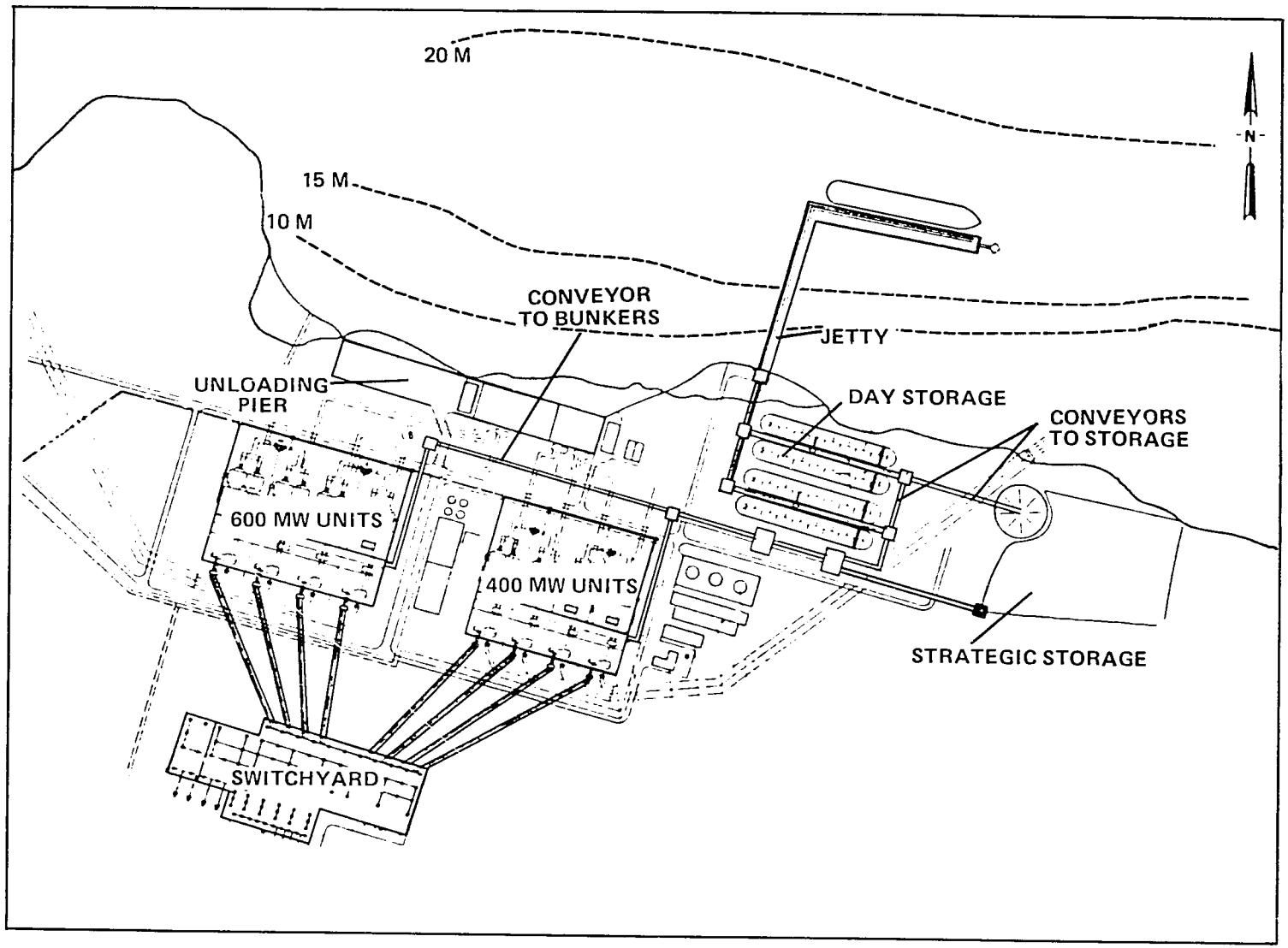

Figure 6.4-4 CONCEPTUAL LAYOUT OF UNLOADING FACILITIES AT PAITON

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such it is outside the scope of considerations in this report. Since every major coal-fired power plant on Java will be located directly at the coast, a similar situation is projected.

6.4.2 Coal Transport in West Java

Figure 6.4-5 shows the land transport situation in west Java. It shows the location of the cement plants at Narogong, Citeurup, and Palimanan in relation to the major roads and railroad network. The present plan calls for coal unloading at Cigading on the west coast, south of Merak. Figure 6.4-6 illustrates the situation at Cigading. Cigading is also the site of Krakatau Steel's special harbor. To the west, the Department of Sea Communications is currently constructing a new port facility. As shown in Figure 6.4-6, a coastal area has been designated as a coal storage area between these two facilities.

The Krakatau Steel port facility was built to unload iron ore pellets and load sponge iron. The port facility is about 8 km from the steel plant. The 20-meter wide jetty is about 300 meters offshore and has an overall length of 570 meters. Water depth at the jetty is 16 meters. Ships of 85,000 DWT, loaded to 70,000 DWT with pellets, have berthed and unloaded at the jetty. Vessels up to 50,000 DWT can be loaded, but only 10,000 DWT vessels have been loaded so far. The right-hand side of the jetty, completed in 1977, is used for unloading iron ore and has a design capacity of 2 MMTPY. Two 750 tonnes per hour ship unloaders move on rails along the jetty. Current experience indicates that the unloaders, equipped with 20 tonne grab buckets, require 5 to 6 days to unload 60,000 tonnes of iron ore. A conveyor system transports the ore to the steel plant. The left-hand side of the jetty, completed in 1979, is used for sponge iron loading, which comes by belt conveyor from the plant and is loaded directly into ships. The overall conveyor system has a length of about 6 km and uses 1 meter wide belts. Krakatau Steel's railroad network extends all the way up to the jetty. The system is newly built and can support a load of 20 tonnes per axle.

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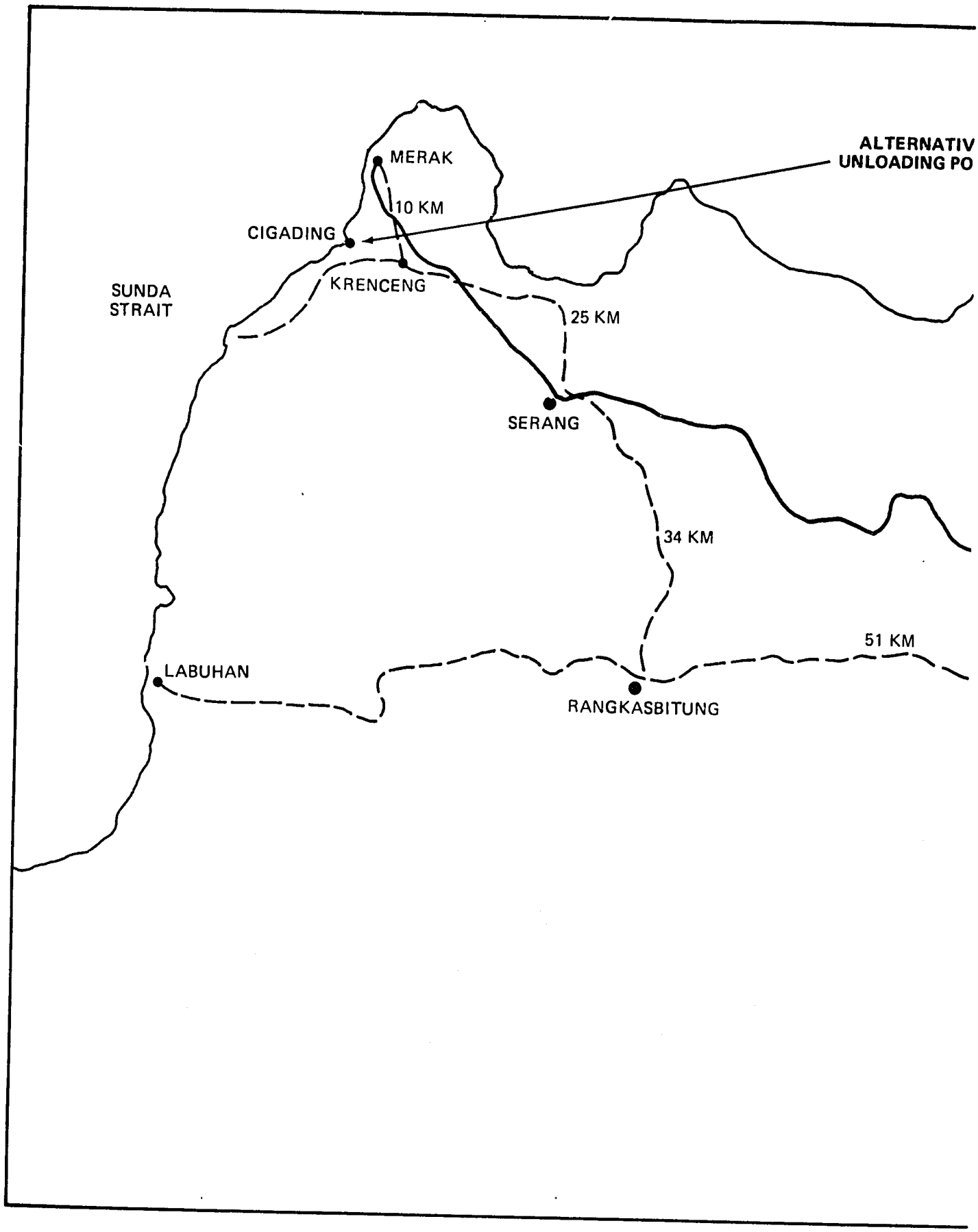
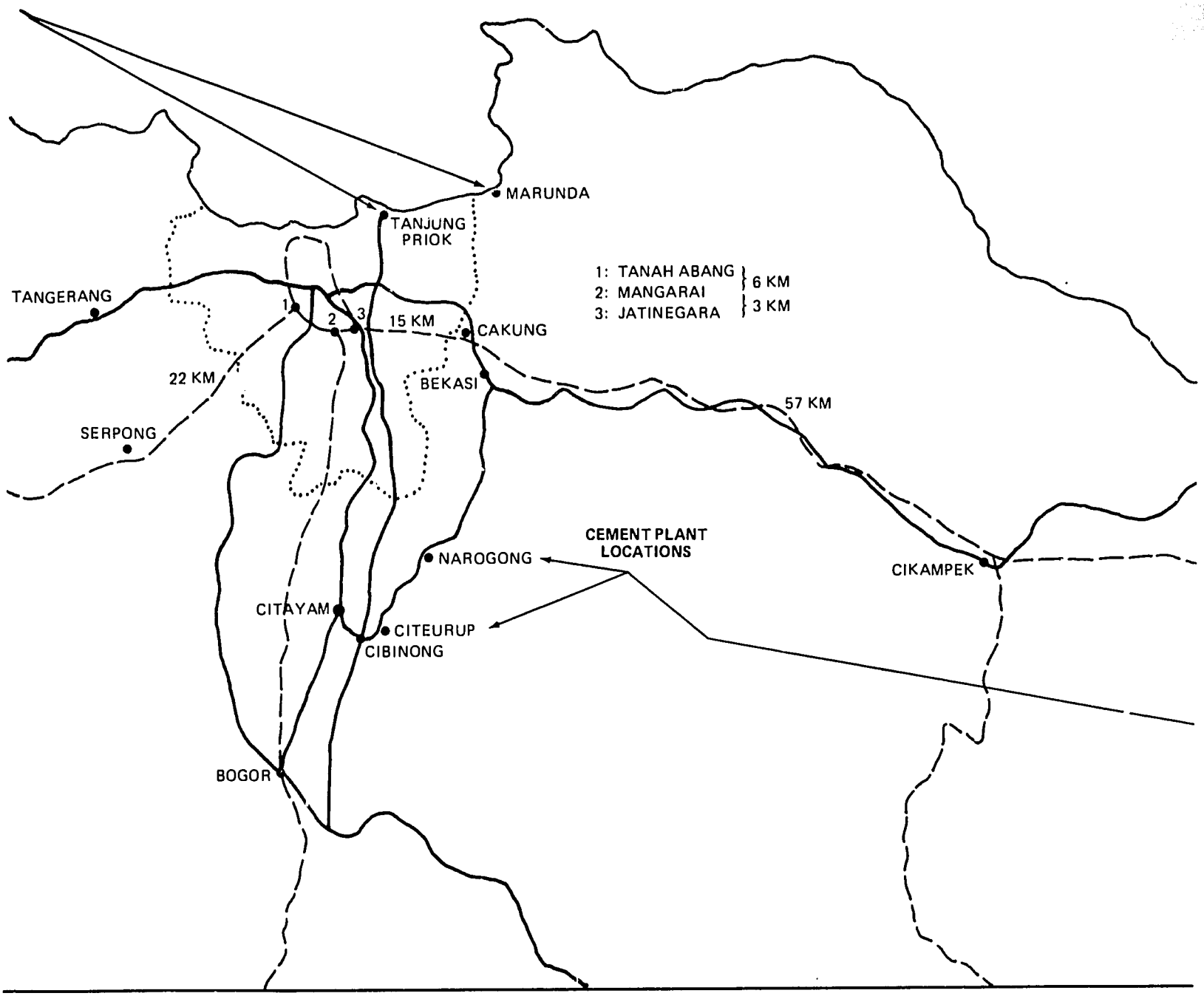

ALTERNATIV
UNLOADING PO
MERAK
10 KM
CIGADING
KRENCENG
SUNDA
STRAIT
25 KM
SERANG
34 KM
51 KM
LABUHAN
RANGKASBITUNG


MARUNDA
TANJUNG PRIOK
TANGERANG
1: TANAH ABANG
2: MANGARAI
3: JATINEGARA
6 KM
3 KM
15 KM
CAKUNG
22 KM
BEKASI
57 KM
SERPONG
CEMENT PLANT LOCATIONS
NAROGONG
CIKAMPEK
CITAYAM
CITEURUP
CIBINONG
BOGOR

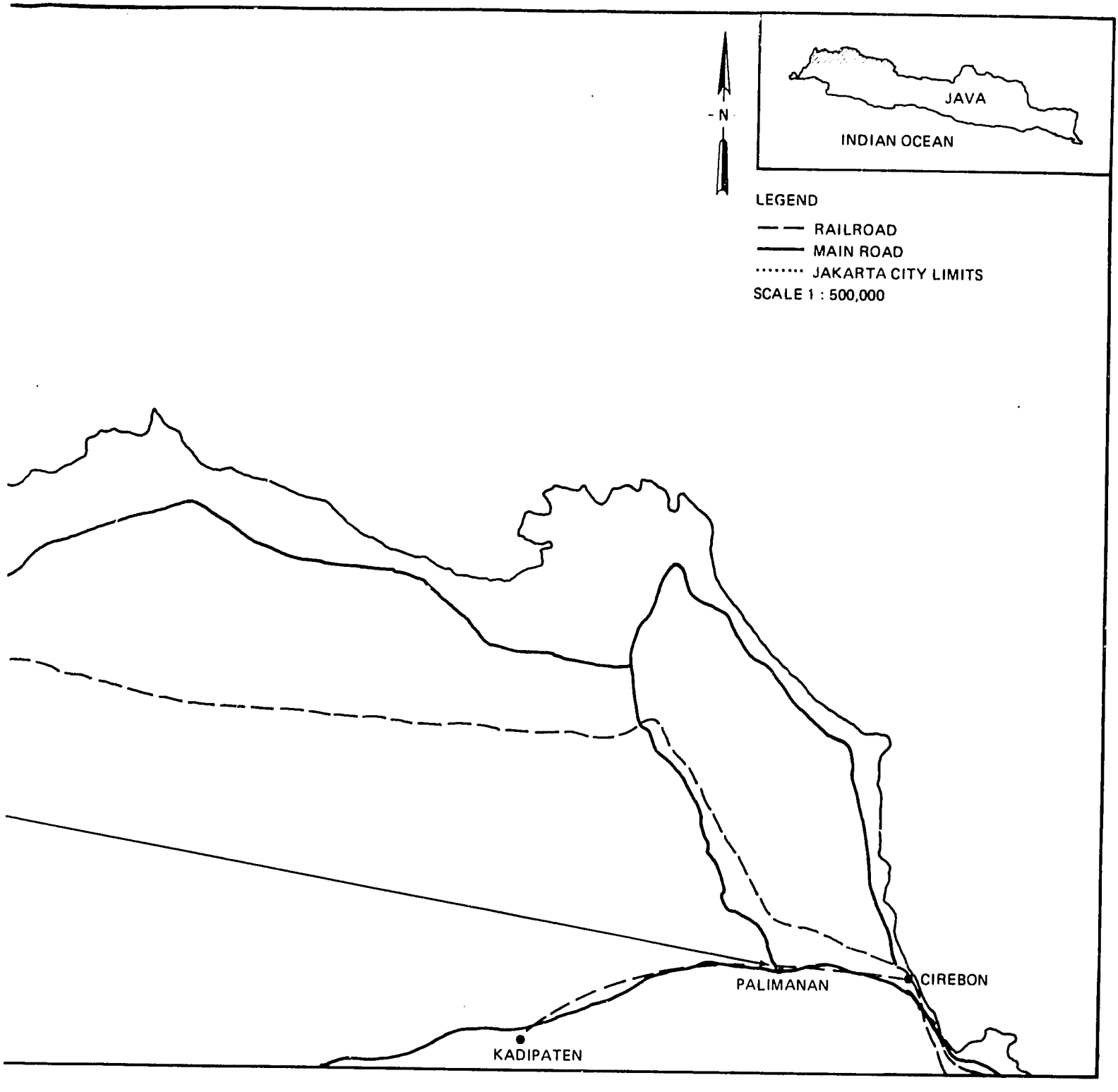


Figure 6.4-5 LAND TRANSPORT IN WEST JAVA

As shown in Figure 6.4-6, a branch line of the PJKA rail system passes Cigading and connects Krenceng to Anyer (see Figure 6.4-5). However, this particular line has not been in operation for at least 20 to 30 years and is currently unusable. Current plans of the Department of Sea Communications for the port next to the Krakatau Steel port facilities include the possibility of unloading coal. However, size of the vessel most likely would be limited to 10,000 DWT.

Detailed plans for transport of coal from the Cigading area to the cement plants at Narogong, Citeurup, and Palimanan have not yet been made, with the exception of plans made by INDOCEMENT to supply their facilities at Citeurup.

Indocement Coal Transport Plan. Under this plan, coal will be unloaded at Krakatau Steel's port facility and transported by conveyor to the coal storage area. This will require slight modifications to the existing conveyor system in order to reach the storage area. At the storage area, coal will be loaded into containers carrying about 23 to 25 tonnes of coal each. Containers will be placed in flatbed railcars with a maximum carrying capacity of about 25 to 27 tonnes per car. Container loading with gantry cranes and rail transport will be the responsibility of PJKA, the National Railroad Company. From the coal storage area, the train will use the Krakatau Steel rail network to Krenceng. This will require an additional spur from the Krakatau system to the storage area (see Figures 6.4-5 and 6.4-6). From Krenceng, PJKA's existing and operating branch line from Merak to the Jakarta area will be used to transport the coal, passing the cities of Serang, Rangkasbitung, and Serpong. The train will go through the Jakarta area, via Tanah Abang, Manggarai, and Jatinegara, with Bekasi as the endpoint. At Bekasi the containers will be unloaded from the railcars and loaded on special trucks for about 45 km of final road transport to the cement plant at Citeurup. In total, coal will be transported 166 km by rail and 45 km by road.

INDOCEMENT estimates its coal requirement at 4,000 tonnes per day. Since each train will have 17 cars, carrying a total of 17 containers or 400 tonnes per train, 10 trains per day will be required from Cigading to

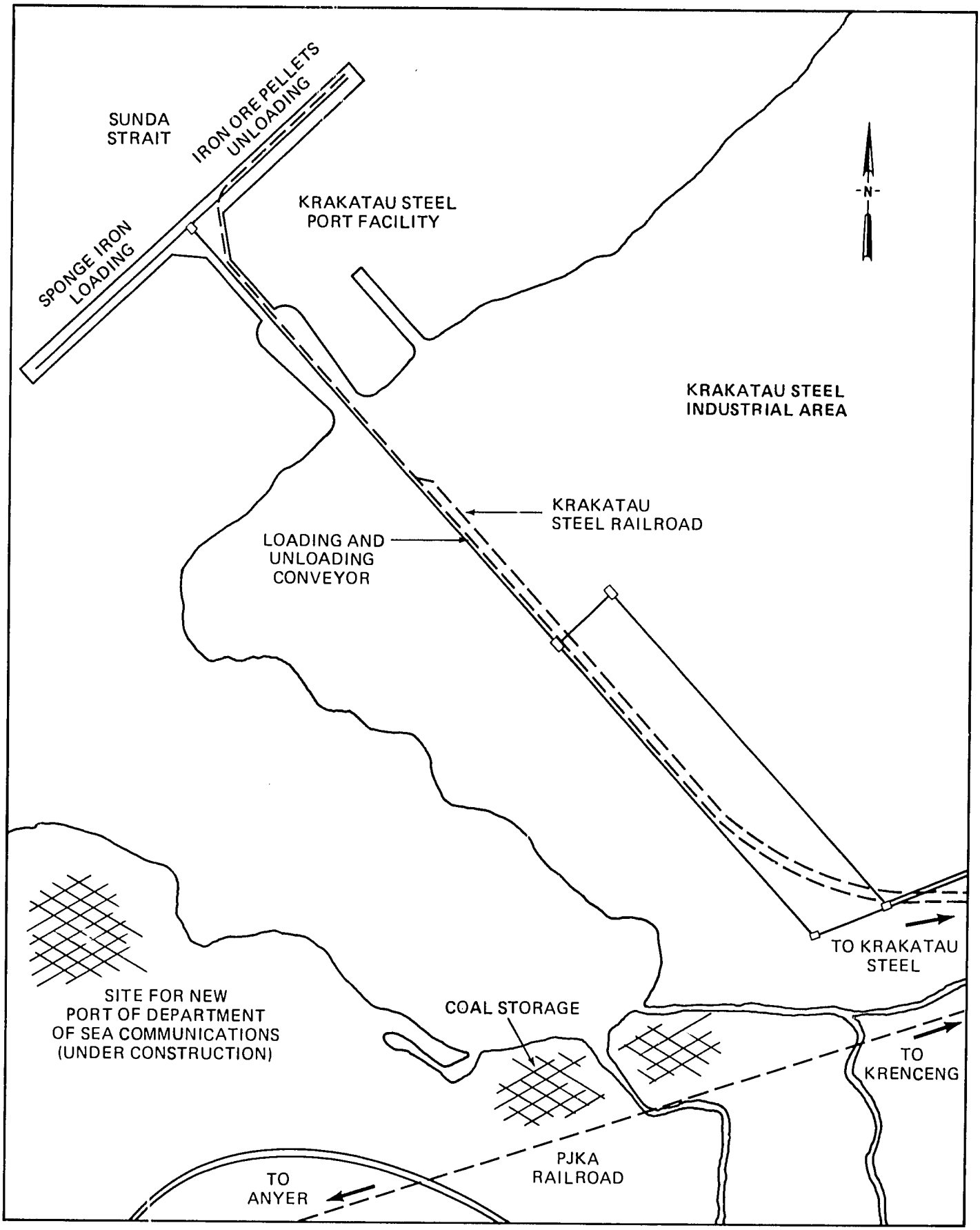


Figure 6.4-6 LAYOUT OF CIGADING HARBOR

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Bekasi, with 10 empty ones returning to Cigading. This will increase traffic on the branch line from Merak significantly. At present, there are only two passenger trains per day between Merak and Jakarta and only two to three freight trains per week from Krakatau Steel, carrying steel products to Jakarta and on to Surabaya. In addition, road traffic between Bekasi and Citeurup will increase significantly, when 170 loaded containers go everyday to Citeurup and 170 empty containers go back to Bekasi.

Finally, the initial plan calls for using the unloading facilities at Krakatau Steel's port. This allows for unloading large vessels, making it possible to use coal imports from Australia, which would arrive in vessels of 40,000 DWT or larger. If the port facility operated by the Department of Sea Communications is used, this option would be less likely, as only vessels up to 10,000 DWT would be able to unload. For the rest, the selection of the specific port facility to be used in the Cigading area would have no influence on the transport scheme. Coal would still be transported by belt conveyor to the storage area for subsequent transport in containers to Citeurup.

Alternative Land Transport Schemes in West Java. Cigading is the only officially designated unloading port for west Java. The advantages of Cigading are that water depth along the west coast is generally not a constraint and that no new unloading facilities will be required if the port facilities of Krakatau Steel can be used. The latter advantage would disappear if the new port facility of the Department of Sea Communications is used, which would require new unloading facilities. This advantage would also disappear if the throughput of iron ore pellets increases, in which case there would not be enough capacity left to unload coal in addition to iron ore. Plans have been discussed to construct a new pier at Krakatau's port facility (extending from the existing one) to unload iron ore and to use the existing unloading facility for coal unloading. A new iron ore unloading facility would allow 150,000 DWT iron ore carriers to berth at Cigading, which would result in significant savings in transport costs for iron ore to Krakatau Steel.

The distinct disadvantage of Cigading is its distance from the cement plants. The transport distance is 201 km to Narogong, 211 km to Citeurup, and 382 km to Palimanan. In addition to the long distance, the above discussion on the transport scheme developed by INDOCEMENT shows the real world complexities of moving coal using the existing railroad without any major modifications. This plan provides an expensive solution to coal transport in west Java for the following reasons:

- The transport distance is long, resulting in larger requirements for rolling stock and higher transport charges per tonne compared to shorter distances.

- The amount transported per rail car (23 to 25 tonnes) is small, thus requiring a comparatively larger number of cars. This amount is constrained by the permissible axle loading on the branch line to Jakarta and in particular by the bridges to be crossed.

- The amount transported per train (400 tonnes) is small, thus requiring a comparatively large number of trains and locomotives. This amount is constrained by the length of the train, which in turn is determined by the existing track system (e.g., the length of sidings on the one-track system between Krenceng and Jakarta).

- Multiple handling of the coal. Coal is unloaded and stored at Cigading and loaded into containers. Containers are loaded on rail cars at Cigading, transloaded at Bekasi and unloaded at Citeurup where the coal is unloaded from the containers. Multiple handling is expensive, and a significant amount of equipment is needed for the various loading and unloading operations.

- In addition to rail transport conducted by PJKA, INDOCEMENT needs to invest in a fleet of special trucks to carry containers between Bekasi and Citeurup.

Although it is entirely possible that the type of transport plan developed by INDOCEMENT is the only practical coal transport scheme available in west Java, it appears desirable to investigate whether there are alternatives that might provide a more economical land transport solution. Such investigation focuses on two related questions:

- What alternative unloading ports could supply the three cement plants?
- What alternative land transport system could link the unloading port and the cement plants?

Because of the close proximity of the plants at Narogong and Citeurup, both south of Jakarta, they can be considered together from the point of view of transportation. The cement plant at Palimanan is geographically separated from these plants and has a different transport situation. Therefore alternatives to supply the plants south of Jakarta will be discussed separately from the supply of the Palimanan plant.

Alternative Routes to Supply Cement Plants South of Jakarta. In addition to Cigading, the cement plants south of Jakarta could be supplied out of an unloading port on the north coast of Java, possibly from a location near the harbor of Tanjung Priok. Although current congestion and expansion needs for other activities could make it difficult to locate coal unloading facilities, the existing infrastructure and available land make Tanjung Priok too attractive to ignore.

To the east of Tanjung Priok, sites are available that could also be used as a special coal unloading port. Marunda is an example of such a site, and it has been considered as a site for a logging port. While it is outside the scope of this study to determine suitable unloading ports on the north coast of Java, it was assumed that such sites exist and that for the purpose of analysis Tanjung Priok and Marunda could be viable alternatives to Cigading.

The next question concerns the type of transport system from the unloading port to the cement plants south of Jakarta. To allow comparison among different transport alternatives, it was assumed that under each alternative a similar rail system as the one currently under construction to transport coal from Tanjung Enim (Bukit Asam) to Tarahan will be implemented. This implies upgrading of the current rail system and construction of new rail where none exists. It is assumed that the

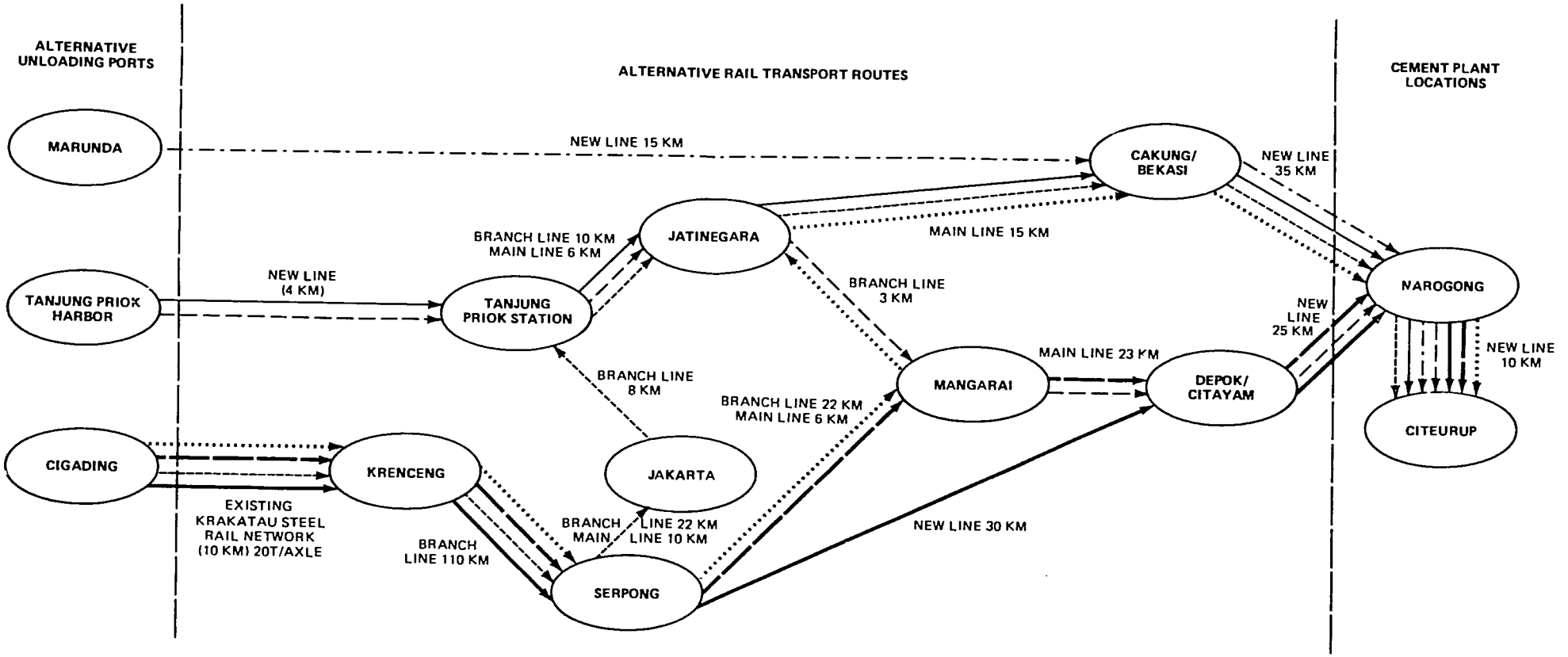
system will use unit trains of 25 wagons with about 40 tonnes of coal per wagon, and that the entire system can support 14 tonnes per axle loading.

Based on analysis of the existing rail system in west Java, and using three possible unloading ports (i.e., Tanjung Priok, Marunda, and Cigading), a large number of alternatives can be postulated, all of which transport the coal by rail from the unloading port to the cement plants south of Jakarta. For the purpose of this analysis seven alternatives are shown in Figure 6.4-7 (see also Figure 6.4-5). They are:

- Alternative 1 - Marunda, Cakung/Bekasi, Narogong, Citeurup (60 km)
- Alternative 2 - Tanjung Priok Harbor, Tanjung Priok Station, Jatinegara, Cakung/Bekasi, Narogong, Citeurup (81 km)
- Alternative 3 - Tanjung Priok Harbor, Tanjung Priok Station, Jatinegara, Manggarai, Depok/Citayam, Narogong, Citeurup (80 km)
- Alternative 4 - Cigading, Krenceng, Serpong, Manggarai, Jatinegara, Cakung/Bekasi, Narogong, Citeurup (211 km)
- Alternative 5 - Cigading, Krenceng, Serpong, Manggarai, Depok/Citayam, Narogong, Citeurup (206 km)
- Alternative 6 - Cigading, Krenceng, Serpong, Jakarta, Tanjung Priok Station, Jatinegara, Cakung/Bekasi, Narogong, Citeurup (236 km)
- Alternative 7 - Cigading, Krenceng, Serpong, Depok/Citayam, Narogong, Citeurup (185 km)

Alternative 1 represents an entirely new line from the north coast to the cement plants at Narogong and Citeurup. This line is very similar to a line proposed for the rail system of the greater Jakarta area (Jabotabek) between Tanjung Priok and Cibinong.

Alternative 4 is similar to the plan developed by INDOCEMENT, except that instead of road transport between Bekasi and Citeurup, transport is entirely by rail.



	TOTAL DISTANCE
ALT. 1: 60 KM OF NEW LINE	60 KM
ALT. 2: 49 KM OF NEW LINE, 21 KM OF MAIN LINE, 10 KM OF BRANCH LINE	80 KM
ALT. 3: 39 KM OF NEW LINE, 29 KM OF MAIN LINE, 13 KM OF BRANCH LINE	81 KM
ALT. 4: 45 KM OF NEW LINE, 21 KM OF MAIN LINE, 135 KM OF BRANCH LINE, 10 KM KRAKATAU STEEL LINE	211 KM
ALT. 5: 35 KM OF NEW LINE, 29 KM OF MAIN LINE, 132 KM OF BRANCH LINE, 10 KM KRAKATAU STEEL LINE	206 KM
ALT. 6: 45 KM OF NEW LINE, 31 KM OF MAIN LINE, 150 KM OF BRANCH LINE, 10 KM KRAKATAU STEEL LINE	236 KM
ALT. 7: 65 KM OF NEW LINE, – KM OF MAIN LINE, 110 KM OF BRANCH LINE, 10 KM KRAKATAU STEEL LINE	185 KM

Figure 6.4-7 RAIL TRANSPORT ALTERNATIVES FOR CEMENT PLANTS SOUTH OF JAKARTA

Alternative 6 is an example in which coal transport trains are routed over less busy segments of the urban rail network, to avoid the heavy traffic at Manggarai and resulting in a longer distance.

Alternative 7 is similar to an alternative recently studied by the Department of Land Communications. To avoid transporting coal through the Jakarta area, a new line is proposed between Serpong and Citayam, on the line from Jakarta to Bogor. In the above study, this line was directly routed to Citeurup, a distance of 11 km.

Each alternative has different requirements for upgrading branch and main lines, laying new track, and port construction and upgrading. To perform a preliminary screening of the various alternatives, an estimate was made of construction cost requirements of each alternative. Since there has been no new railroad construction in Java in the recent past, it is difficult to gauge what would be required to upgrade existing lines or to build new lines. Nonetheless, an order-of-magnitude estimate was developed for upgrading and new construction, based on recent projects in west and south Sumatra. In 1979, 14 km of new railroads were completed between Bukitputus and Indarung in west Sumatra, while the railroad between Tanjung Enim and Tarahan is currently being upgraded. Based on review of these projects and allowance for higher costs in Java, inflation, and different conditions, the following construction estimates have been made for the purposes of preliminary screening:

New track	US$1.25 to 1.75 million/km
Upgrading of branch lines	US$0.25 to 0.75 million/km
Upgrading of main lines	US$0.10 to 0.35 million/km

The cost range includes all structures (bridges, etc.) and equipment necessary to operate a unit train system.

For the purpose of this analysis it was assumed that Krakatau Steel's port facility is used and therefore the cost of unloading port facilities should be significantly less at Cigading than at Tanjung Priok and

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Marunda because of existing facilities. The following ranges of port construction cost have been estimated for preliminary evaluation:

- o Marunda US$40 to 80 million
- o Tanjung Priok US$40 to 80 million
- o Cigading US$10 to 20 million

Table 6.4-2 shows the estimated track construction and upgrading requirements for each alternative and the resulting range of costs, including port construction and upgrading. With respect to the estimates in Table 6.4-2, the following is noted:

- o If Krakatau Steel's facilities are not used, the costs of alternatives 4, 5, 6, and 7 will be higher
- o All alternatives provide the same "quality" of rail transport

Although the estimates in Table 6.4-2 are admittedly rough, it is possible to draw these conclusions based on this preliminary analysis.

- o It appears that both Tanjung Priok and Marunda could offer potential economic advantages over Cigading as a coal unloading port. Distance to the plants would be significantly less, and construction costs of the system would be similar or less.
- o If Cigading is chosen as an unloading port, it appears that a new line from Serpong directly to the plants, (Alternative 6), avoiding the Jakarta area, could be advantageous.

Many other factors enter into the comparison, such as:

- o Transportation requirements of other goods
- o Existing levels of port traffic
- o Effect on industrial development

Any upgrading or new construction of the rail system for coal transportation would make the system more accessible for other types of traffic and could also make some routes more accessible than others. For

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Table 6.4-2

COMPARISON OF CONSTRUCTION COST OF LAND TRANSPORTATION ALTERNATIVES FOR CEMENT PLANTS SOUTH OF JAKARTA

Alternatives	Unloading Port	Total Rail Distance (km)	Track Length (km)			Cost Range for Track (10^6 US$)	Cost Range for Port Facilities (10^6 US$)	Total Cost Range (10^6 US$)	Mid Point Cost Range (10^6 US$)
			Upgrading		New Construction				
			Branch Lines	Main Lines					
1	Marunda	60	0	0	60	75-105	40-80	115-185	150
2	Tanjung Priok	80	10	21	49	66-101	40-80	106-181	143
3	Tanjung Priok	81	13	29	39	55-88	40-80	95-168	131
4	Cigading	211	135	21	45	92-187	10-20	102-207	154
5	Cigading	206	132	29	35	80-170	10-20	90-190	140
6	Cigading	236	150	31	45	97-202	10-20	107-222	164
7	Cigading	185	110	0	65	109-196	10-20	119-216	167

example, if the railroad from Krenceng to Jakarta were upgraded, steel products from Krakatau Steel to Jakarta, which currently go mostly by road and cause severe congestion (especially around Tangerang) would be much easier to transport. On the other hand, traffic problems from Jakarta to west Java (Cilegon and Merak) will be alleviated by the newly constructed freeway, making the need to upgrade the railroad less pressing.

With regard to existing levels of port traffic, although Tanjung Priok may be the best choice from an economic standpoint, further expansion of other harbor activities may make it less desirable to allocate valuable space to a coal terminal.

If Marunda were developed as a special-purpose harbor and chosen as an unloading port with rail connections to Cakung/Bekasi and Narogong and Citeurup, the entire industrial area between Citeurup and Bekasi, as well as the Bekasi industrial estate, would have direct access to sea transportation without having to go through Tanjung Priok. This direct access has the potential to greatly alleviate road traffic (e.g., cement exported out of Tanjung Priok) and congestion at Tanjung Priok harbor.

It is impossible to draw firm conclusions, but it is clear from this preliminary analysis that alternatives to Cigading warrant serious consideration because they could provide a less costly transport alternative for the cement plants south of Jakarta. Therefore, it is recommended that as soon as possible a feasibility study be undertaken to determine the best unloading port and associated land transport system for supplying the cement plants at Narogong and Citeurup with coal. This study should address in detail alternatives for the entire transport chain to bring Kalimantan coal to the cement plants south of Jakarta, including loading in Kalimantan, type and size of vessel to be used, selection of unloading port and handling equipment in west Java, and land transport to the cement plants. Not only would such study result in the optimal land transport scheme to supply the cement plants, but more importantly, it would demonstrate for the first time how and at what cost Kalimantan coal can be made available to domestic consumers, taking into

account all the logistical requirements involved. As discussed in Subsection 5.2.1, the fact that consumers at present don't know the "bottom line" price for coal delivered to their facilities is a key constraint to the development of the domestic market for Kalimantan coal. Furthermore, since the cement plants south of Jakarta are among the first potential private domestic customers of Kalimantan coal, the recommended study is an essential element in efforts to promote the use of Kalimantan coal and therefore should be conducted immediately.

Alternative Routes to the Cement Plant at Palimanan. If Cigading is selected to supply the cement plant at Palimanan, coal will have to be transported by rail over a distance of 382 km (the entire length of the West Java province). It requires no analysis to determine that this solution would most likely be very expensive, unattractive, and should only be chosen as a last resort.

The obvious alternative to Cigading is the port of Cirebon (see Figure 6.4-5). At present, this port has been designated as a trunkport in the Interisland Liner System structure of gateway, collector, and trunkports. The current situation at the port is less than satisfactory. There are six concrete jetties of varying length (275, 235, 171, 50, 30, and 30 meters). The two longest jetties are 30 meters wide while depth along the jetties ranges from 4.5 to 5.5 meters. The longest jetties are in very poor condition. Although the approach channel is reported to have sufficient depth, the harbor suffers from siltation problems. Current capacity is only sufficient to serve the inter-island trade. Plans are being made to upgrade the port of Cirebon to decrease the load on the port of Tanjung Priok (Reference 6-9).

While recognizing the current situation at the port of Cirebon, the short distance to the cement plant at Palimanan makes it imperative that the possibility of unloading coal at Cirebon harbor be further investigated. There is an existing right of way of an old PJKA branch line between the towns of Cirebon and Palimanan. Assuming a rail connection between Cirebon Harbor and the town of Cirebon, total length to the cement plant would be approximately 21 km. Thus, a short rail line could provide an

alternative for coal supply to the plant and backhaul of cement to Cirebon Harbor. Clearly, at this point it cannot yet be recommended that coal should be transported by rail. Other possibilities to be evaluated are truck and belt conveyor.

The situation at Palimanan provides an excellent example of a situation where the use of coal requires more than a policy decision. A simple, low-cost, coal transport system must be developed to get the coal from the coast to the plant. In the absence of such a plan and in view of frequently less demanding alternatives to fire the kilns (such as natural gas), the use of coal is unattractive to the consumer. Only on the basis of a specific plan can be economic advantage of using coal be demonstrated.

6.4.3 Coal Transport in South-central Java

Figures 6.4-8 and 6.4-9 show the land transport situation in south-central Java. The port of Cilacap is the officially designated coal unloading port. Land transport of coal needs to be provided to the existing cement plant at Karang Talun, operated by P.T. Semen Nusantara. In addition, coal will be provided to a new cement plant at Gombong and a new cement plant to be operated by P.T. Perkasa Sembada Karya. Exact location of the latter is not known, but was assumed to be near Cilacap and Karang Talun (see Figure 6.4-9).

The port of Cilacap has a sufficiently deep (at least 12 meters) and protected approach channel allowing 30,000 to 40,000 DWT bulk carriers to berth. Plans for improving and expanding port facilities have been made by the Department of Sea Communications as part of recent efforts to upgrade Indonesian ports. Finally, there is an existing rail line that connects the port with the cement plant at Karang Talun. The new cement plant at Gombong can also be served by existing rail without major effort. Thus, it is expected that coal transport in south-central Java will not present a major problem. It will require development of new unloading facilities and coal storage within the existing Cilacap port complex. However, prior to adopting a particular land transport scheme to supply the cement plants in south-central Java, it is recommended that

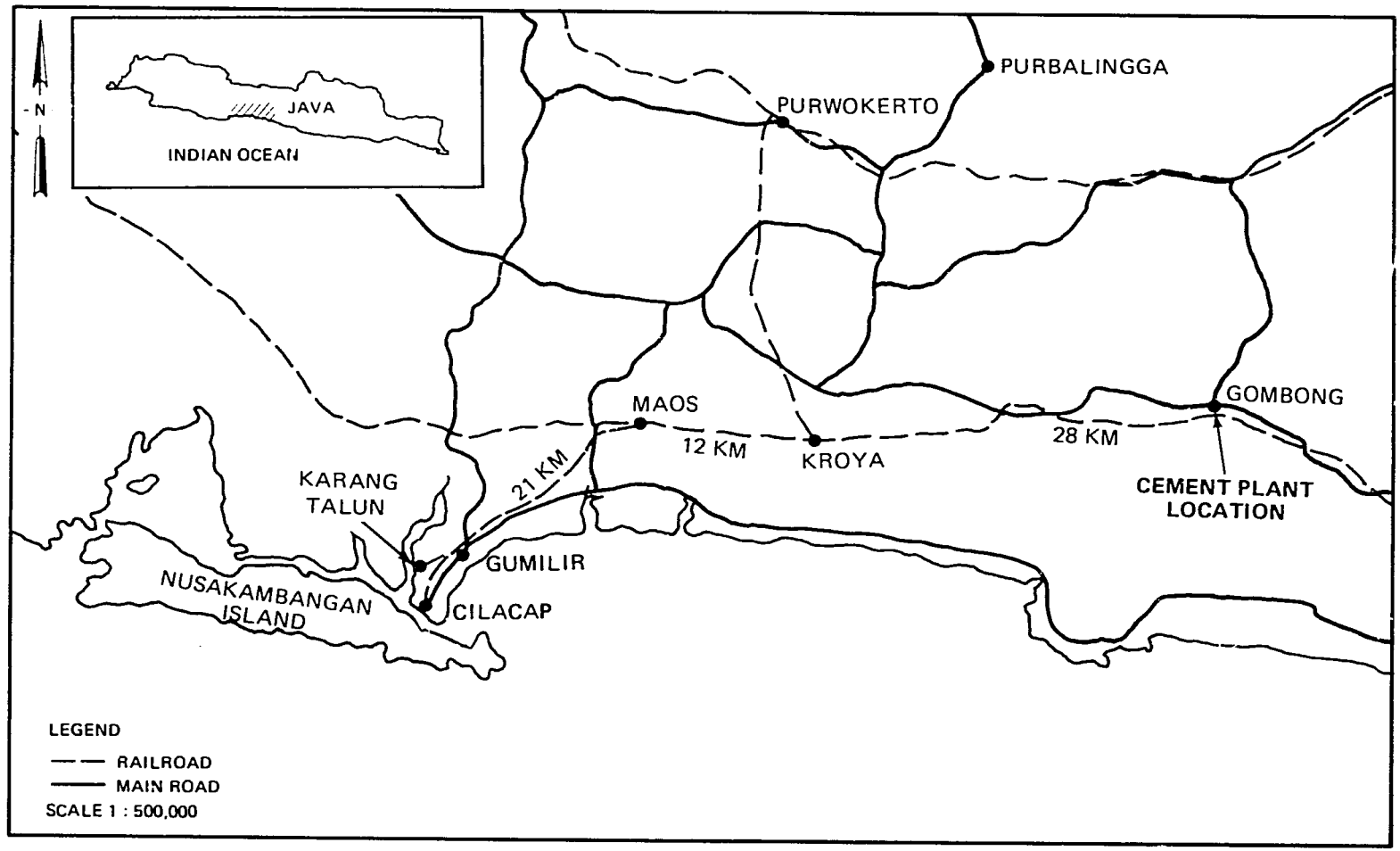


Figure 6.4-8 LAND TRANSPORT IN SOUTH-CENTRAL JAVA

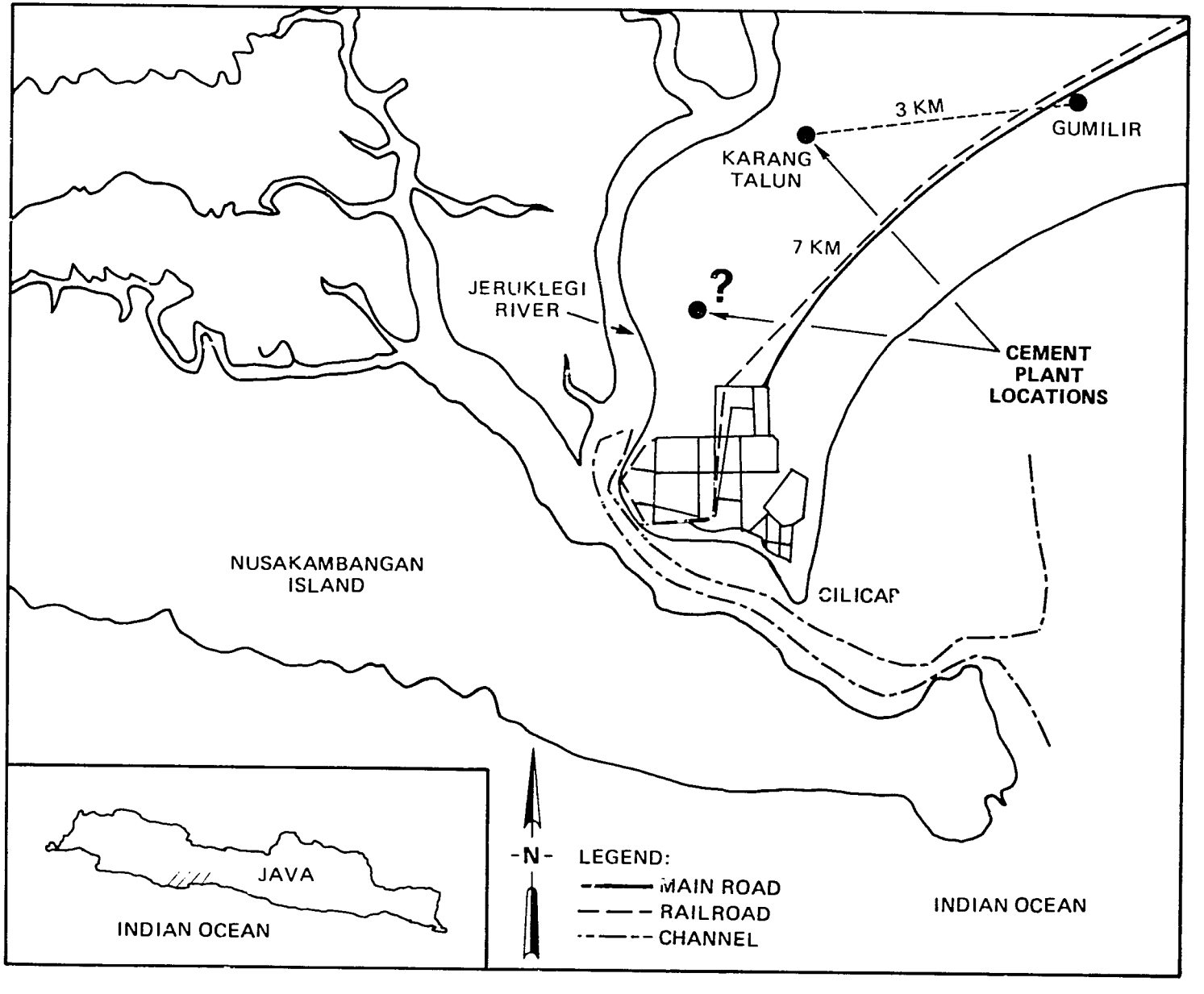


Figure 6.4-9 LAND TRANSPORT AROUND CILACAP

alternative transport schemes be evaluated. The basic rationale in seeking alternatives is that economies of scale could be achieved if the same supply system could be used to serve more than one plant, while locating coal unloading and storage facilities outside the existing prot complex may create less interference with current and projected port activities.

Figure 6.4-10 illustrates the type of land transport alternatives that can be considered. It was assumed that it is possible to develop a special coal unloading facility farther upstream of the Jerukleg River and closer to the two cement plants near Cilacap (less than 10 km). Simple conveyor systems could be used to supply the two plants. Finally, coal could be barged to the cement plants, as is currently done with limestone between Nusakambangan Island and the cement plant at Karang Talun. In conclusion, it is recommended that the land transport situation in the immediate vicinity of Cilacap be reviewed in detail to ensure the lowest cost land transport system is adopted.

6.4.4 Coal Transport in North-central Java

Semarang is the officially designated unloading port for coal in north-central Java (see Figure 6.4-11). Two future cement plants will need to be supplied, one near Purwodadi and one near Grobogan at Tanggung (about 6 km from Purwodadi).

As indicated in Figure 6.4-12, Purwodadi can be reached from Semarang by two rail routes of approximately the same length (59 or 67 km) by using either a branch line or the main line system to Ngrombo and a branch line to Purwodadi. From Purwodadi, coal can be transported to the P.T. Sugih Harapan cement plant by truck using existing roads or by using a conveyor system or railroad spur originating from the storage area at P.T. Semen Purwodadi.

The key transport issues in north-central Java are possible unloading sites at or near Semarang Harbor, and the transport connection between the unloading port and the existing rail system. As discussed in Section 5, the port of Semarang is the least equipped to receive bulk

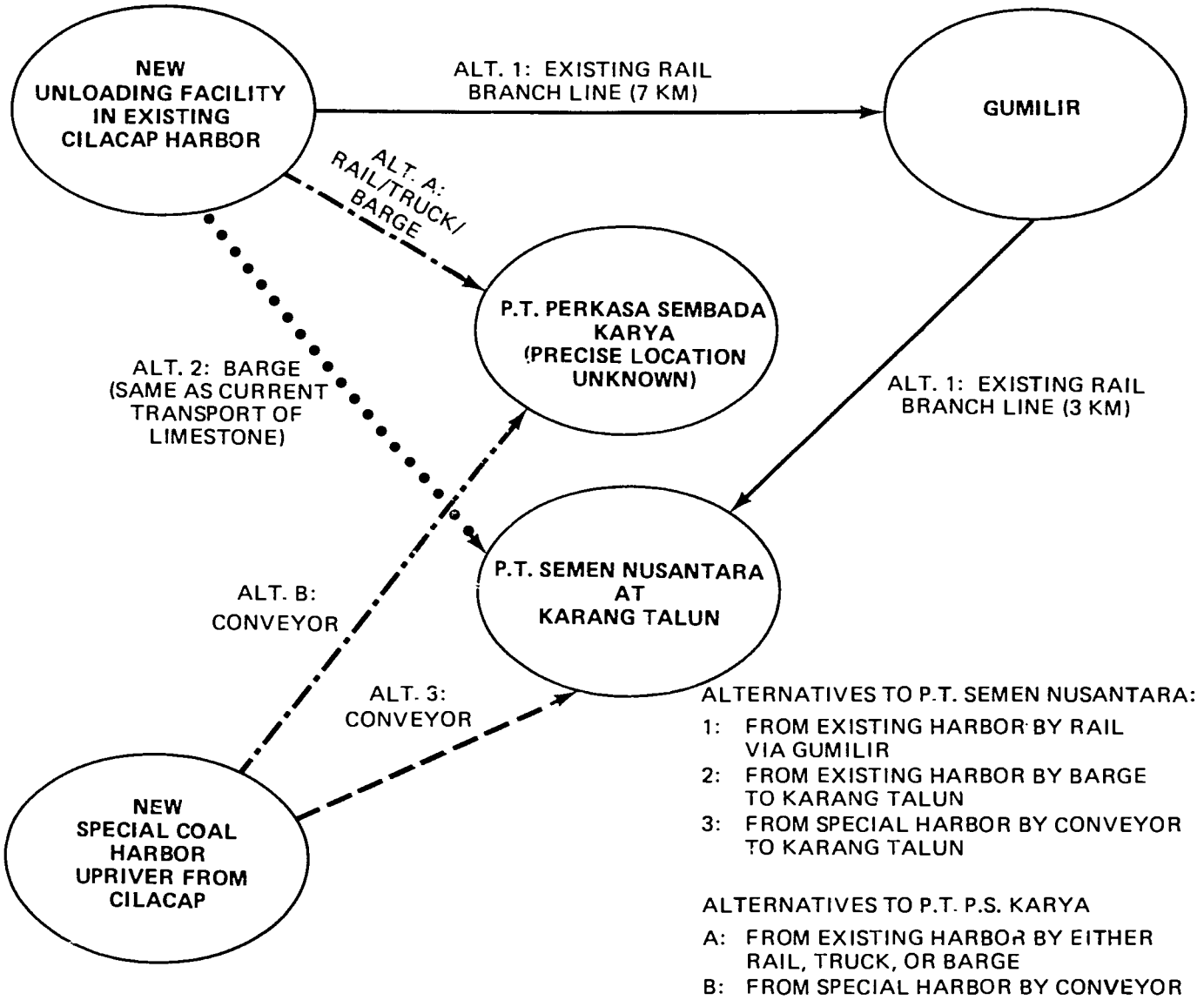


Figure 6.4-10 LAND TRANSPORT ALTERNATIVES TO SUPPLY P. T. SEMEN NUSANTARA AND P. T. PERKASA SEMBADA KARYA

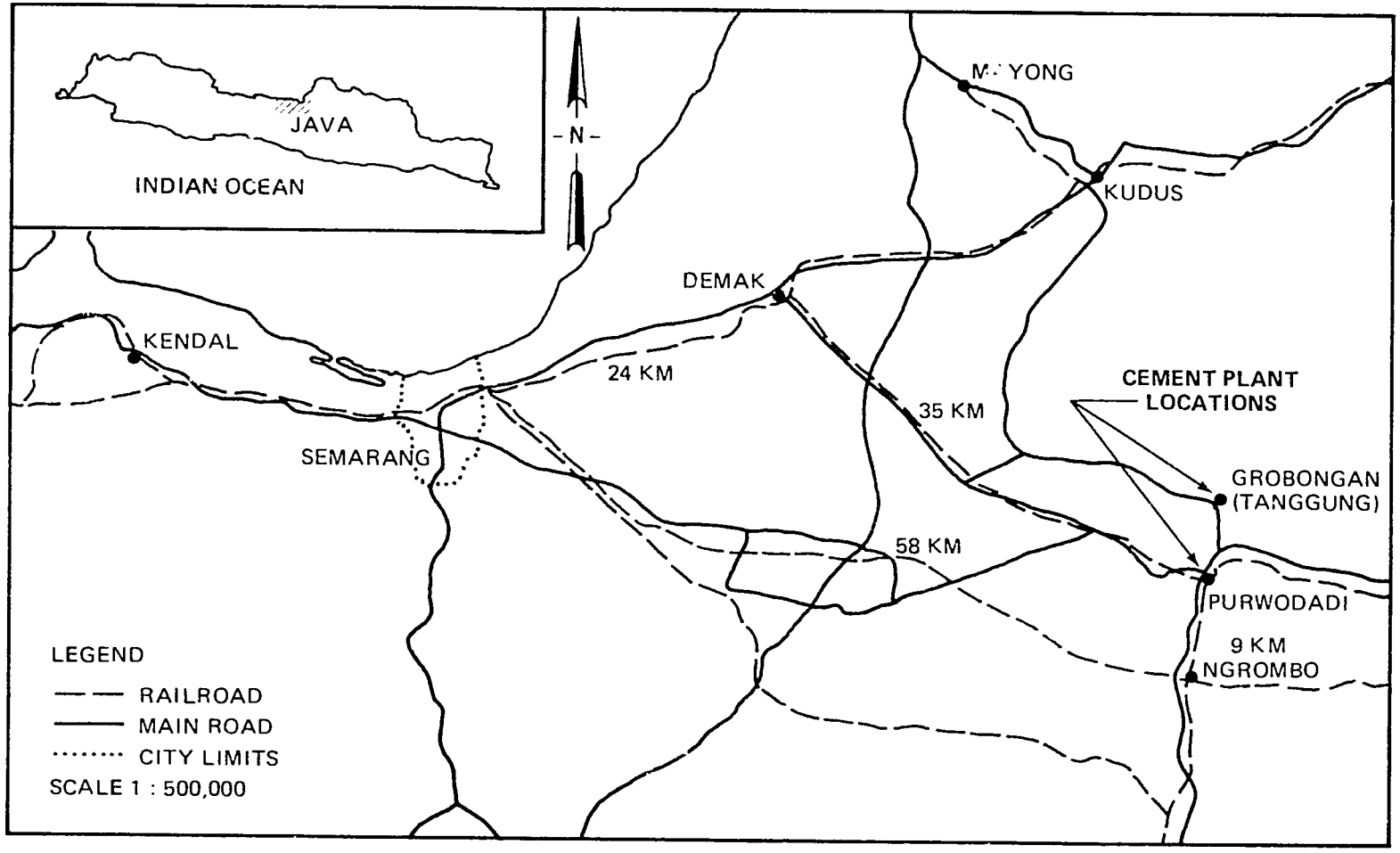
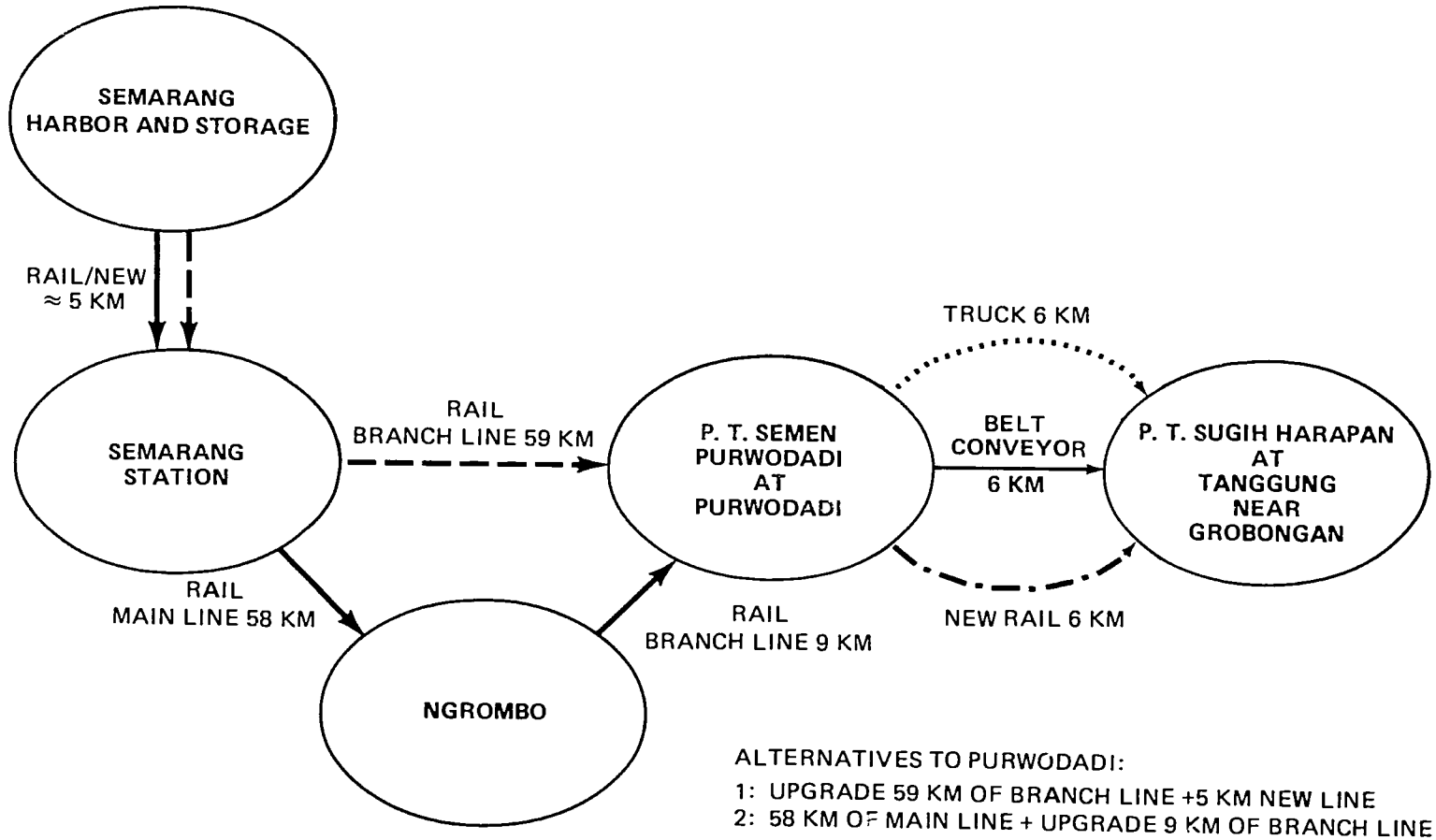


Figure 6.4-11 LAND TRANSPORT IN NORTH-CENTRAL JAVA



ALTERNATIVES TO PURWODADI:

1: UPGRADE 59 KM OF BRANCH LINE +5 KM NEW LINE
2: 58 KM OF MAIN LINE + UPGRADE 9 KM OF BRANCH LINE +5 KM NEW LINE

ALTERNATIVES TO TANGUANG

1: BY TRUCK FROM STORAGE AT PURWODADI
2: BY BELT CONVEYOR FROM STORAGE AT PURWODADI
3: EXTEND RAIL LINE TO SUGIH HARAPAN

Figure 6.4-12 LAND TRANSPORT ALTERNATIVES TO SUPPLY P. T. SEMEN PURWODADI AND P. T. SUGIH HARAPAN

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transport vessels because the existing harbor can only accommodate vessels with maximum draft of 3.5 meters, and the relatively long approach channel has a limiting draft of 4 meters. For this reason it is recommended that the option of unloading coal outside the existing harbor of Semarang be investigated in a feasibility study. This study should take into account the transport alternatives shown in Figure 6.4-12, including the need to construct a short rail connection (about 5 km) between the point of unloading and the existing rail system. Thus, the tradeoff between upgrading 59 km of branch line between Semarang and Purwodadi and upgrading 58 km of main line to Ngrombo followed by only 9 km of branch line to Purwodadi will have to be assessed. Factors such as the relative condition of the branch lines as well as traffic patterns on the main line can easily sway the decision. The essential requirement of the study is to consider the entire sequence of necessary operations between vessel unloading and storage at the two cement plants.

6.4.5 Coal Transport in East Java and on Sulawesi

In east Java two cement plants -- one at Gresik and one on Madura -- need to be supplied, in addition to the power plant at Paiton. Figure 6.4-13 shows the location of these plants. As discussed in Subsection 6.4.1, proximity of the unloading facility to these plants makes land transport less difficult. At the distances involved, both truck and belt conveyors should be considered as options.

A situation similar to the one in East Java exists in supplying coal to the cement plant of P.T. Semen Tonasa. This is shown in Figure 6.4-14. Although modifications are required, coal can be unloaded at the existing port facility at Biringkassi, transported by belt conveyor to a storage area nearby, and transported by truck to the cement plants. Since Tonasa's cement plants are at two different locations, locating the coal storage area near the unloading port could be the preferred solution.

6.4.6 Rail Car Requirements

Providing efficient and low-cost rail transport on Java will require a significant effort to improve the existing system, including:

- Possible upgrading of branch and main lines
- Constructing new lines to connect unloading ports and customer facilities to the existing system
- Acquiring rolling stock, including railroad cars and possibly locomotives

To gauge the impact of coal transport on rolling stock requirements a calculation was made for those routes that most likely will be served by rail. For the calculation the following assumptions were made:

- Coal will be transported by rail between unloading ports and destinations as shown in Table 6.4-3
- The rail system will be upgraded to allow for axle loading of 14 tonnes and rail cars with a net payload of 40 tonnes
- Coal will be transported by unit trains of 25 cars, carrying a total of 1000 tonnes of coal
- The unit train system will work 24 hours a day 300 days a year
- The average speed of the train will be 40 km per hour
- Loading and unloading of the train will be fully automated, requiring a maximum of 1 hour for each operation, including waiting time

Based on these assumptions, Table 6.4-3 shows the requirement for the number of unit trains in each area of Java. As shown, all destinations can be easily served with just one unit train, except the cement plants south of Jakarta. In the south-central Java area, only one unit train will be required, serving both Gombong and the Karang Talun area. The unit trains operating out of Cirebon, Cilacap, and Semarang will still have a large underused capacity and could carry significantly more coal. To service the cement plants south of Jakarta, three unit trains will be required to shuttle between Cigading and the Narogong/Citeurup area. Throughout the next 10 years, six unit trains or a total of 150 rail cars will be required. If each train is pulled by two locomotives, a total of 12 locomotives will be needed.

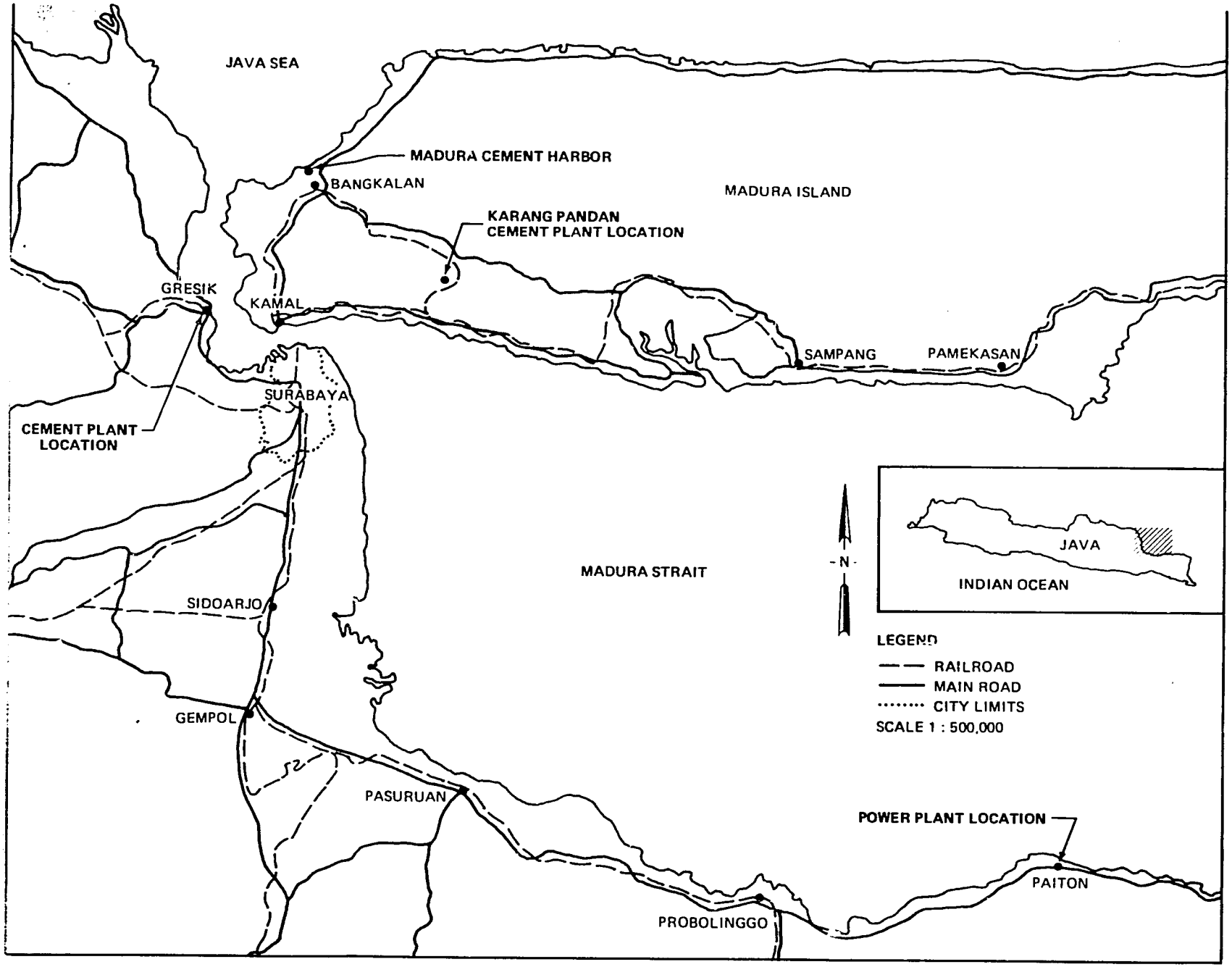

Figure 6.4-13 LAND TRANSPORT IN EAST JAVA

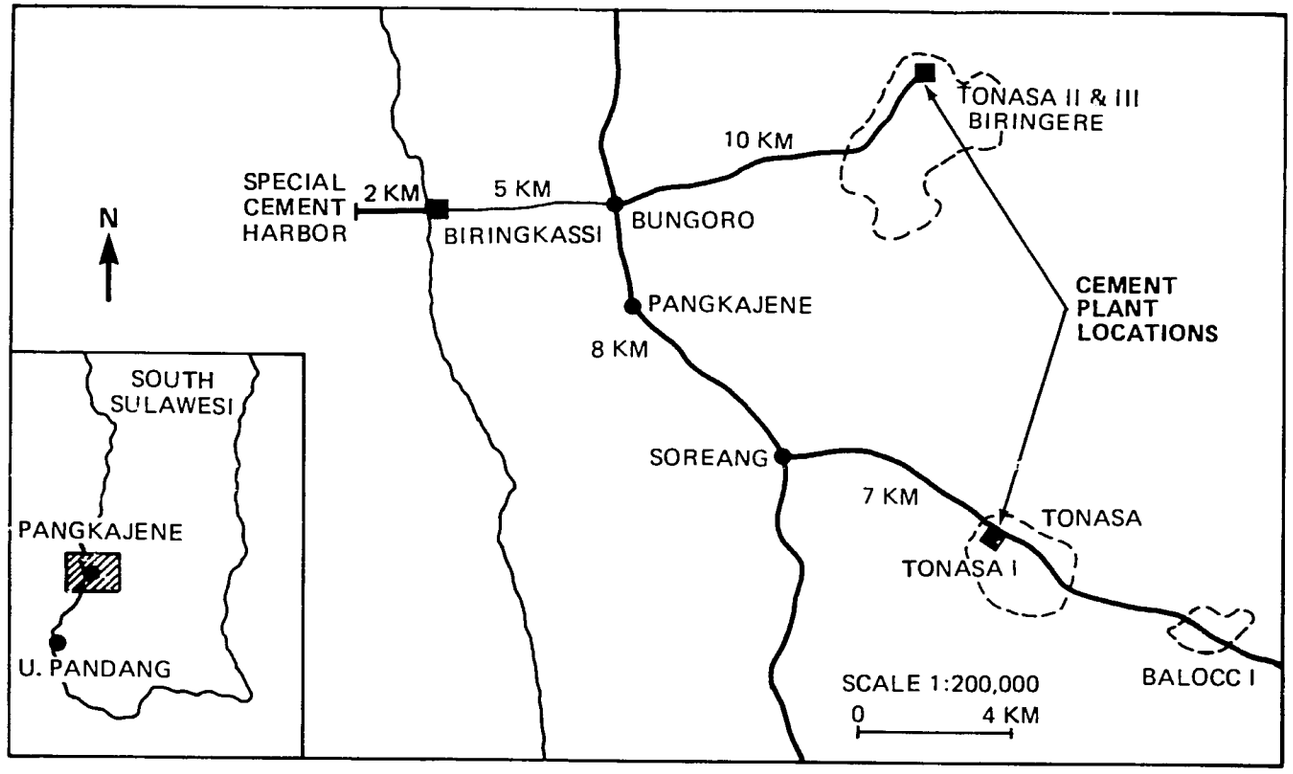

Figure 6.4-14 LAND TRANSPORT AT P. T. SEMEN TONASA

Table 6.4-3

UNIT TRAIN REQUIREMENTS FOR COAL TRANSPORT IN JAVA[a]

Area	Unloading Port	Destination	Distance[b] (km)	Coal Transport Requirements[b] (MMTPY)			Number of Unit Trains Required[c]		
				1988	1991	1994	1988	1991	1994
West Java	Cigading	Narogong/Citeurup	206	1.5	1.5	1.61	3 (2.56)	3 (2.56)	3 (2.75)
	Cirebon[d]	Palimanan	21	0.17	0.21	0.34	1 (0.07)	1 (0.09)	1 (0.14)
South-central Java	Cilacap	Gombong	68	-	0.06	0.30	-	(0.05)	(0.23)
		Karang Talun Area[b]	10	0.30	0.34	0.67	1 (0.10)	1 (0.12)	1 (0.23)
North-central Java	Semarang	Purwodadi/Tanggung Area[b]	71	0.27	0.67	0.84	1 (0.21)	1 (0.52)	1 (0.65)

(a) Each train has 25 cars and total payload of 1,000 tonnes
(b) For the purpose of rail transport, plants close to each other are treated as one destination with an average distance and transport requirements equal to the sum of requirements of each plant
(c) Unit train requirements are expressed in whole units. Requirements in parenthesis are expressed as a fraction of the unit trains required as a minimum. Thus, if 2.56 trains are required, 3 are assumed to be available, resulting in a lower utilization factor
(d) Cirebon is assumed as the unloading port instead of Cigading. The distance to Cigading makes rail transport from Cirebon to Palimanan economical

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6.5 CONCLUSIONS AND RECOMMENDATIONS

6.5 CONCLUSIONS AND RECOMMENDATIONS

This section addressed issues related to land transport of Kalimantan coal, both from future mines to loading ports on Kalimantan, and from unloading ports to customer facilities on Java and Sulawesi. Conclusions and recommendations are as follows.

6.5.1 Land Transport Requirements in Kalimantan (Subsection 6.3.1)

- With the exception of land transport out of the Tanjung area, the major land transport requirements in Kalimantan are from the South Kalimantan and Samarangau areas. In 1988 these two areas combined will account for 85 percent of all requirements, decreasing to 62 percent in 1994.

- Requirements in South Kalimantan will grow from 55 million tonne km in 1988 to 160 million tonne km in 1994.

- Requirements in Samarangau will grow from 77 million tonne km in 1988 to 90 million tonne km in 1994.

- Although no adequate transport infrastructure currently exists in any of the coal producing areas, there are no significant constraints to the development of any land transport mode.

6.5.2 Characteristics Important to Land Transport in Kalimantan (Subsection 6.3.1)

- With the exception of East Senakin, all coal production levels up to 1994 are projected to be less than or equal to 2 MMTPY.

- With the exception of the Tanjung area, all mines are less than 45 km from a possible loading point.

6.5.3 Likely Transport Modes in Kalimantan (Subsection 6.3.1)

- Of the various possible transport modes, trucking is the most likely option for all areas, except the Tanjung area. Low production levels and short distance favor this option.

- Conveyors may have to be considered under conditions where new haul roads have to be built or where projected production levels exceed the range of economic operations of a trucking system. The Sangatta area is an example of the first condition, and the east Senakin area is an example of the second condition.

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- It is very unlikely that rail will be a viable land transport option in Kalimantan.

- For all practical purposes, the use of slurry pipelines for land transport of Kalimantan coal can be eliminated.

6.5.4 Land Transport from the Samarangau Area (Subsection 6.3.2)

- Two alternatives for transport of coal from the Samarangau area to the coast have been considered:

  - To a deepdraft harbor on the coast, a distance of at least 100 km

  - To a barge loading point on the Kuaro River, a distance of 45 km

- Since trucking is the most likely transport option under both alternatives, use of the loading point on the Kuaro River will most likely result in an economically advantageous overall transport system, even if coal were to be transloaded into larger vessels to be shipped to final destinations.

- In view of the above, the potential for operating a join Kideco-Utah loading facility on the Kuaro River should be fully explored as soon as possible.

6.5.5 Vehicle Requirements for Kalimantan Coal Transport (Subsection 6.3.3)

- To transport the total coal production by truck from the mines to respective loading ports (except for the Tanjung area), a total of 76 30-tonne truck-trailer combinations will be required in 1988, increasing to 162 in 1991, and 201 in 1994.

- The number of trucks required to sustain projected Kalimantan coal production levels requires a vehicle acquisition program with an average annual requirement of about 50 to 100 truck-trailer combinations per year.

6.5.6 Land Transport Requirements on Java and Sulawesi (Subsection 6.4.1))

- Land transport requirements on Java and Sulawesi far exceed Kalimantan. In 1988, land transport requirements on Java and Sulawesi are 418.5 million tonne km versus 156 million tonne/km on Kalimantan, excluding the Tanjung area. Similar numbers for 1991 and 1984 are 469.1 versus 325 and 578.6 versus 401, respectively.

- Since power plants at Paiton and Cilacap on Java are located on the coast, no land transport of coal is involved other than within the limits of the power plant site. The only requirement for land transport of coal on Java and Sulawesi is to supply cement plants.

- Of all areas on Java and Sulawesi, the largest requirements for land transport are in west Java to supply two cement plants south of Jakarta and one near Cirebon. By using Cigading on the west coast of Java as the officially designated unloading port, transport requirements to supply these three plants account for 91, 84, and 81 percent of the total requirement on Java and Sulawesi in 1988, 1991, and 1994, respectively.

- Based on the above, the major task of transporting Kalimantan coal overland is not on Kalimantan but on Java and in particular in west Java to supply cement plants at Narogong, Citeurup, and Palimanan near Cirebon.

- Land transport on Java and Sulawesi can broadly be categorized in terms of two types of situations, cement plants with inland locations (Table 6.5-1) and those with coastal or near-coastal locations (Table 6.5-2). Approximate transport distances in the tables are based on officially designated unloading ports.

6.5.7 Land Transport Options on Java and Sulawesi (Subsection 6.4.1)

- Population density, current road congestion, lack of available land, and the high cost of new road construction virtually rule out the use of trucks to supply cement plants with inland locations (listed in Table 6.5-1). Fortunately, Java possesses an extensive rail system and most inland locations can, with some modifications to the existing system, be reached by rail. As a result the only viable land transport solution for supplying cement plants located inland is to use rail. The only other long-distance option -- slurry pipeline -- is unlikely because of the already existing rail system, and throughputs are too small to justify the expense of slurry preparation, pipeline construction, and dewatering of coal.

- Land transport options to supply cement plants with coastal or near-coastal locations (listed in Table 6-8), are in general truck and conveyor. The only reason that rail could be an option in such cases is because rail connection between unloading port and cement plant already exists, as in the case of the cement plant at Karang Talun near Cilacap.

Table 6.5-1

CEMENT PLANTS WITH INLAND LOCATIONS

Area	Location	Approximate Transport Distance (km)
West Java	Narogong	201
	Citeurup	211
	Palimanan	382
South-central Java	Gombong	68
North-central Java	Tanggung	74
	Purwodadi	68

Table 6.5-2

CEMENT PLANTS WITH COASTAL OR NEAR-COASTAL LOCATIONS

Area	Location	Approximate Transport Distance (km)
South-central Java	Cilacap	10
	Karang Talun	10
East Java	Gresik	1.5
	Karang Pandan (Madura)	30
Sulawesi	Tonasa	15
	Bitung (Menado)	15

- Compared to supplying cement plants that are located inland, land transport to supply coastal or near-coastal cement plants is not considered a major problem. Within the scope of studies to convert existing plants to coal or to construct new coal-fired plants, the optimal land transport mode (truck or conveyor) needs to be determined. Cement plants with an inland location provide a far more complex situation. In this case, the choice of unloading port and the associated land transport system and rail routing require careful study to ensure that the lowest cost transport system is developed.

6.5.8 Coal Transport to Cement Plants South of Jakarta (Subsection 6.4.2)

- Cigading has been officially designated as the unloading port to supply cement plants south of Jakarta. Using Cigading and the existing rail system, INDOCEMENT has developed a plan to supply 4,000 tonnes per day to its facilities at Citeurup. This plan provides an expensive solution because:

  - The transport distance is long (211 km)

  - The amount transported per rail car is small (23 to 25 tonnes)

  - The amount transported per train is small (400 tonnes)

  - Transloading from rail to truck and multiple handling is involved

  - Additional investment is required for containers to carry the coal, and for a fleet of trucks to carry the containers over the last 45 km to the cement plant at Citeurup

- Although it is possible that the type of transport plan developed by INDOCEMENT is the only practical scheme for west Java, it appears that there are other alternatives that could provide a more economical land transport solution.

- For the purpose of preliminary screening, a new coal unloading facility near Tanjung Priok and one near Marunda on the north coast of west Java were postulated as alternatives to Cigading. With these three alternative unloading ports, seven alternative land transport systems were formulated, using various different rail routings. Subsequently, these alternatives were compared on the basis of construction cost required to provide a transport system that would result in a rail service of similar quality.

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- On the basis of the above preliminary screening, it was concluded that Cigading is not necessarily the most economic unloading port on west Java and that ports such as Tanjung Priok and Marunda could well provide a better solution. In addition, and if Cigading would have to be selected as the unloading port for other reasons, the current routing used in the INDOCEMENT plan could be improved by constructing a new railroad line directly to the plant facility at Citeurup, avoiding transport through the Jakarta area and coal transport by truck from Bekasi to Citeurup.

- Based on the above conclusion it is recommended that a feasibility study be undertaken as soon as possible to determine the optimal land transport system to supply the cement plants at Narogong and Citeurup. In addition, this study should address the entire coal transport chain to bring Kalimantan coal to these plants. The latter is considered especially important because it would, for the first time, demonstrate how and at what cost Kalimantan coal can be made available to domestic consumers, taking into account all the logistical requirements involved. Major work elements of the study relate to:

  - Loading ports and terminals in Kalimantan

  - Type and size of vessel for sea transport

  - Unloading ports and receiving terminals in west Java

  - Formulation of entire coal chain alternatives

  - Evaluation of coal chain alternatives in terms of coal price to the consumer

  - Specification of construction projects to implement the preferred alternative

6.5.9 Coal Transport to the Cement Plant at Palimanan near Cirebon (Subsection 6.4.2)

- Cigading has also been designated to supply the cement plant at Palimanan, which involves a transport distance of 382 km.

- Without analysis it is concluded that coal transport in west Java over 382 km most likely is a very unattractive alternative to the consumer. If the consumer also has the option to fire the cement plant with natural gas from a nearby source, it appears likely that the latter is preferred because the logistics of getting coal to the plant are prohibitive.

- The port of Cirebon is close to the cement plant at Palimanan and should be studied as an alternative to Cigading. A feasibility study should be conducted to identify the best way of transporting coal over the relatively short distance (21 km) from Cirebon Harbor to Palimanan.

6.5.10 Coal Transport in South-central Java (Subsection 6.4.3)

- Facilities at Cilacap (the unloading port) as well as the condition of the existing rail system in south-central Java, leads to the general conclusion that land transport of coal should not present major problems.

- However, prior to adopting a particular land transport scheme it is recommended that a feasibility study be undertaken to investigate the possibility of locating coal unloading facilities outside the existing Cilacap port complex and closer to the two cement plants near Karang Talun. If such location is technically feasible, coal transport can be accomplished by simple conveyor systems, resulting in lower transport cost.

6.5.11 Coal Transport in North-central Java (Subsection 6.4.4)

- Future cement plans in north-central Java are to be supplied out of Semarang via the existing rail system in the area. Although alternative rail routes will need to be evaluated, this issue is of minor importance. The key issue in this area is the interface between sea transport and land transport. The current harbor of Semarang is inadequate to receive coal.

- It is recommended that a feasibility study be undertaken to determine how and where coal will be unloaded in the Semarang area and how the connection is made with the existing railroad system to supply the two cement plants near Purwodadi.

6.5.12 Rail Car Requirements for Coal Transport on Java (Subsection 6.4.6)

- Using trains of 25 cars carrying a total of 1,000 tonnes per train, the total land transport requirements over the next 10 years to supply inland cement plants can be met by six unit trains; three to supply cement plants south of Jakarta, one to supply the cement plant near Palimanan, one in south-central Java, and one in north-central Java.

- With six unit trains, total demand for railcars is 150 cars with a maximum demand of 20 locomotives. With these unit trains all destinations can be easily served, leaving a considerable amount of capacity that could be used to carry more coal for other uses. In conclusion, demand for rolling stock for coal transport is relatively minor.

6.6 REFERENCES

6.6 REFERENCES

6-1 Wardiman Djojonegoro, Ir., Technical Issues in Coal Transportation, paper presented at the Indonesia-United States Coal/Lignite Symposium, October 18-22, 1983, Jakarta.

6-2 Eldridge, C.C., Lijesen D.P., Slater, J.A., Snoek, P.E., Land Transport and Terminals: "What Makes Sense in Indonsia?", paper presented at the Indonesia-United States Coal/Lignite Symposium, October 18-22, 1983, Jakarta.

6-3 Report of meeting on March 15, 1984 between Ministers of Communications, Industry, and Mines and Energy, prepared by Drs. Soetaryo Sigit, Secretary General of the Ministry of Mines and Energy, March 20, 1984.

6-4 Buku Jarak Singkat Bagi Angkutan Penumpang, PJKA, 1979.

6-5 Indonesian State Railways, Facts and Figures, PJKA, 1979.

6-6 Perkiraan Kebutuhan Dana Investasi Pendukungan Angkutan Batubara, Tahun 1984-1990, March 31, 1984, Departmen Perhubungan.

6-7 Indonesian Shipping Directory, 1982-1983, Marindo Press, Jakarta.

6-8 East Java Steam Power Plant, Feasibility Study, Volume 5, Site Selection Report, Electrowatt Engineering Services, Ltd., Zurich, in cooperation with Nippon Koei Co., Ltd., Tokyo and P.T. Amythas and Associates, Jakarta, July 1982.

6-9 Penelitian Pembuatan Desain Sistim Perhubungan Nasional, 2 Volumes, P.T. Indulexco for Departmen Perhubungan, July 1983.

Section 7

IMPLEMENTATION OF KALIMANTAN COAL TRANSPORT

This section contains the following subsections:

- 7.1 Introduction
- 7.2 Shipping
- 7.3 Shipbuilding and Repair
- 7.4 Manufacture of Trucks and Railroad Cars
- 7.5 Institutions
- 7.6 Conclusions and Recommendations
- 7.7 References

7.1 INTRODUCTION

7.1 INTRODUCTION

The objectives of this final section are threefold:

- Review the country's current capabilities in shipping and shipbuilding to evaluate shipping and vessel requirements
- Review the country's current capability to manufacture trucks and rail cars needed in coal transport
- Review the existing institutional structure for development and transport of Kalimantan coal

While Sections 5 and 6 dealt with coal transport as a technical problem to be solved, this section focuses on existing conditions that will strongly influence any transport solutions. Thus the focus shifts to issues such as the type and size of vessel currently available to transport coal. In this regard it is important to understand that solutions for both sea and land transport of Kalimantan coal will ultimately result from joint consideration of technical requirements and domestic support capabilities. Transport systems other than the least costly ones may have to be implemented because they provide the only reasonable solution within the real world context of the country's development.

Domestic support capabilities and the existing institutional structure related to coal transport are probably the most important factors determining the government's success in developing Kalimantan coal resources. They are also the most difficult areas of analysis.

To provide for efficient and low cost coal transport systems, the most significant improvements are needed in the area of domestic support capabilities. In addition, an efficient organization able to conceive and implement such systems must be developed.

The discussion in this section represents merely a first step towards resolution of implementation issues. Much more work will be needed to fully address how specific coal supply chains between individual

producers in Kalimantan and consumers in Java and Sulawesi can be efficiently organized. This involves selection of a sea transport company, deciding the type of vessels to be used, setting transport tariffs and other charges, and many other issues.

With this caveat in mind, Subsection 7.2 reviews the shipping system in Indonesia to determine how future sea transport of coal fits into the current system. Subsection 7.3 reviews domestic shipbuilding and repair capabilities to evaluate requirements for construction of new coal transport vessels. Subsection 7.4 discusses requirements for coal transport trucks and railroad cars in view of current capabilities. Finally, Subsection 7.5 discusses the institutional structure, as it relates to coal development and transport. Subsection 7.6 summarizes conclusions and recommendations.

7.2 SHIPPING

7.2 SHIPPING

7.2.1 Introduction

Significant efforts are currently being undertaken to improve the country's shipping related industries. Most important among these are:

- Implementation of the Inter-island Liner System (ILS). This provides a regular, reliable, and comprehensive system of inter-island sailings. Within the system, four gateway ports (Tanjung Priok, Surabaya, Belawan, and Ujung Pandang) have been established to exclusively handle import and export cargos. Cargos are shipped from feeder ports (points of origin) to trunk and collector ports, and then to gateway ports. Each of the four gateway ports serves its own region, sustained by their own trunk-collector and feeder ports. Trunk service is accomplished with 24 trunk ports.

- Implementation of a National Ship Scrapping Policy. This policy requires that all ships over 25 years old in January 1985 be removed from the domestic fleet. This policy will resolve one of the key problems of domestic shipping; excess capacity coupled with very high average age of domestic ships, resulting in inefficient ship operations. Reportedly, a total of no less than 220 ships will be scrapped.

- Improvement and Upgrading of Ports. Many ports and harbor facilities throughout the country are being improved, including Tanjung Priok, Surabaya, Belawan, Panjang, Banjarmasin, Balikpapan, Bitung, Sorong, Semarang, Palembang, Cirebon, Cilacap, and many others.

- Implementation of a Major Domestic Shipbuilding Program. This program is aimed at replacing scrapped capacity as well as providing future capacity. The program calls for construction of three sizes of vessels: 1,000 DWT, 2,000 DWT, and 3,000 DWT. It is projected that at least 100 of the new vessels, called Caraka Jaya, will be built, starting in 1985-1986.

As a result of the above programs, the country is in a state of flux, moving from what can be called the "old situation" towards a "new situation" that will reflect the improvements made possible by these programs. Taking this into account, the discussion in this and the

following section provides a profile of the shipping and shipbuilding situation as of 1984.

7.2.2 Current Situation in Shipping

Vessel Classifications. The country's shipping system can be broadly classified into domestic and international shipping components, which can be further grouped into several classes of service. Domestic shipping can be grouped into:

- Inter-island Service (ILS). Regular liner service on fixed routes
- Local Service. Sea transport service exclusively within each of the country's nine maritime districts
- Special Service. Shipping services to the following industries:
  - Offshore support
  - Forestry
  - Fishing
  - General industry (cement, fertilizer, etc.)
  - Mining
  - Oil and gas
- Pioneer Service. Sea transport to outlying and less populated areas of Indonesia
- "People's" Service. Transportation provided by many individuals throughout the country in their own small motorized sailing vessels, maintaining essential and traditional services to bring goods to market, transport people, etc.

International shipping can be grouped into:

- General Service. Regular liner service to Europe, Japan, America, etc.
- Special Service. General cargo, bulk transport, and container services

A total of about 295 companies are engaged in shipping services. Inter-island services are provided by 46 companies, and local services by 130 companies. About 113 companies provide special services, with 22 of them involved in international trade. Six companies provide regular liner service to areas outside Indonesia. Most companies are privately owned. The Government owns four companies:

- P.T. Pelni, the largest ILS company
- P.T. Djakarta Lloyd, involved in international liner service
- P.T. Bahtera Adiguna, involved in both domestic and international special service
- P.T. Angkutan Pertambangan (P.T. AP), a small company set up in 1968 to support the mining industry

Fleet Breakdown. Table 7.2-1 provides an approximate classification of the total Indonesian fleet as of 1984. This table, compiled from reviews and analysis of many different sources, only provides an approximation of the number, type, and size of vessels in the fleet. Table 7.2-2 categorizes the total fleet by type of vessels. The fleet can be characterized as follows:

- A total of about 8,500 vessels, with an approximate carrying capacity of 6.5 million DWT
- A large domestic fleet that is generally old and very small, not exceeding 2,000 DWT in most cases
- Almost 50 percent of the domestic fleet are sailing vessels engaged in traditional "people's" service, including small vessels, wooden vessels, and special vessels, this percentage increases to 79
- About 15 percent tugboats and barges, limited in carrying capacity to less than 2,000 to 3,000 DWT
- About 6 percent steel vessels, able to carry general cargo
- A large fleet of mostly barges, tugboats, and small motor vessels engaged in special purposes such as offshore support, forestry, fishing, mining, and the oil and gas industry

Table 7.2-1

APPROXIMATE CLASSIFICATION OF INDONESIAN FLEET
BY TYPE OF SERVICE AS OF 1984[a]

Item	Number of Vessels Estimate	Approximate Carrying Capacity (10,000 DWT)	Notes
Domestic Fleet			
Inter-island service	422	53.5	About 85 percent regular steel vessels, with the remainder barges, wooden ships, etc. Average size about 1,000 to 1,500 DWT
Local service	1,201	27.4	Operates exclusively within each of the nine districts of Indonesia. Small vessels, most between 50 and 200 DWT
Special service			
Offshore support	414	19.9	Special offshore vessels, barges, supply ships, and crew-carrying motor boats. Barges average 1,000 DWT
Forestry	665	43.0	Vessels owned and operated by forest industry companies. Includes tugboats, barges, motor ships, and special purpose ships. Barges and motor ships less than 1,000 DWT
Fisheries	350	5.4	Relatively small fishing boats of 100 to 200 DWT owned and operated by companies exclusively engaged in the fishery industry
General industry	56	17.7	Ships owned and operated by companies transporting various products including salt, rice, vegetables, etc. Consists of barges, tugboats, motor vessels, and special vessels. Vessels generally not larger than 1,000 to 2,000 DWT
Mining	340	18.8	Tugboats, barges, and motor ships, owned and operated exclusively for transport of minerals and mineral products such as rock, nickel ore, alumina, tin, limestone, etc.
Oil	742	154.7	Owned and operated by Pertamina and include barges, tugboats, supply vessels, lighters, etc.
Pioneer fleet	35	2.3	Largely government owned, and maintain regular service to and among outlying and less populated areas of Indonesia
Sailing fleet (motorized)	4,015	61.0	Relatively small traditional vessels
DOMESTIC FLEET	8,240	403.7	

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Table 7.2-1 (Cont'd)

Item	Number of Vessels Estimate	Approximate Carrying Capacity (10,000 DWT)	Notes
Ocean-going Fleet			
General service	64	85.4	Engaged in international trade with Europe, U.S., Japan, Canada, Taiwan, Hong Kong, and Middle East. Operated by six companies. Includes full and semi-container ships, conventional-cargo, multipurpose vessels, and bulk carriers. Average size about 13,000 DWT
Special Service	157	160.0	Consists of oil tankers (average 10,000 DWT), log carriers (average 6,500 DWT), ore carriers (average 40,000 DWT), wheat carriers (average 28,000 DWT), and general cargo vessels (about 7,000 DWT)
OCEAN-GOING FLEET	221	245.4	
GRAND TOTAL	8,461	649.1	

(a) Profile compiled based on a number of sources, including Reference 7-1

Table 7.2-2

APPROXIMATE CLASSIFICATION OF INDONESIAN FLEET BY TYPE OF VESSEL[a]

	Steel Vessels Able to Carry General Cargo	Tug Boats	Barges	Small, Sailing, Wooden, and Special Purpose Vessels	Total
Domestic Fleet					
Inter-island service	345	2	30	45	422
Local service	-	-	-	1,201	1,201
Special service					
Offshore support	-	200	214	-	414
Forestry	-	275	265	125	665
Fisheries	-	-	-	350	350
General industry	17	6	19	14	56
Mining	14	117	173	36	340
Oil	-	-	-	742	742
Pioneer fleet	-	-	-	35	35
Sailing fleet	-	-	-	4,015	4,015
DOMESTIC FLEET	376	600	701	6,563	8,240
PERCENT OF DOMESTIC FLEET	5	7	9	79	100
Ocean-Going Fleet					
General service	64	-	-	-	64
Special Service	149	-	-	72	221
OCEAN-GOING FLEET	149	-	-	72	221
GRAND TOTAL	525	600	701	6,635	8,461
PERCENT OF TOTAL FLEET	6	7	8	79	100

(a) Derived from same data as Table 7.2-1

- A relatively small ocean-going fleet. Since most Pertamina tankers are used domestically, the number of vessels for international trade is small

- Ships engaged in International Liner Service are relatively small, comparable to trampers

- Oil tankers (about 50) and log carriers (about 85) make up most of the ocean-going special services fleet.

Inter-island Cargoes. Total inter-island cargo handled by the domestic fleet is shown in Table 7.2-3. Although less than in the past, crude oil and refined products account for about half of all inter-island cargo in the country.

Kalimantan coal transport will be 4.05 MMTPY in 1988, 7.10 MMTPY by 1991, and 11.48 MMTPY by 1994. In view of Table 7.2-3, it can be concluded that Kalimantan coal transport alone will become the second largest commodity in the inter-island trade. If domestic market requirements justify postulated production levels, the volume of Kalimantan coal to be transported could easily surpass the combined total of all other commodity flows, with the exception of crude oil and refined products. Such a situation would clearly present an enormous task for the domestic shipping system.

7.2.3 Suitability of the Current Fleet for Coal Transport

Using minimum coal transport cost as the main criterion, Section 5 developed two sea transport systems:

- Direct shipping between Kalimantan and customers on Java and Sulawesi

- Transshipment in Kalimantan prior to inter-island transport.

The vessel requirements for each of these systems are repeated in Table 7.2-4. The objective of the following discussion is to evaluate how these requirements match the current fleet.

Table 7.2-3

INTER-ISLAND CARGO BY MAJOR COMMODITY GROUPS
(million tonnes)

Cargo	1979	1980	1981	1982	1983
Food related products	2.5	2.9	3.1	3.3	3.7
Raw materials	2.7	3.4	4.2	3.8	4.6
Semi-finished and finished products	1.8	2.6	2.5	3.2	3.1
Crude oil and refinery products	14.9	13.9	13.2	14.0	14.9
Others	2.3	2.6	3.0	3.4	3.5
TOTAL	24.2	25.4	26.0	27.7	29.8
Percent crude oil and refinery products	61.6	54.7	50.8	50.5	50.0

Source: Reference 7-2

The most important point is that the vast majority of the domestic fleet is entirely unsuitable for coal transport. As indicated in Table 7.2-2, some 79 percent of all vessels are either too small, of unsuitable type, or are already committed to dedicated services and therefore unavailable for coal transport.

Barges, while numerous, are generally far smaller than the 10,000 DWT required for coal transport. Similarly, most tugboats sized to support small barges (up to a maximum of 3,000 DWT) are inadequate for coal transport. In addition, a large percentage of barges and tugboats are in dedicated service and therefore not available.

If a number of small barges could be made available for coal transport, the transport cost for coal would be significantly higher than if 10,000 DWT barges were used, particularly on the inter-island routes.

Table 7.2-4

FLEET COMPOSITION AT THE END OF PHASES I, II, AND III FOR OPTIONS 1 AND 2[a]

Vessels	Number of Vessels		
	1988	1991	1994
Option 1: Direct Shipping			
10,000 DWT barges	10	16	17
Tugs	10	16	17
10,000 DWT bulk carriers	1	3	8
20,000 DWT bulk carriers	-	1	2
Option 2: Transshipment			
10,000 DWT barges	10	7	12
Tugs	10	4	5
10,000 DWT bulk carriers	1	3	1
40,000 DWT bulk carriers	-	3	6

(a) Developed in Subsections 5.4 and 5.5

Round-trip transport cost per tonne for a one-way distance of 25 nautical miles with a 2,000 DWT barge was estimated to be 28 percent higher than using a 10,000 DWT barge (see Table 5.4-13). If one-way distance increases to 750 nautical miles, round-trip transport cost per tonne increases by 86 percent of the cost of using a 10,000 DWT barge. Thus, the use of 2,000 to 3,000 DWT barges carries a serious economic penalty and should be discouraged whenever possible.

The only category of vessels that could possibly be used for coal transport are the steel vessels able to carry general cargo. Most of these vessels, however, are tied up in the inter-island service and ocean-going general service. This makes them unavailable for coal transport. In addition, the inter-island fleet is too small and too old. Finally, the operational ban on ships more than 25 years old on January 1, 1985 may reduce this fleet by as much as 30 to 40 percent of its carrying capacity. As a result, existing cargo demand will be spread over a much smaller fleet, making it very unlikely that there would be fleet capacity to carry coal.

Among the remainder of the fleet, consisting of special services vessels, there are two distinct possibilities of vessel availability for coal transport:

- Vessels owned and operated by P.T. AP
- Specialized log carriers made available by the government's decision to ban the export of logs in favor of the export of processed timber. As of January 1985, 80 to 90 log carriers less than 20 years old will be available.

Beyond these two possibilities, there are no other vessels available in the special services classification, because most of them are committed to dedicated service. For example, the special services ocean-going fleet includes Pertamina tankers, three ore carriers, and three wheat/flour carriers, none of which are available for coal transport.

P.T. AP owns and operates eight small bulk carriers of 3,453 DWT each. These vessels were ordered in 1964 by the government for use in transporting mineral products, particularly coal. The vessels, equipped with self-unloading gear, were delivered in 1966, 1967, and 1968. Initially, the ships were operated as a special project within the then Ministry of Basic Industry and Mining. In 1968 the government owned P.T. AP was formed. Currently, P.T. AP has about 370 employees; 240 crew members for eight ships, and 130 office personnel. P.T. AP's main office is in Jakarta, with branch offices in other cities.

In the early years, P.T. AP's vessels carried coal and other mineral products. In 1971 coal transport ceased, while transport of other mineral products (iron sand, nickel ore, asphalt, tin) as well as other products (rice, sugar, flour) kept increasing. To accommodate this change in cargo, P.T. AP's vessels were modified by installing loading cranes with grab buckets on most ships and removing the self-unloading gear. Two ships were modified to be able to carry containers between Jakarta and Singapore on a regular weekly schedule.

Because of the renewed interest in coal, P.T. AP has been called upon to increase participation in coal transport. This includes transport of Ombilin coal in West Sumatra to domestic destinations, Malaysia, Thailand, and South Korea. P.T. AP will also be involved in transporting Bukit Asam coal via Kertapati to Suralaya, and anthracite to the mini-cement plant at Kupang on Timor. For coal transport to Suralaya, and until the new self-unloading vessel for transport between Tarahan and Surabaya is ready, P.T. AP will use three 6,000 DWT flat top barges equipped with grab buckets to unload at Surabaya.

P.T. AP's current vessels are undersized, however, for Kalimantan coal transport. In addition, they are becoming old and may not be available because of other transport commitments. Although P.T. AP could be assigned the responsibility of transporting Kalimantan coal, they would have to acquire new vessels and start developing their fleet. As such, the use of P.T. AP does not represent a transport solution that can be implemented on short notice.

In conclusion, the only real possibility for Kalimantan coal transport, based on availability of vessels, is provided by the existing fleet of log carriers that are less than 20 years old. Table 7.2-5 presents a profile of the log carrier fleet. The average size is about 6,500 DWT. Log carriers are versatile vessels that can carry coal, even in their present state. For example, small private companies along the Mahakam River (e.g., P.T. Bukit Baiduri) have been transporting coal in log carriers owned and operated by P.T. Bahtera Adiguna. If such vessels would carry coal on a continuous basis, vessel modifications would be warranted for both safety and efficiency reasons. Whether log carriers should be used to transport Kalimantan coal is a subject for further study. It should be noted that, in comparison with the vessel requirements shown in Table 7.2-4, they are smaller than desired. Nonetheless, only detailed financial analyses of using such vessels vis-a-vis new 10,000 DWT barges and/or new bulk carriers of at least 10,000 DWT can provide a definitive answer. For the time being, it is assumed that some of the existing log carrier fleet may be used for coal transport during Phase I (up to 1988). Thus, a sea transport system for

Table 7.2-5

FLEET PROFILE OF LOG CARRIERS LESS THAN 20 YEARS OLD

Owner/Operator	Number of Vessels	Total Capacity (DWT)	Average Capacity (DWT)	Commercial Operation Dates
P.T. Andhika Lines	18	122,504	6,806	1973-1983
P.T. Arpeni Pratama Ocean Lines	4	27,704	6,926	1972-1975
P.T. Bahana Utama Lines	8	51,415	6,427	1971-1981
P.T. Bahtera Adhiguna	4	29,604	7,401	1973-1980
P.T. Bhinneka Lines	7	41,886	5,984	1964-1976
P.T. Dasa Lines	2	12,229	6,115	1970-1977
P.T. Garsa Lines	2	14,305	7,153	1967-1978
P.T. Gurita Lintas Samudra	5	34,633	6,927	1968-1977
P.T. Indo Baruna Bulk Transport	2	12,105	6,053	1975
P.T. Mare Sakti	2	16,445	8,223	1975
P.T. Moges Shipping	3	20,564	6,855	1966-1977
P.T. Pahoka	1	6,500	6,500	1977
P.T. Pakarti Tata	3	21,700	7,233	1978-1979
P.T. Pan Asia Express Lines	1	5,772	5,772	1964
P.T. Porodisa Shipping Lines	5	32,511	6,502	1968-1976
P.T. Rimba Segara Lines	2	11,835	5,918	1970-1975
P.T. Samudera Kallog	3	18,418	6,139	1968-1970
P.T. Sarunta Waya Raya Lines	5	31,193	6,239	1968-1978
P.T. Sentarum Lines	3	18,316	6,105	1970-1978
P.T. Wahansa	4	22,856	5,714	1968-1975
TOTAL	84	552,495	6,577	1964-1983

Source: Reference 7-3

Kalimantan coal could be started with the use of converted log carriers. To provide further insight into this option, the following subsections discuss the feasibility of converting log carriers and the number of vessels required during Phase I.

7.2.4 Conversion Feasibility of Log Carriers

A brief analysis was conducted to explore the feasibility of converting existing cargo vessels currently configured as log carriers to colliers. It was assumed that this would be a simple conversion retaining the present hull of the ship intact. However, the alternative of increasing ship length and carrying capacity and providing sophisticated coal-handling facilities (cutting out the old hold section of the ship and inserting a new, prefabricated section) might prove advantageous under some circumstances. This alternative has been used extensively in tankers and colliers.

As an example for study, the Adhiguna Dharma, owned and operated by P.T. Bahtera Adiguna, was selected. Geibi Shipbuilding Co., Ltd. drawings of the midship section, and the general arrangements of the 7,200 DWT were used as study references (see Table 7.2-6). Calculations were made following the American Bureau of Shipping (ABS) Rules for Building and Classing Steel Vessels, 1983. Naval architectural principles outlined in Reference 7-4 were used. Calculation results were expressed in terms of tonnes of required steel construction to permit cost estimating on the basis of cost per tonne and to facilitate comparison with other alternatives such as building coal barges.

The following simplifying assumptions were made:

- No provisions for loading/unloading. It was assumed that this could be accomplished by using either pier-side facilities or the ship's existing booms and winches, modified as necessary to employ grab buckets (clamshells) for self-unloading.

- No provisions for prevention of coal fires. If required, a sprinkling capability could readily be added.

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Table 7.2-6

PRINCIPAL DIMENSIONS OF THE LOG CARRIER "ADHIGUNA DHARMA"

Item	Measurement
Length (O.A.)	107.6 meters
Length (P.P.)	100.6 meters
Breadth (Mld.)	17.0 meters
Depth (Mld.)	8.5 meters
Draft (designed)	6.75 meters
Gross tonnage (aprox.)	4,300 tons
Dead weight (aprox.)	7,200 tonnes
Main engine (diesel)	4,500 PS x 1 set
Speed, service 85%, S.M. 15% (aprox.)	12.9 knots
Trial maximum speed (aprox.)	15.5 knots
Crew	30 persons

To meet ABS thickness requirements for ships to be unloaded by grab buckets, the alteration design provides for a doubler plate to be added to the inner bottom. This plate was increased slightly beyond the ABS requirements to allow for corrosion. Plate thickness was estimated at 9 mm, of which 1,080 m^2 will be required. Attachment will be by welding. The open construction in way of transverse frames will have to be sheathed to provide a smooth pocket-free construction for coal handling. The frames are close enough together that sheathing can be welded directly to them. Based on current practice and on ABS criteria for bulkhead design, 9 mm plate was also selected for the sheathing, of which 1,015 m^2 will be required.

With respect to construction methods, individual plates will be welded into the ship, with little or no prefabrication requirements. No drydocking would be required, so minimal shipyard facilities would be

required. Depending on the regulatory agencies, quality control requirements should be minimal because the ship's girder will be strengthened by the alteration.

Total new plate requirements are 18.86 m^3, which implies that the total steel weight added as a result of the alteration will be about 150 tonnes. (The quality of the steel material should conform to the existing ship's specifications as shown in the referenced Geibi drawings.

To estimate the total cost for the alteration, a unit cost of 2.5 million rupiah/tonne of steel construction was assumed for new ship construction. Allowances to this unit cost are made to account for the fact that alteration of an existing ship is generally more expensive than new construction. Table 7.2-7 shows total conversion cost with the assumptions made for these allowances. Total conversion cost is estimated at about 0.5 billion rupiah which at 1,000 rup per US$1 implies that the conversion of the 7,200 DWT Adhiguna Dharma is estimated to cost about US$0.5 million or US$68/DWT.

The above estimate provides rough order of magnitude cost only and actual cost may differ by as much as ± 25 percent. However, in comparison with new built costs of various types and sizes of vessels listed in Table 5.4-2, it shows that the cost of conversion is significantly below that of new built cost. For example, a new 5,000 DWT barge-tug combination is estimated to cost US$7 million, or US$1,400/DWT, which is more than 20 times the cost per DWT of converting the Adhiguna Dharma.

7.2.5 Use of Log Carriers During Phase I

To calculate the approximate number of vessels that would be required if log carriers were to be used during Phase I of Kalimantan coal development, the following assumptions were made:

- The average log carrier has a nominal carrying capacity of 6,500 DWT and an effective carrying capacity of 6,000 tonnes of coal

Table 7.2-7

ESTIMATED CONVERSION COST FOR ADHIGUNA DHARMA

Cost Item	Total Cost (million rupiah)
Cost of New Construction	
150 tonnes x 2.5 million rupiah/tonne	375
Preparation Allowance	
Allowance for rip-out and preparation of vessel for alteration: 10 percent of cost of new construction	37.5
Installation Allowance	
Allowance for installation complexity compared with new construction: 20 percent of cost of new construction	75.0
TOTAL CONVERSION COST	487.5

- Vessel speed is the same as the service speed of the Adhiguna Dharma (12.9 knots)
- Loading and unloading capacities are as indicated in Table 5.5-5, except for Gresik/Madura, Semarang, and Biringkassi. For the latter, an average unloading capacity of 400 TPH is assumed
- Number of commission days and total waiting time are the same as used in Section 5 (340 days, 16 hours)
- Log carriers, loaded to 6,000 DWT can exit all loading ports. In case of draft restrictions, log carriers could still be used, but would have to carry less coal (4,000 to 5,000 tonnes)

With the above assumptions, Table 7.2-8 shows the number of log carriers required to serve the seven routes existing in 1988. To transport a total of 4.05 MMTPY, three log carriers would have to operate out of Linding, seven out of Tanah Merah, and two out of Tanjung Batu. In

Table 7.2-8

REQUIREMENTS FOR LOG CARRIERS TO MEET SEA TRANSPORT
REQUIREMENTS IN 1988

Route	One Way Distance (Nautical Miles)	Round-trip Time					Annual Transport Requirements (MMTPY)	Number of Vessels Required	
		Loading (Hours)	Unloading (Hours)	Sailing (Hours)	Waiting (Hours)	Total (Days)			
Linding - Cigading	700	12.0	8.0	108.5	16.0	6.0	1.00	2.9	
Tanah Merah - Cigading	775	12.0	8.0	120.2	16.0	6.5	0.67	2.1	
Tanah Merah - Gresik/Madura	450	12.0	15.0	69.8	16.0	4.7	0.93	2.1	
Tanah Merah - Semarang	570	12.0	15.0	88.4	16.0	5.5	0.27	0.7	6.4
Tanah Merah - Cilacap	1,000	12.0	8.0	155.0	16.0	8.0	0.30	1.2	
Tanah Merah - Biringkassi	300	12.0	15.0	46.5	16.0	3.7	0.19	0.3	
Tsujung Batu - Paiton	450	8.6	6.0	69.8	16.0	4.2	0.69	1.4	
TOTAL							4.05	10.7	

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comparison with the vessel requirements identified for Options 1 and 2 (Table 7.2-4), about the same number of transport vessels would be required in 1988 (12 log carriers versus ten 10,000 DWT tug-barge combinations and one 10,000 DWT bulkcarrier).

As indicated earlier, only a detailed financial analysis can provide a definitive answer on the use of log carriers vis-a-vis other vessels. It is recommended that the actual transport charge that would have to be levied be determined as soon as possible, in case existing log carriers are considered for Kalimantan coal transport. This transport charge would have to account for the cost of conversion, and would need to be compared with charges for using either new 10,000 DWT barges or new 10,000 DWT bulk carriers. At this point, it can only be concluded that log carriers, because of their availability, provide an option to be further pursued.

7.3 SHIPBUILDING AND REPAIR

7.3 SHIPBUILDING AND REPAIR

Regardless of whether the initial transport of Kalimantan coal will use log carriers or new vessels, vessel requirements for coal transport will have a significant impact on the country's capability in shipbuilding and ship repair. In particular, if transshipment proves to be a viable option, the larger vessels required for coal transport provide a significant industrial development opportunity. The shipbuilding and repair industries could benefit greatly from the additional orders for coal carriers. A brief survey of the country's shipbuilding and repair industry was conducted to evaluate the industry's ability to supply the required vessels for Kalimantan coal transportation. Unfortunately, there is no consistent data base that allows an accurate appraisal of this industry. However, based on review and analysis of various references, it is possible to characterize the industry in a general way (References 7-5 through 7-11).

7.3.1 General

There are approximately 80 to 100 locations in Indonesia where shipyards are operated. These yards are run by some 50 companies, including state and private companies. The total lifting capacity (TLC) of the domestic yards is approximately 150,000 tonnes, capable of accommodating a total of approximately 275,000 DWT. However, the yards with TLCs larger than 500 tonnes (40 to 45 percent of the total number of yards) account for 90 to 95 percent of total domestic yard capacity.

Within the category of larger yards (total TLC of 140,000 tonnes and 260,000 DWT), and excluding Pertamina yards (TLC of 22,050 tonnes and 40,000 DWT), 11 companies operating 19 yards account for more than 90 percent of large yard capacity. Table 7.3-1 shows the results of a survey by the Ministry of Industry on the production capability of these yards in terms of bulk carriers and barges (Reference 7-5).

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Table 7.3-1

PRODUCTION CAPABILITY OF MAJOR INDONESIAN SHIPYARDS

Company Name	Yard Location	Ownership	Largest Vessel Possible								
			Bulk Carriers			Tugboats			Barges		
			1,500 DWT	3,000 DWT	8,000 DWT	2,400 HP	3,600 HP	6,000 HP	1,500 DWT	3,000 DWT	8,000 DWT
P.T. PAL	Surabaya	State			X		X				X
P.T. Dok dan Perkapalan	Tanjung Priok	State			X		X				X
P.T. Dok dan Perkapalan	Surabaya	State		X			X			X	
P.T. Pelita Bahari	Jakarta	State			X		X				X
P.T. Koja	2 Locations	State		X			X		X		
P.T. Ippa	4 Locations	State		X			X			X	
P.T. Iki	4 Locations	State	X				X		X		
P.T. Intan Sengkunyit	Palembang	Private			X			X			X
P.T. Inggom	Jakarta	Private		X			X			X	
P.T. Adiguna	Jakarta	Private	X			X			X		
P.T. Menara	Tegal	Private		X		X				X	

Source: Reference 7-5

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7.3.2 Ship Repair

The Netherlands Maritime Institute's (MARIN) 1981 survey (Reference 7-6) deals at some length with ship repair and points to low productivity and lack of adequate facilities for ship repair. To meet future demand, the industry will have to at least triple the total tonnage drydocked each year.

As shown in Table 7.2-1, the total domestic and oceangoing fleet has a tonnage of approximately 6.5 million DWT. Assuming 75 percent of the fleet drydocks each year to ensure adequate maintenance and repair, all Indonesian yards should have drydocked around 4.9 million DWT of the existing fleet. In fact, the MARIN survey indicates that in 1981 a total tonnage of only 1.3 million DWT drydocked, which by now may have increased to possibly 1.5 million DWT. Therefore, productivity of the yards will have to increase significantly and/or new repair facilities will have to be provided.

The key problems identified in the MARIN survey are the relatively high average age of the fleet and the less than efficient operation of most yards. Both factors give rise to a significantly higher than average dock repair time per ship, as compared with yards in other countries. The result is a low annual repair productivity of the shipyards. The current program of ship retirement should increase productivity, but will not relieve demand for limited drydock space because of increased shipbuilding requirements.

7.3.3 Shipbuilding

As can be seen from Table 7.3-1, only four companies (P.T. PAL, P.T. Dok dan Perkapalan, P.T. Pelita Bahari, and P.T. Intan Sengkunyit) have the capability of building ships larger than 3,000 DWT. Table 7.3-2 provides an overview of the shipyard facilities of these four companies. The total labor force of these companies accounts for more than half of all employment in the shipbuilding and repair industry. From Table 7.3-2, it can be observed that the maximum of 8,000 DWT may be on the conservative side, although it is unlikely that the maximum size will be far above 12,000 DWT.

Table 7.3-2

SHIPYARD FACILITIES OF THE FOUR LARGEST INDONESIAN SHIPYARDS

		Docking Facilities						1982 Productivity		
Company Name	Yard Location	Type of Dock[a]	Length (m)	Breadth (m)	Draft (m)	Lifting Capacity (tonnes)	Capacity (DWT)	Number of Vessels Docked	Vessels Docked for Repair (%)	Approx. Labor Force
P.T. PAL	Surabaya	GD	230	26	12.0	20,000	13,000	59	85	2,500
		GD	85	8	6.5	1,000	3,500			
		GD	85	8	6.5	1,000	3,500			
		FD	126	20	6.7	5,000	10,500			
		FD	109	14	3.8	1,500	5,000			
		SW	NA	NA	NA	1,000	1,000			
P.T. Dok dan Perkapalan	Jakarta	FD	143	29	6.8	10,000	14,700	248	65	1,500
		FD	130	19	4.5	6,000	11,500			
		FD	100	19	6.0	3,500	5,500			
		FD	73	15	2.5	600	2,000			
		SW	80	13	NA	1,200	2,800			
P.T. Pelita Bahari	Jakarta	GD	120	22	4.6	8,000	9,300	42	60	500
		FD	103	14	3.3	3,000	6,000			
		FD	67	21.6	4.0	2,000	3,000			
P.T. Intan Sengkunyit	Palembang	SW	45	16	5.8	1,000	3,000	25	27.5	700
		SW	50	18	6.0	3,000	6,000			
		SW	66	22	6.5	6,000	9,000			

Source: References 7-5 and 7-8

(a) GD = Graving dock
FD = Floating dock
SW = Slipway

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The demand for drydock and shipbuilding space is currently high and will continue to be so, in part because of the forced retirement of old vessels but, more importantly, due to requirements for new shipping capacity. Table 7.3-3 presents the 5-year production programs for the four largest yards for the years 1982-1986, with the exception of P.T. PAL, for which the 1983-1988 production program for commercial ships is presented (Reference 7-7). Beginning in 1988, P.T. PAL plans to produce four 30,000 DWT tankers. For the periods indicated, 65 vessels of all types and sizes are planned by these companies. These are ambitious programs, leaving little spare capability for increased production.

The same situation exists for the other seven major shipbuilding companies. Excluding the production of tugboats and specialty-type vessels, such as inspection ships, training ships, offshore rigs etc., a total of approximately 200,000 DWT is planned for passenger and cargo vessels by the country's 11 major companies (Reference 7-5). This implies that domestic production during the 5-year period considered is approximately 40,000 DWT/year, while the maximum-size ship to be built is 3,500 DWT.

In sharp contrast to annual production levels are the demand projections for new ship capacity. For example, in 1982 the Department of Industry developed a projection of gross tonnage requirements (Bruto Registered Tonne--BRT) for new ship capacity by size and class for all types of service (Reference 7-11). Using the rule of thumb that 1 BRT equals 1.5 DWT, projections for 1985, 1990, and 1995 indicate total demands for new capacity of around 345,000 DWT, 500,000 DWT, and 750,000 DWT, respectively. Clearly, such levels of demand are far greater than current production levels. Although the above discussion is by no means conclusive, it supports the statement made by the Directorate General for Sea Communications, "... Indonesian shipowners are forced to order ... new vessels abroad, thereby presenting a heavy burden on the nation's foreign exchange reserves" (Reference 7-9).

Table 7.3-3

COMMERCIAL SHIPBUILDING PROGRAMS OF LARGEST INDONESIAN SHIPYARDS

Item	P.T. PAL	P.T. Dok dan Perkapalan (Tanjung Priok)	P.T. Pelita Bahari	P.T. Intan Sengkunyit
Program duration	1983-1988	1982-1986	1982-1986	1982-1986
Cargo/passenger ship (3,000 DWT)		3		3
Coaster (3,000 DWT)	5			
Tugboat (< 1,000 HP)	6	2		2
Tugboat (> 1,000 HP)		12	4	2
Tanker (3,500 DWT)	2		1	2
Self-propelled oil barge (1,500 DWT)				2
Cement carrier (3,500 DWT)		3	4	3
LPG carrier (3,500 DWT)	2			
Floating docks and other special facilities/vessels	2	4	1	—
TOTAL	17	24	10	14

Source: References 7-5 and 7-7

7.3.4 Conclusions on Current Situation in Shipbuilding and Repair

Based on the foregoing, the following conclusions are drawn regarding the shipbuilding and repair industry:

- The industry is small and geographically spread out, consisting predominantly of small yards with lifting capacity less than 500 tonnes.
- Eleven companies operating 19 yards account for the majority of repair and new building capacity.
- The largest vessel ever built in Indonesian yards is 3,500 DWT.

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- The largest vessel that can be built in Indonesia is approximately 8,000 to 12,000 DWT. Only four yards are able to build such vessels.

- Excluding speciality vessels, current annual production of new ships is approximately 40,000 DWT, which is very small compared to domestic demand.

- Yards capable of producing larger ships are currently in full production and do not appear to have much reserve capacity.

- Demand for repair and annual maintenance of the current fleet alone could occupy all domestic yards, but the country still does not have the drydock tonnage required to ensure adequate repair and maintenance.

- Generally, the problems of the industry are two-fold:

  - There are not enough yards and facilities to satisfy the demand for drydocking, repair, and new building.

  - Most existing facilities are old and outdated (with the exception of those of the 4 largest companies), leading to inefficiencies, low productivity, and relatively high cost for ship repair and construction.

7.3.5 Impact of Kalimantan Coal Transport on Shipbuilding and Repair

Each of the two sea transport options discussed in Section 5 and shown in Table 7.2-4 implies a different shipbuilding program. In addition, if converted log carriers prove to be an economically viable option, this would imply a still different program. Table 7.3-4 shows how the vessel requirements under each option translate into shipbuilding programs characterized by:

- Number and type of vessels to be delivered prior to 1988, 1991, and 1994

- Production capacity in DWT to be made available to produce these vessels

- Number of specialty vessels to be delivered prior to 1988, 1991, and 1994

Use of converted log carriers during Phase I is included in Table 7.3-4 as an option. The program requirements for using log carriers in

Table 7.3-4

SHIPBUILDING PROGRAMS ASSOCIATED WITH SEA TRANSPORT OPTIONS FOR KALIMANTAN COAL

Item	1988	1991	1994
Option 1: Direct Shipping			
Type of vessels to be delivered			
10,000 DWT barge and tug	10	6	1
10,000 DWT bulk carrier	1	2	5
20,000 DWT bulk carrier	-	1	1
Production requirement (DWT)	110,000	100,000	80,000
Special vessel requirement	10 tugs[b]	6 tugs[b]	1 tug[b]
Option 2: Transshipment			
Type of vessels to be delivered			
10,000 DWT barge and tug	10	-	2
10,000 DWT bulk carrier	1	2	-
40,000 DWT bulk carrier	-	3	3
Production requirement (DWT)	110,000	140,000	140,000
Special vessel requirement	10 tugs[b]	-	-
Option 1*: Direct Shipping/ Transshipment			
Type of vessel to be delivered			
6,500 DWT converted log carrier	12	(a)	(a)
Production requirement (DWT)	78,000	(a)	(a)
Special vessel requirement	-	(a)	(a)

(a) Program requirements for this option have not been evaluated for 1991 and 1994 because they depend on the choice between direct shipping and transshipment during Phases II and III

(b) 5,000 HP

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Phases II and III have not been evaluated for two reasons. First, their continued use for coal transport will depend on whether a direct shipping system or transshipment system emerges. With transshipment, a coastal barging system would be preferable to using log carriers for going back and forth between the coal producing areas and the transshipment center, and larger bulk carriers would be preferred for inter-island transport between the transshipment center and customers on Java and Sulawesi. The second reason is that although log carriers currently provide excess capacity, continued increases in cargo flows will create a demand for this capacity, without having to convert the vessels. Thus as time goes by the current overcapacity will diminish and log carriers will most likely be used for purposes more akin to what they were designed for.

To evaluate the three programs shown in Table 7.3-4, there are three essential questions to be addressed:

- Will the shipbuilding industry have the technical capability to build the type of vessels required?
- Will the shipbuilding industry have the production facilities and capacity to build the type of vessels required?
- Can the vessels be produced prior to the time they are required?

Based on the brief survey of the shipbuilding industry provided in previous sections, the following observations can be made.

Option 1. Technically, and based on Table 7.3-2, it appears that the four largest shipbuilding companies will be able to produce the type of vessels required for Phase I. Since P.T. PAL plans to have yard facilities in the late 1980s to build vessels up to 30,000 DWT, even the 20,000 DWT bulk carriers required in Phases II and III can in all likelihood be produced domestically. In addition, the requirement for building 5,000 HP tugboats can be met domestically. As indicated in Table 7.3-1, P.T. Intan Sengkunyit already possesses the capability of building 6,000 HP tugboats.

Total required production capacity to build coal transport vessels is approximately 290,000 DWT for the period up to 1994, or approximately 29,000 DWT per year. Given that the current 5-year production program for passenger and cargo vessels by the four largest companies is about 100,000 DWT (see Table 7.3-3) or 20,000 DWT per year, it follows that annual production of this type of vessels by all four companies would have to be at least double what it is today. Since at present the four largest yards don't have much capacity to spare and since the new Caraka Jaya program will also create significant demand for yard capacity (see Subsection 7.2.1), it is clear that not enough facilities are available to build all the vessels required for Option 1 in the time available.

On the surface, lack of yard facilities in and by itself appears not to be a serious constraint. Existing yards can be expanded and/or new yards can be built but new yard construction will require investments that under current conditions may be difficult to arrange. Assuming, for example, a cost of US$350 per DWT of new yard capacity (Reference 7-7), about US$10 million is needed to provide new capacity to build coal transport vessels (i.e., 29,000 DWT x US$350/DWT). Clearly it does take time to arrange such a project, and it may therefore be difficult (although not impossible) to construct the vessels required for Phase 1 prior to the time they are required.

Option 2. From a shipbuilding perspective, the major differences between Option 2 and Option 1 are:

- Under Option 2 a total of six 40,000 DWT bulk carriers will need to be constructed, for which there is currently no yard capability

- Total required yard capacity for Option 2 up to 1994 is 390,000 DWT, or 100,000 DWT more than under Option 1

Construction of six 40,000 DWT bulk carriers (three to be delivered during Phase II and three during Phase III) will require expansion of current yard facilities. Since these vessels are not required prior to 1988, there is still sufficient time to construct a dry dock, slipway, or synchrolift facility capable of handling 40,000 DWT vessels, and to

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complete the vessels for delivery in Phase II and Phase III. If this facility were developed, it would also alleviate the yard capacity constraint discussed under Option 1. It would still be doubtful that vessels required during Phase I could be completed in time for reasons similar to those discussed before.

Option 1. The use of converted log carriers places a minimal demand on yard capacity. As discussed in Subsection 7.2.4, the alteration procedures require no drydocking and could be performed in any reasonably sized ship repair yard while the ship is in the water. It is likely that any of the 19 yards of the 11 largest shipbuilding companies discussed before could perform this type of work. The time needed to convert a log carrier to a coal transport vessel is estimated to require not more than 2 to 3 months. Thus if the conversion program were to be conducted by several yards, it is likely that the entire program could be accomplished in at most 4 to 6 months. At a cost of about US$0.5 million per ship, total cost would amount to US$6 million dollars.

7.3.6 Log Carriers Feasibility Study

From the limited perspective of the domestic capability in shipbuilding and repair, the use of converted log carriers to transport Kalimantan coal appears preferable to the use of new 10,000 DWT barges and bulk carriers, since log carriers could be made available on short notice at relatively low cost. Therefore, it is recommended that a feasibility study be undertaken as soon as possible to determine total cost, time required, and other program requirements to convert 12 log carriers to coal transport during Phase 1. Furthermore, this study is to be combined with the recommendation made earlier (Subsection 7.2.5) to determine the actual transport charge that would have to be levied in case log carriers are to be used for Kalimantan coal transport. Thus, the recommended feasibility study consists of two distinct parts:

- Determine all requirements to prepare 12 log carriers for use in the Kalimantan coal trade during Phase I
- Assuming conversion to coal colliers, determine the actual capital and operational components of the round-trip transport cost per tonne for all routes to be serviced during Phase I

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7.4 MANUFACTURE OF TRUCKS AND RAILROAD CARS

7.4 MANUFACTURE OF TRUCKS AND RAILROAD CARS

Section 6 provided a preliminary estimate for the required number of 30-tonne truck-trailer combinations (15-tonne truck and 15-tonne trailer) for transport of coal between mine and loadout port in Kalimantan. A continuous truck production program of about 50 to 100 units annually is expected to be sufficient to meet the demand for trucks by all contractors. Similarly, and since most land transport of coal on Java will need to use rail, Section 6 provided an estimate of the required number of new 40-tonne railroad cars. Transporting coal from the various unloading ports (Cigading, Cirebon, Semarang, and Cilacap) to cement plants located inland on Java will require approximately 150 railroad cars. The first requirement for new cars will be in west Java, to be met almost immediately, while demand in north-central and south-central Java will have to be met in a few years, when coal consumption at new cement plants is expected to start.

7.4.1 Truck Manufacturing Capabilities

To evaluate the above requirements a brief survey was conducted regarding current domestic capabilities in truck manufacturing and construction of railroad cars, based on References 7-12 through 7-14.

At present, eight domestic companies have been licensed by the government to manufacture and assemble heavy duty trucks. Six companies are near Jakarta and two companies are near Surabaya. The license is for trucks with 6 cylinder diesel engines of approximately 6,000 cc. Total licensed capacity for all type and sizes of trucks is approximately 40,000 to 50,000 units per year. However, actual production is considerably smaller, frequently not surpassing 50 percent of licensed capacity (e.g., 1984 production of all trucks over 3.5 tonnes of payload was only 7,874 units). Trucks that can be assembled domestically include Dodge, Ford, Berliet, Mercedes, Volvo, Nissan, Fuso, and Isuzu. In view of the requirements for Kalimantan coal transport, it can be concluded that domestic production of 15-tonne trucks does not present any problem.

The above conclusion is only valid for so-called highway trucks not exceeding 15 tonnes in payload. It does not apply to larger off-highway trucks, which can have payloads as large as 50 to 100 tonnes. At present there is no domestic truck assembling company licensed to manufacture such trucks. As discussed in Section 3, some of the future mining operations in Kalimantan will be able to use the larger trucks, and some of the contractors have considered using them. Since there is, in principle, no reason that such trucks cannot be assembled domestically, it is recommended that a brief analysis be conducted to investigate domestic assembly of off-highway trucks. Because there is currently a large overcapacity in the truck manufacturing industry, assembly of off-highway trucks could provide a welcome addition to the present product line.

It is recommended that number of trucks and delivery schedule be determined in close coordination with Kalimantan coal producers. Subsequently, analysis should focus on determining the net benefits, including cost savings as well as other benefits such as employment generated, of domestic assembly vis-a-vis import of off-highway trucks.

7.4.2 Railroad Car Manufacturing Capabilities

To assess domestic manufacturing of railroad cars, a visit was made to P.T. INKA in Madiun, east Java. P.T. INKA, belonging to the Department of Land Communications, started assembly of railroad cars in 1982, in a PJKA facility previously used for maintenance of steam locomotives. P.T. INKA has a workforce of about 1,000 people, most skilled workers such as welders, fitters, etc. The company has two production lines, one for freight cars (e.g. cement carriers, box wagons, ballast cars) with a capacity of 600 units per year, and one for passenger cars with a capacity of 60 units per year.

Most production/assembly of railroad cars to date has come in the form of "project-packages" financed from abroad. The first completed major project consisted of 150 PJKA 25-tonne coal wagons, currently used in west Sumatra, and 250 PJKA palm oil tank cars. As part of the package

financed by Japan, P.T. INKA constructed a new metal workshop and grit blasting shop, and procured several heavy duty cranes. P.T. INKA currently has several projects under way. These include production of 334 new coal wagons for south Sumatra financed by Canada and using a Hawker-Siddely design; 667 freight cars of various types financed by Rumania; and 100 additional freight cars for PJKA financed by Japan.

P.T. INKA follows a so-called progressive manufacturing/assembly procedure that is best explained by the recently started project to produce 126 passenger cars for the Jabotabek rail system. The passenger cars are designed by Nippon Saryo of Japan and financed with Japanese export credits. Of the total production series of 126, the first 6 cars will arrive in Indonesia in semi knocked-down (SKD) fashion (all parts and materials produced and partly assembled in Japan, with final assembly in Madiun). The next 106 cars come as completely knocked-down (CKD) cars and are totally assembled in Madiun. For the last 16 cars, only some raw materials come from Japan, and cars are manufactured and assembled locally. The objective of the procedure is to progressively increase the domestic content of the cars. Thus in the last phase, materials such as for the interior, paint, wiring, etc. are all produced domestically. However, some parts such as wheels, brake systems, steel plate (1.2-3.4mm) are still imported as they cannot be produced domestically.

Three conclusions regarding P.T. INKA stand out:

- It has been able to build a highly skilled and motivated workforce
- It has been able to build a rather well equipped production facility because of the way current production has been financed
- It has had no opportunity to accumulate retained earnings (because most manufacturing/assembly has come in project packages), leaving little or no funds to expand the business on its own

To improve this last situation and leverage its capabilities, P.T. INKA joined recently with Japanese interest and bid successfully on a project

to construct 100 rail cars for Thailand. This will allow for further business expansion.

Technically, there is no problem in producing new railroad cars for land transport of coal on Java. P.T. INKA is clearly capable of meeting the demand. The main issue will be financing. It is recommended that a project be formulated as soon as possible to supply PJKA with the 150 new coal cars to be used on Java.

7.5 INSTITUTIONS

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7.5 INSTITUTIONS

The last and most important subject addressed in this report concerns the institutions, agencies, and companies involved in the development and transport of Kalimantan coal to domestic customers. Drawing in part on issues discussed at various places in this report, the intent of the following discussion is to review the status quo and to identify areas where improvements in institutional relationships may be beneficial to the overall success of Kalimantan coal development, transport, and use.

7.5.1 Importance of Effective Institutional Relationships

A strong, efficient, and supportive institutional framework is important because it will have a direct impact on the development of Kalimantan coal. Barring presently unforeseen developments (such as discovery of large amounts of gas that could be made available to customers on Java) there is little question that good quality coal can be developed in Kalimantan, transported to Java, and used by power and cement plants at prices competitive or lower than other available fuels. Hence, the government's policy to encourage the use of Kalimantan coal, thereby saving on domestic consumption of refined products.

It is equally important to recognize that coal development, transport, and use represent a most complex logistical operation when compared to other energy sources. Coal mines are generally more disruptive to the environment than oil or natural gas wells, and careful planning and control must be continuously exercised. In addition, transport, storage, and handling require complex machinery. Finally, coal use in any industrial facility is generally more complex because of the handling and preparation requirements prior to firing. Thus, to ensure that the coal's essential advantage is maintained, all the steps necessary to extract coal out of the ground and bring it to the point of end use require careful planning and coordination among many different stakeholders, each with different objectives.

Review of actual implementation of coal supply projects shows that crucial roles are assigned to many different organizations. To prevent cost overruns and delays in implementation requires a clearly defined common objective for all involved. The current Bukit Asam to Surabaya coal chain provides an excellent example of the many complexities in the implementation of a coal supply project.

In conclusion, the complexities associated with coal development, transport, and use require that the implementation of virtually all coal supply projects be supported by an institutional framework capable of efficient and expedient decision making aimed at providing coal to consumers at a price that results in benefits to both producers and consumers.

7.5.2 Review of Current Institutional Relationships

It is far beyond the scope of this study to analyze in detail the roles and responsibilities of the many agencies, institutions, and companies that are in some way associated with development, transport, and use of Kalimantan coal. Instead, Figure 7.5-1 provides an overview of the agencies/companies involved and describes what is believed to be their main area of involvement.

Review of Figure 7.5-1 leads to the observations that follow. No order of importance should be attached to the sequence in which these observations are presented, and none of the observations are intended to reflect a value judgment (good or bad).

Number of Institutions. The number of institutions and companies that are in some way related to Kalimantan coal development, transport, and use is quite large. Aside from at least seven potential producers and at least twelve major potential consumers, there are at least some twenty other organizations involved, mostly government. These are either involved in policy formulation regarding Kalimantan coal or they issue approvals and/or permits related to some aspect of development, transport, and use. The large number of participants leads quite

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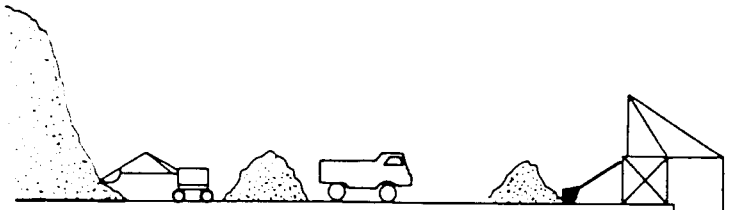
KALIMANTAN COAL DEVELOPMENT, LAND TRANSPORT, AND LOADING



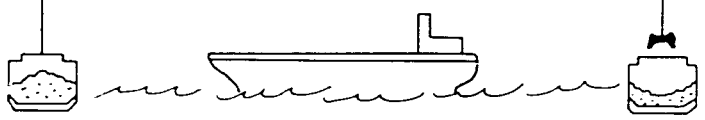
PRINCIPLE AGENCIES/COMPANIES

- MINISTRY OF MINING AND ENERGY
  - ENERGY POLICY DECISIONS
- MINISTRY OF COMMUNICATIONS
  - OVERALL TRANSPORT POLICY
- DIRECTOR GENERAL FOR MINING
  - COAL DEVELOPMENT POLICY
- DIRECTOR FOR COAL
  - COAL DEVELOPMENT
- DIRECTOR GENERAL FOR LAND COMMUNICATIONS
  - APPROVAL FOR ROAD TRANSPORT
- P.N. TAMBANG BATUBARA (PNTB)
  - RESPONSIBLE FOR COAL DEVELOPMENT
  - MAIN CONTACT WITH CUSTOMERS
- PRIVATE COAL COMPANIES
  - MINING CONTRACTORS TO PNTB

APPROVALS/PERMITS

- LOCAL GOVERNMENT
- PROVINCIAL GOVERNMENT
- OTHERS INCLUDE
  - DIRECTOR GENERAL OF FORESTRY
  - DEPARTMENT OF ENVIRONMENT
  - SEKNEG/TPP

SEA TRANSPORT



PRINCIPLE AGENCIES/COMPANIES

- MINISTRY OF COMMUNICATIONS
  - OVERALL TRANSPORT POLICY
- MINISTRY OF INDUSTRY
  - SHIPBUILDING POLICY
- DIRECTOR GENERAL FOR SEA COMMUNICATIONS
  - APPROVAL LOADING PORT
  - APPROVAL UNLOADING PORT
  - LICENSING TRANSPORT ROUTE
  - LICENSING TRANSPORT COMPANY
- SEA TRANSPORT COMPANY (PRIVATE)
  - UNDER CONTROL OF DIRECTOR GENERAL FOR SEA COMMUNICATIONS
- SEA TRANSPORT COMPANY (GOVERNMENT)
  - UNDER CONTROL OF DIRECTOR GENERAL FOR SEA COMMUNICATIONS
  - UNDER CONTROL OF GOVERNMENT MINISTRY OR MINISTRIES

UNLOADING, LAND TRANSPORT, AND CONSUMPTION ON JAVA

PRINCIPLE AGENCIES/COMPANIES

- MINISTRY OF MINING AND ENERGY
  - ENERGY POLICY DECISIONS
- MINISTRY OF COMMUNICATIONS
  - OVERALL TRANSPORT POLICY
- MINISTRY OF INDUSTRY
  - FUEL DECISIONS FOR STATE OWNED INDUSTRIAL PLANTS
- DIRECTOR GENERAL FOR POWER AND NEW ENERGY
  - FUEL DECISIONS FOR PLN
- DIRECTOR GENERAL FOR LAND COMMUNICATIONS
  - APPROVAL FOR TRANSPORT MODE
- NATIONAL RAILROAD COMPANY (PJKA)
  - RESPONSIBLE FOR RAIL TRANSPORT
- COAL CUSTOMERS
  - NATIONAL ELECTRIC COMPANY (PLN)
  - PRIVATELY OWNED CEMENT PLANTS
  - STATE OWNED CEMENT PLANTS

APPROVALS/PERMITS

- LOCAL GOVERNMENT
- PROVINCIAL GOVERNMENT
- OTHERS INCLUDE
  - DEPARTMENT OF ENVIRONMENT
  - SEKNEG/TPP

Figure 7.5-1 OVERVIEW OF SOME OF THE AGENCIES/COMPANIES INVOLVED IN DEVELOPMENT AND TRANSPORT OF KALIMANTAN COAL

naturally to a slow, extended and sometimes difficult process of negotiating and advancing specific proposals and plans to implement particular Kalimantan coal supply chains. The very requirement of a large number of approvals and permits can also lead to considerable administrative delays.

Producer/Customer Interaction. At present private companies engaged in exploration and development of Kalimantan have no formal access to domestic customers, other than through PN Tambang Batubara, which is responsible for Kalimantan coal development and is the main official contact with customers. While this arrangement can be satisfactory, it increases the chance that technical information regarding Kalimantan coal might reach customers slowly, particularly information on proven reserves, detailed quality analyses, and results of bulk sample testing that are critical to customer decisions. PLN can only make commitments on the basis of detailed technical information. Similarly, the ordering of equipment for cement plant conversion depends critically on coal specification. When INDOCEMENT provided coal specification for coal conversion equipment in early 1984 they specified Australian coal because no information was available to them about Kalimantan coal.

Integration of Coal Development with Coal Transport and Distribution. As can be seen in Figure 7.5-1, there is an "organizational vacuum" between coal producers and PN Tambang Batubara on the one hand and coal consumers on the other. This "vacuum" is currently filled by the Directorates General for land and sea communications as well as by transport companies (government or private) which depend on these directorates for policy direction, approvals, and permits.

The current situation is that PN Tambang Batubara prefers to sell FOB Kalimantan, while the consumers prefer to buy CIF. Thus, the aforementioned agencies and transport companies will have to take care of transport and distribution. This arrangement would work well if the consumer was eager to buy Kalimantan coal and/or PN Tambang Batubara was eager to sell. If either was the case, the consumer or PN Tambang Batubara would actively negotiate a transport charge for Kalimantan coal

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delivery, which, together with the FOB price, would provide the customer with the "bottom line cost" for Kalimantan coal.

If the above conditions are not met it is quite natural that the consummation of sales contracts for Kalimantan coal delivery will be slow in coming. PN Tambang Batubara, as the main contact with the consumers, has no control over transport and delivery and thus cannot guarantee a CIF price. Without a CIF price, consumers will be reluctant to enter into a sales contract with PN Tambang Batubara, because they will not know what transport charges they might have to pay.

There are three alternatives to the above mentioned scheme:

- One or all of the producers or PN Tambang Batubara could be assigned the additional responsibility of transporting and distributing coal to consumers in a scheme closely resembling the situation with domestic refined products, where Pertamina not only is the producer but has its own fleet of tankers, lighters, and trucks to take care of bulk transport

- Consumers could organize coal transport from areas in Kalimantan to their own facilities

- A transport company (either government or private) could act as a middleman buying coal FOB from the producers and selling CIF to the consumers

The first alternative is attractive because it provides for a greater measure of control, however it does require producers to set up a special shipping organization where currently there is none. The second alternative is likely to only be attractive to PLN, the one customer large enough to organize its own shipping. Cement plants would still have to depend on a separate shipping organization. The third alternative is similar to the current scheme, except that the middleman/transport company would actively engage in the buying and selling of Kalimantan coal. This could raise the CIF price of coal if the profit margin to the middleman were larger then the mere transport tariff charged by a transport company engaged in transport of many commodities.

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Promotion/Marketing of Kalimantan Coal. With an undeveloped resource, a premium is placed on promotion and aggressive marketing. Potential customers need to be convinced that Kalimantan coal use is to their advantage. With the exception of PN Tambang Batubara, there is in the current institutional arrangement no group or agency with this responsibility. Even for PN Tambang Batubara, promotion and marketing of Kalimantan coal represents a significant additional task. In view of PN Tambang Batubara's already broad responsibilities and its available manpower, this task is difficult to accomplish.

Analysis of Complete Coal Supply Chain. Related to the above is the observation that at present there is no organization empowered to analyze in detail the requirements and costs associated with each and every element of specific supply chains between Kalimantan and Java. Instead, the organizations shown in Figure 7.5-1 concern themselves mostly with that part of the chain under their control (coal producers plan and design up to the loading port, PJKA only considers rail transport, etc.) and there is nobody who "puts it all together." An important consequence of the lack of overall analysis capability was mentioned in Section 4, namely it is very difficult to accurately project future Kalimantan coal use without it.

Resolution of Policy Differences. Currently, policy coordination regarding Kalimantan coal development, transport, and use is achieved through an interministerial committee consisting of the Ministers of Mining and Energy, Industry, and Communications. It is not clear whether policy differences are resolved after careful evaluation of alternatives or by decree. As indicated in Section 6, the port of Cigading has been preliminarily selected by the Minister of Communications as the coal unloading port for all of west Java. However as also indicated in Section 6, it appears that there are viable alternatives to Cigading to supply the cement plants south of Jakarta, and in particular to supply the cement plant at Cirebon.

Implementation of Policy. Development and use of coal is one of the clearly defined elements of the government's energy diversification policy (Reference 7-15). However the organizational structure shown in Figure 7.5-1 that deals with coal appears to have few "tools" to facilitate implementation of this policy. Clearly, the best incentive to increase use (and thus development) of coal is to ensure that it is delivered to customers at the lowest possible cost. No measures have yet created this incentive. From a transport perspective, coal is treated as just another commodity without any priority assigned to facilitate its use.

7.5.3 Areas of Possible Improvement

Implementation of projects for Kalimantan coal development, transport, and use most likely will be a slow process, and therefore, the projects presented in both Section 3 and 4 can be regarded as optimistic. Following a slow process has advantages and disadvantages; hasty decisions most likely will be prevented, but the process may be too slow for those private coal companies looking for a timely and reasonable return on their exploration and development investments.

The implementation process can be accelerated by strengthening some of the institutional arrangements that govern Kalimantan coal development, transport, and use. Such measures do not require setting up a new organization to deal with Kalimantan coal, such as a Kalimantan Coal Development Board, in fact, such an action would be entirely counterproductive. The existing institutional framework is adequate provided certain measures are taken. The following outlines areas that need immediate action:

- Analysis Capability. A special and independent analysis group should be attached to the Interministerial Committee on Kalimantan coal development to act as a special staff to the committee and work in close coordination with producers, affected agencies, and consumers. Areas needing analysis include, for example, realistic projections of Kalimantan coal use, least cost transport schemes and routes, Kalimantan coal pricing, facilitating

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procurement of necessary equipment or implementation of projects to improve/upgrade transport routes, special incentives to increase use of Kalimantan coal, etc. It is further recommended that the interministerial committee allocates a budget for this purpose so that brief, well focused, specialized studies can be undertaken by the staff, assisted by outside consultants where necessary.

- Producer/Customer Interaction. A formal mechanism should be established to improve the technical dialogue between private coal producers on Kalimantan and potential consumers. Interaction and exchange can be established in various formats, visits by consumers to Kalimantan coal deposits, regularly held meetings to discuss results and progress in exploration, development and production, specialized seminars to discuss preparation and use characteristics of Kalimantan coal, etc. Whatever the format, frequent interaction and exchange of technical information is essential.

- Technical Advisory/Support Group. Potential consumers contemplating the use of coal frequently face many logistical and technical problems. The recent experience of INDOCEMENT provides evidence of such problems. It is recommended the government establish a group or assign responsibility to a particular agency that can be called upon by potential consumers to advise on how such problems are to be resolved.

- Marketing/Promotion. The government should organize an active campaign to promote the use of Kalimantan coal with the objective to disseminate information to the public at large, and in particular to all potential consumers, regarding the government's efforts to develop Kalimantan coal resources and use coal development as an important tool for regional development. An important benefit of such a campaign would be to dispel the widely held notion that "coal is dirty and should be avoided."

- Integration of Coal Development and Transport. The government should investigate alternatives to integrate the function of development and bulk transport of Kalimantan coal. Several alternatives were discussed in the previous Subsection. These should be further analyzed. Specifically, if no expertise is available domestically, to efficiently organize coal transport it is recommended that the government seek outside assistance to organize this important interface between coal producers and consumers.

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7.6 CONCLUSIONS AND RECOMMENDATIONS

7.6 CONCLUSIONS AND RECOMMENDATIONS

This section addressed four subjects:

- Suitability of the country's fleet to transport coal
- Domestic capability for building coal transport vessels
- Manufacturing capability for trucks and railroad cars
- Institutional arrangements for Kalimantan coal development and transport

Following is a brief summary of the main conclusions and recommendations.

7.6.1 Shipping and Shipbuilding

- Transport of coal from Kalimantan to Java and Sulawasi will add a significant amount of cargo to the inter-island commodity flows; becoming the second largest commodity after crude oil and refined products.
- Although large in number of vessels and total carrying capacity (8,500 vessels and 6.5 million DWT), most of the country's fleet is inadequate to transport coal because of type and size of vessel, vessel age, and current commitments.
- Aside from building new vessels for coal transport, the existing fleet offers two possibilities. Transport vessels owned and operated by P.T. Angkutan Pertambangan (P.T. AP) could be used or coal could be transported with converted log carriers.
- P.T. AP's eight small vessels are less likely to be used in the Kalimantan coal trade because they are too small (3,453 DWT), they are getting old (almost 20 years), and they are already committed to other trades.
- The only real possibility is to select some vessels from the 80-90 log carriers owned and operated by 20 companies that have available capacity due to the export ban on logs, effective January 1, 1985. Log carriers average 6,500 DWT.
- It is recommended that log carriers be considered to start off coal transport during Phase I. Twelve vessels would be required to transport 4.05 MMTPY in 1988. Three vessels would operate out of Linding, seven out of Tanah Merah, and two out of Tanjung Batu.

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- Prior to committing log carriers to the coal trade, it is recommended that the actual transport charge to be incurred be determined and compared with the charges if new 10,000 DWT barges and bulk carriers were to be used.

- If log carriers are to be used as coal colliers it is recommended that their construction be strengthened. It was estimated that the simplest conversion procedure would cost about $0.5 million per vessel.

- Section 5 identified two transport options each with different vessel requirements. Option 1 required 10,000 DWT barge-tug combinations, 10,000 DWT bulk carriers and 20,000 DWT bulk carriers. Option 2 required the same type of vessels except the 20,000 DWT vessels would be replaced by 40,000 DWT bulk carriers. Use of log carriers for Phase I presents another option.

- Four domestic yards have the technical capability to build vessels for Option 1 and 2 up to 10,000 DWT. These yards are owned and operated by:

  - P.T. PAL (Surabaya)

  - P.T. Dok dan Perkapalan (Tanjung Priok)

  - P.T. Pelita Bahari (Jakarta)

  - P.T. Intan Sengkunyit (Palembang)

  By the late eighties, P.T. PAL will have the capability to build vessels up to 30,000 DWT. No company possesses the capability nor has plans to build 40,000 DWT vessels. Because of the minimum requirement for shipyard facilities, log carriers can be converted at some 19 yards, owned and operated by 11 companies, including the above four.

- With respect to Option 1 and without considering expansion of yard facilities beyond what is currently planned, the above mentioned companies most likely do not have sufficient production capacity to build all Option 1 vessels on time. This is due to their current production program (causing yards to be busy for the next few years), as well as the demand created by the building of the Caraka Jaya vessels.

- Option 2 required construction of 40,000 DWT vessels which in turn requires expansion or new construction of yard facilities. If such facilities were to be provided, it would alleviate the above mentioned lack of required production capacity. However even for

Option 2, it is doubtful that the vessels required for Phase I could be built on time.

- Since conversion of log carriers imposes minimum demands on required yard capacity, it is the option that has the least impact on the shipbuilding and repair industry, adding to the attractiveness of using log carriers.

- In view of the above it is recommended that as soon as possible a two-part feasibility study for using log carriers be undertaken:

  - Part 1: Conversion program for 12 log carriers to be used during Phase I

  - Part 2: Financial and economic analysis of using log carriers for coal transport vis-a-vis newly constructed barges and bulk carriers

7.6.2 Manufacturing of Trucks and Railroad Cars

- Currently there is more than enough domestic capacity to build trucks for coal transport up to about 15 tonnes of payload.

- There are at present no companies licensed to build larger trucks and in particular off-highway coal transport trucks.

- Since the use of larger trucks may be required in Kalimantan coal mining, it is recommended that a brief analysis be conducted to determine the economic viability of assembling these vehicles in Indonesia. If economically viable, such assembly could be beneficial to the domestic automobile industry, which currently operates far below design capacity.

- P.T. INKA in Maduin, East Java, has both the technical capability and required facilities to meet the railroad car demand for coal transport on Java. It is recommended that as soon as possible a project be formulated to have P.T. INKA initiate production and supply PJKA with some 150 new cars.

7.6.3 Institutions Related to Kalimantan Coal Development and Transport

- Implementation of projects for Kalimantan coal development, transport, and use will most likely be a slow process. Therefore, projections for coal

production and use (Sections 3 and 4) can be considered optimistic.

- Accelerated implementation does not require an entirely new institutional structure, since the current arrangements are adequate. The implementation process can be accelerated by taking measures, generally aimed at improving the exchange of information between producers and consumers (both general and technical), strengthening the analysis capability needed to make decisions, and further integrating the coal development and production function with the subsequent transport of coal.

- Specifically, it is recommended that:

  - An independent analysis group be attached to the interministerial committee for Kalimantan coal development

  - Formal interaction and exchange be established between private coal companies on Kalimantan and potential domestic consumers

  - A technical advisory/support group be established to advise potential customers on requirements and systems, including transport, for the most efficient use of Kalimantan coal

  - A public campaign be organized to promote development and use of Kalimantan coal in particular and development of Kalimantan in general

  - Specific alternatives be investigated to further integrate coal development and transport, with particular emphasis on the type of organization for bulk transport of coal

7.7 REFERENCES

7.7 REFERENCES

7-1 Laporan Tahunan (1981, 1982, 1983), Direktorat Lalu Lintas Angkutan Laut, Direktorat Jenderal Perhubungan Laut, Departemen Perhubungan. Jakarta.

7-2 Statistik Indonesia 1983, Biro Pusat Statistik, Jakarta, Indonesia, January 1984.

7-3 Rekapitulasi Potensi Armada Pelayaran Khusus Luar Negeri, Konsbuksi Baja Menurut Penggolongan Usianya, Direktorat Jenderal Perhubungan Laut, Departemen Perhubungan, Maret 1984, Jakarta.

7-4 D'Arcangelo, A.M., Ship Design and Construction, Society of Naval Architects and Marine Engineers, 1969.

7-5 Kemanpuan Industri Perkapalan, Direktorat Jenderal Industri Logam Dasar, April 1984.

7-6 Maritime Sector Investment Plan, Draft Final Report, Volume 2, Part 4, Dock, Repair, Shipbuilding Facilities, Netherlands Maritime Institute, prepared for the Directorate General of Sea Communications, Jakarta, January 1982.

7-7 Visit, BPPT Energy Planning Team to P.T. PAL, Surabaya, April 3, 1984.

7-8 Report on Shipyard Facilities, BPPT Internal Report, 1983, Jakarta.

7-9 Maritime Sector Development Program, Directorate General of Sea Communications, June 1983.

7-10 Integrated Sea Transport Study, Final Report, Volume 1, Summary and Conclusions, August 1982, Netherlands Maritime Institute, Prepared for Directorate General of Sea Communications.

7-11 Pola Pengembangan Industri Perkapalan Indonesia, Direktorat Penyiapan Program, Direktorat Jenderal Industri Logam Dasar, October 1982, Jakarta.

7-12 Informasi Potensi Industri Periode Maret 1983, Departemen Perindustrian, Maret 1983, Jakarta.

7-13 Program Industri Otomotif Tahun 1981 - 1982, BPP Teknologi, Direktorat Pengkajian Industri, Juni 1981.

7-14 Visit, BPPT Energy Planning Team to P.T. INKA, Madium, April 2, 1984.

7-15 Policies and Prospects for Sustained Development Under Challenging Conditions, Repelita IV, The Fourth Five Year Development Plan of Indonesia, 1984/85 - 1988/89, May 1984, Jakarta.

APPENDIX A
CONTRACTUAL ARRANGEMENTS FOR DEVELOPMENT OF KALIMANTAN COAL

Appendix A

CONTRACTUAL ARRANGEMENTS FOR DEVELOPMENT OF KALIMANTAN COAL

This appendix provides highlights of Presidential Decree No. 49 of 1981. This decree concerns contractual arrangements for the development of coal resources in Kalimantan by private companies operating as production sharing contractors to PN Tambang Batubara. The following was extracted from Reference 3-1.

A.1 CONTRACTOR'S OBLIGATIONS

- Contract time is to stipulate a standard 8-year period for survey exploration, feasibility study, and construction
- Contractor is to found an Indonesian-based company
- Contractor is to submit 13.5 percent of the annual production to PN Tambang Batubara
- Contractor is subject to the 35 percent corporation tax from the taxable income for the first 10 years of operation, increasing to 45 percent for the 11th year and beyond
- Regional taxes are to be paid in an agreed lump sum payment, as specified in the contract
- Depending on the size, a proportional dead rent payment is to be paid for the contracted working area to PN Tambang Batubara
- After the end of the 10th year of operation, a total of 51 percent of shares should be offered for sale to Indonesian nationals or entities
- If a requirement for large quantities of coal develops in Indonesia, the contractor is to sell all or part of its coal to PN Tambang Batubara. The selling price for that delivery shall be equal to current average prices for sale in the Southwest Pacific Regions

A.2 CONTRACTOR'S RIGHTS AND FACILITIES

- Contractor is given the right to exploit the area for the duration of 30 years
- Contractor is exempted from import and export tax duties
- Losses suffered during the first 5 years of operation may be carried over into the following years
- Contractor may apply accelerated depreciation on the invested capital
- An investment allowance may be taken amounting to 20 percent of the total investment, stretched over a period of 4 operating years
- The contractor is allowed to transfer the following in any currency, without limitations:
  - Net profit of the operation in proportion to share-holding by foreign participants
  - Installments of foreign loans and their interest
  - Funds generated through depreciation of imported capital assets
  - Proceeds from the sales of shares by foreign shareholders to Indonesian nationals
  - Compensation in case of nationalization
- The contractor is allowed to export their products (including to their own country), provided due consideration is given to the host country's coal needs in the relevant year

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APPENDIX B
SUMMARY OF KALIMANTAN COAL RESOURCES

Appendix B

SUMMARY OF KALIMANTAN COAL RESOURCES

This appendix provides a summary of information on quantity (Table B-1) and quality (Table B-2) characteristics of coal deposits in Kalimantan. Currently, not much is known about the various deposits, so Tables B-1 and B-2 merely represent a compilation of data provided in the references cited in the tables. By and large, it can be concluded from the tables that coal deposits in Kalimantan are widespread, but to find out exactly how much coal there is and what quality it is will require significantly more exploration than has been done. Please note that with few exceptions (such as the Senakin and Pasir areas), the reliability of most information reported in the literature and in these tables is suspect, or at least needs to be verified in considerable detail.

Table B-1

QUANTITY OF MAJOR COAL RESOURCES IN KALIMANTAN

Province, Area, Deposit	Operator/ Contractor	Type of Coal-Mining Method[a]	Resources (million tonnes)					Depth	Reference (see Subsection 3.11)
			Measured	Indicated	Inferred	Speculative	Total	Up to/ Thickness (meters)	
Central Kalimantan									
o Muara Teweh - Buntok		SB -			120.0		120.0		3-2
South Kalimantan									
o Senakin	P.T. Arutmin								
- Sangsang		BT - OC	30.0				30.0	60/6	3-13
- Sepapah		BT - OC	10.0				10.0	60/4	3-13
- East Senakin		BT - OC	50.0				50.0	60/4	3-13
o Bengkalaan		SB(LN) -						/2.0	3-7
o South Ata		SB(LN) -						/5.0	3-7
o Kintap		SB(LN) -						/5.7	3-7
o Kukusan		SB(LN) -							3-7
o Pulau Laut and Pulau Sebuku		BT -		23.0	150.0		173.0	200/	3-4
o Bunati		LN -							3-7
o Sarangga		LN -				150.0	150.0	60/	3-7
o Tanjung	P.T. Adaro Indonesia								
- Warukin		SB -			912.9	1,500.0	2,412.9		3-2
- Tutupan I		SB -			661.7		661.7		3-2
- Tutupan II		SB -			150.2	2,590.0	2,740.2		3-2
- Paringin		SB -				829.0	829.0		3-2
- Ambakiang		SB -				628.0	628.0		3-2
Southeast Kalimantan									
o Pasir									
- Bindu (Block V)	P.T. Utah	BT - OC	32.0				32.0	100/6.9	3-20
- Petangis (Block V)		BT - OC	30.0				30.0	100/4.4	3-20
- Betitit (Block V)		BT - OC	5.0				5.0	100/5.7	3-20
o Oku	P.T. Kideco Jaya Agung							/1-10	3-2
o Susubung		SB -			54.0		54.0	/6.5-13	3-4, 3-25
o Terik								/0.3-1.5	3-2
o Samarangau		SB - OC			62.0		62.0	100/2-13.5	3-2, 3-25
		- UD			153.0		153.0	100/2-13.5	3-2, 3-25
o Biu									
o Samu									
South-Central Kalimantan									
o Block VII	P.T. Utah								

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Table B-1 (Cont'd)

Province, Area, Deposit	Operator/ Contractor	Type of Coal-Mining Method[a]	Resources (million tonnes)					Depth	Reference (see Subsection 3.11)
			Measured	Indicated	Inferred	Speculative	Total	Up to/ Thickness (meters)	
East Kalimantan									
o Area 2	Agip-Consol								
- Semalis syncline									
- Busang syncline		BT - OC				100	100	100/1-5	3-26
- Gitan syncline									
o Area 1	Agip-Consol								
- Simengaris		BT -							
o Samarinda area	P.T. Kaltim								
- Santan	Prima Coal	LN -						/2.0-3.0	3-27
- Sapari		LN -						/5.0	3-27
- Loakulu		SB - OC					0.0		3-2
		- UD			34.9		34.9		
- Loa Haur		SB - OC					0.0		3-2
		- UD			14.9		14.9	/4.75	
- South Prangat		SB - OC			24.2		24.2		3-2
		- UD			95.0	62.0	157.0		
- Bukit Merah		SB - OC			29.0		29.0		3-2
		- UD			85.5	8.0	93.5		
- Pelarang		SB - OC			16.6		16.6		3-2
		- UD			92.4	22.6	115.0		
- Kamboja		SB - OC			62.0		62.0		3-2
		- UD			229.8	112.1	341.9		
- Central Badak		SB - OC			-		0.0		3-2
		- UD			201.3		201.3		
- Saka Kanan		SB - OC			2.0		2.0		3-2
		- UD			23.6	41.4	65.0		
o Sangatta area	P.T. Kaltim								
- West Pinang	Prima Coal	BT - OC				50-100	50-100	/5.0-8.0	3-27
- Lembak block		BT - OC						/3.0-5.0	3-27
- Loa Ulung	P.T. Fajar Bumi Sakti	BT -							
- Loa Tebu	P.T. Tanito Harum	BT -							
- Sigihan	P.T. Kitadin Corp.	BT -							
- Merandai	P.T. Bukit Baiduri	BT -							

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Table B-1 (Cont'd)

Province, Area, Deposit	Operator/ Contractor	Type of Coal-Mining Method(a)	Resources (million tonnes)					Depth	Reference (see Subsection 3.11)
			Measured	Indicated	Inferred	Speculative	Total	Up to/ Thickness (meters)	
East Kalimantan (cont'd)									
o Berau area	P.T. Berau Coal								
- Perapatan (T.G. Redeb)		BT -		40.0	150.0		190.0	70/5	3-4
- Lati		BT - OC							
- Kelai		BT - OC				250.0	250.0	/ 5	3-28
Total Resources			157.0	974.2	2,659.9	6,122.0	9,913.0		

(a) BRN - Brown coal
SB - Sub-bituminous
BT - Bituminous
LN - Lignite
AN - Anthracite
OC - Open cast mine
UD - Underground mine

Table B-2

QUALITY OF MAJOR COAL RESOURCES

Province, Area, Deposit	Type of Coal	Analytical Basis	Proximate Analysis (percent)					Ultimate Analysis (percent)						Other Properties				Reference (see Subsection 3.11)
			Fixed Carbon	Volatile Matter	Ash	Inherent Moisture	Total Moisture	Sulfur	Carbon	Hydrogen	Oxygen	Nitrogen	Ash (Na20)	Calorific Value (kcal /kg)	Fusion (°C)	Free Swell Index	Grind-ability	
Central Kalimantan																		
o Muara Teweh - Buntok	SB		53.17	38.9	3.54	3.74		0.64						7080				3-2
South Kalimantan																		
o Senakin		Raw/air dried	36.2-40.2	37.2-41.2	14.5 20.5		4.5-7.0	0.2-1.0	57.2-64.2	4.3-5.5	8.75-11.25	1.0-1.3	14.5 20.5	5600 6500	1350-1600	0.5-1.5	34.0-42.0	3-13
- Sangsang	BT																	
- Sepapah	BT																	
- East Senakin	BT																	
o Benkalaan	SB(LN)	Raw/air dried			4.3-5.9		22.2-29.2	0.3-0.5						4710-5420				3-7
o South Ata	SB(LN)	Raw/air dried			10.2-13.5		4.9-7.1	0.4-0.8						6070-6390				3-7
o Kintap	SB(LN)	Raw/air dried			6.4-15.9		5.6-7.9	0.2-0.8						5820-6660				3-7
o Kukusan	SB(LN)																	
o Pulau Laut and Pulau Sebuku	BT	Dry	52.3	29.9	17.7	-	5.8	0.8	76.7	7.3	13.2	2.0		6600-7600				3-4
o Bunati	LN	Raw/air dried			14.2		14.4	0.45						4650				3-7
o Sarangga	LN																	3-7
o Tanjung	SB		42.8	41.8	1.9		13.6	0.4						5854				3-2
- Warukin																		
- Tutupan I																		
- Tutupan II																		
- Paringin																		
- Ambakiang																		

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Table B-2 (Cont'd)

Province, Area, Deposit	Type of Coal	Analytical Basis	Proximate Analysis (percent)					Ultimate Analysis (percent)						Other Properties				Reference (see Subsection 3.11)
			Fixed Carbon	Volatile Matter	Ash	Inherent Moisture	Total Moisture	Sulfur	Carbon	Hydrogen	Oxygen	Nitrogen	Ash (Na_2O)	Calorific Value (kcal /kg)	Fusion (°C)	Free Swell Index	Grindability	
Southeast Kalimantan																		
o Pasir																		
- Bindu (Block V)	BT	Raw/air dried	34.9	33.7	28.2		3.2	3.17	80.39	6.07	8.60	1.77	0.22	5470	1300-1575		55	3-22
- Petangis (Block V)	BT	Raw/air dried	36.7	38.1	20.6		4.6	0.84	79.01	6.17	12.54	1.44	0.49	5900	1370-1470		39	3-21
- Betitit (Block V)																		
o Oku																		
o Susubung																		
o Terik																		
o Samarangau	SB	Raw/air dried	46.9 48.6	47.2 49.4	3.2 5.0		3.6-5.3	.12-0.15						6092-6390	1300-1465			3-25
o Bui																		
o Samu																		
South-Central Kalimantan																		
o Block VII																		
East Kalimantan																		
o Area 2																		
- Semalis syncline																		
- Busang syncline	BT	As rec.			4-5		≈ 15	< 1						6000-6500				3-26
- Gitan syncline																		
o Area 1																		
- Simengaris	BT	Raw/air dried	45-40					3.5						6450-6690				3-2

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Table B-2 (Cont'd)

Province - Area/Deposit	Type of Coal	Analytical Basis	Proximate Analysis (percent)					Ultimate Analysis (percent)						Other Properties				Reference (see Subsection 3.11)
			Fixed Carbon	Volatile Matter	Ash	Inherent Moisture	Total Moisture	Sulfur	Carbon	Hydrogen	Oxygen	Nitrogen	Ash (Na_2O)	Calorific Value (kcal /kg)	Fusion (°C)	Free Swell Index	Grindability	
East Kalimantan (Cont'd)																		
o Simarinda area																		
- Santan	LN	Air dried				6.0-7.0												3-25
- Sapari	LN	Air dried				13.0-15.0								4780-5736				3-25
- Loa Kulu	SB																	
- Loa Haur	SB	Dry	43.0-49.0	41.0-50.8	1.1-11.0	3.3-9.8	5.0-20.0	2.0-3.4					2.2	6000-6500	1450	1.0-1.5	49	3-2
- South Prangat	SB																	
- Bukit Merah																		
- Pelarang																		
- Kamboja																		
- Central Badak																		
- Saka Kanan																		
o Sangatta area																		
- West Pinang		Air dried			0.8-3.1		9.7-12.2	< 0.5						6638-6692				3-2
- Lembak Block		Air dried					20-30											3-2
- Loa Ulung	BT	Air dried	51.3	41.4	1.0		6.3	0.17						7003				3-6
- Loa Tebu																		
- Sigihan																		
- Merandai	BT	Air dried	43.7	39.9	1.5		14.9	1.2						5899				3-6

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Table B-2 (Cont'd)

Province - Area/Deposit	Type of Coal	Analytical Basis	Proximate Analysis (percent)					Ultimate Analysis (percent)						Other Properties				Reference (see Subsection 3.11)
			Fixed Carbon	Volatile Matter	Ash	Inherent Moisture	Total Moisture	Sulfur	Carbon	Hydrogen	Oxygen	Nitrogen	Ash (Na_2O)	Calorific Value (kcal /kg)	Fusion (°C)	Free Swell Index	Grindability	
East Kalimantan (Cont'd)																		
o Berau area																		
- Perapatan (T.G. Redeb)																		
- Lati																		
- Kelai																		

BRN - Brown coal
SB - Sub-bituminous
BT - Bituminous
LN - Lignite

AN - Anthracite
OC - Open cast mine
UD - Underground mine

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APPENDIX C
SUPPORTING INFORMATION ON SECTION 5: SEA TRANSPORT SYSTEM

Appendix C

SUPPORTING INFORMATION ON SECTION 5: SEA TRANSPORT SYSTEM

This appendix contains the following tables in support of the information provided in Section 5.

- C-1 through C-8: Loading and Unloading Costs per Tonne (as a function of vessel size, and loading and unloading rates)
- C-9: Vessel Requirements for all Routes Considered in Section 5
- C-10: Vessel Requirements for Option 1, Organized by Loading Port
- C-11: Vessel requirements for Option 2, Organized by Loading Port

Table C-1

LOADING AND UNLOADING COSTS PER TONNE FOR 2,000 DWT BARGES

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost (US$/day)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time, Loading, and Unloading (days)	Total Time (days)	Loading, Unloading, and Harbor Cost (US$/tonne)
				Design Rate (TPH)	Loading Time (Days)	Design Rate (TPH)	Unloading Time (days)			
Barge and tug	2,000	2,000	2,105	500	0.2	150	1.1	0.7	2.0	2.11
						300	0.6		1.5	1.58
						750	0.2		1.1	1.16
						1,000	0.2		1.1	1.16
						2,000	0.1		1.0	1.05
				1,000	0.1	150	1.1		1.9	2.00
						300	0.6		1.4	1.47
						750	0.2		1.0	1.05
						1,000	0.2		1.0	1.05
						2,000	0.1		0.9	0.95
				1,500	0.1	150	1.1		1.9	2.00
						300	0.6		1.4	1.47
						750	0.2		1.0	1.05
						1,000	0.2		1.0	1.05
						2,000	0.1		0.9	0.95

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Table C-2

LOADING AND UNLOADING COST PER TONNE FOR 5,000 DWT BARGES

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost (US$/day)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time, Loading and Unloading (days)	Total Time (days)	Loading, Unloading, and Harbor Cost (US$/tonne)
				Design Rate (TPH)	Loading Time (days)	Design Rate (TPH)	Unloading Time (days)			
Barge and tug	5,000	5,000	4,253	500	0.6	150	2.8	0.7	4.1	3.49
						300	1.4		2.7	2.30
						750	0.6		1.9	1.62
						1,000	0.4		1.7	1.45
						2,000	0.2		1.5	1.28
				1,000	0.3	150	2.8		3.8	3.23
						300	1.4		2.4	2.04
						750	0.6		1.6	1.36
						1,000	0.4		1.4	1.19
						2,000	0.2		1.2	1.02
				1,500	0.2	150	2.8		3.7	3.15
						300	1.4		2.3	1.96
						750	0.6		1.5	1.28
						1,000	0.4		1.3	1.11
						2,000	0.2		1.1	0.94

RR:6545a

Table C-3

LOADING AND UNLOADING COST PER TONNE FOR 10,000 DWT BARGES

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost (US$/day)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time, Loading, and Unloading (days)	Total Time (days)	Loading, Unloading, and Harbor Cost (US$/tonne)
				Design Rate (TPH)	Loading Time (days)	Design Rate (TPH)	Unloading Time (days)			
Barge and tug	10,000	10,000	5,510	500	1.2	150	5.6	0.7	7.5	4.13
						300	2.8		4.7	2.59
						750	1.1		3.0	1.65
						1,000	0.8		2.7	1.49
						2,000	0.4		2.3	1.27
				1,000	0.6	150	5.6		6.9	3.80
						300	2.8		4.1	2.26
						750	1.1		2.4	1.32
						1,000	0.8		2.1	1.16
						2,000	0.4		1.7	0.94
				1,500	0.4	150	5.6		6.7	3.69
						300	2.8		3.9	2.15
						750	1.1		2.2	1.21
						1,000	0.8		1.9	1.05
						2,000	0.4		1.5	0.83

RR:6545a

Table C-4

LOADING AND UNLOADING COST PER TONNE FOR 6,000 DWT MINI-BULK CARRIERS

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost (US$/day)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time, Loading, and Unloading (days)	Total Time (days)	Loading, Unloading, and Harbor Cost (US$/tonne)
				Design Rate (TPH)	Loading Time (days)	Design Rate (TPH)	Unloading Time (days)			
Mini-bulk carrier	6,000	5,580	4,708	500	0.7	150	3.1	0.7	4.5	3.80
						300	1.6		3.0	2.53
						750	0.6		2.0	1.69
						1,000	0.5		1.9	1.60
						2,000	0.2		1.6	1.35
				1,000	0.3	150	3.1		4.1	3.46
						300	1.6		2.6	2.19
						750	0.6		1.6	1.35
						1,000	0.5		1.5	1.27
						2,000	0.2		1.2	1.01
				1,500	0.2	150	3.1		4.0	3.37
						300	1.6		2.5	2.11
						750	0.6		1.5	1.27
						1,000	0.5		1.4	1.18
						2,000	0.2		1.1	0.93

RR:6545a

Table C-5

LOADING AND UNLOADING COST PER TONNE FOR 10,000 DWT BULK CARRIERS

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost (US$/day)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time, Loading, and Unloading (days)	Total Time (days)	Loading, Unloading, and Harbor Cost (US$/tonne)
				Design Rate (TPH)	Loading Time (days)	Design Rate (TPH)	Unloading Time (days)			
Bulk carrier	10,000	9,300	6,137	500	1.1	150	5.2	0.7	7.0	4.62
						300	2.6		4.4	2.90
						750	1.0		2.8	1.85
						1,000	0.8		2.6	1.72
						2,000	0.4		2.2	1.45
				1,000	0.6	150	5.2		6.5	4.29
						300	2.6		3.9	2.57
						750	1.0		2.3	1.52
						1,000	0.8		2.1	1.39
						2,000	0.4		1.7	1.12
				1,500	0.4	150	5.2		6.3	4.16
						300	2.6		3.7	2.44
						750	1.0		2.1	1.39
						1,000	0.8		1.9	1.25
						2,000	0.4		1.5	0.99

Table C-6

LOADING AND UNLOADING COST PER TONNE FOR 20,000 DWT BULK CARRIERS

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost (US$/day)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time, Loading, and Unloading (days)	Total Time (days)	Loading, Unloading, and Harbor Cost (US$/tonne)
				Design Rate (TPH)	Loading Time (days)	Design Rate (TPH)	Unloading Time (days)			
Bulk carrier	20,000	18,600	9,363	500	2.2	150	10.3	0.7	13.2	6.64
						300	5.2		8.1	4.08
						750	2.1		5.0	2.52
						1,000	1.6		4.5	2.27
						2,000	0.8		3.7	1.86
				1,000	1.1	150	10.3		12.1	6.09
						300	5.2		7.0	3.52
						750	2.1		3.9	1.96
						1,000	1.6		3.4	1.71
						2,000	0.8		2.6	1.31
				1,500	0.7	150	10.3		11.7	5.89
						300	5.2		6.6	3.32
						750	2.1		3.5	1.76
						1,000	1.6		2.9	1.46
						2,000	0.8		2.1	1.06

RR:6545a

Table C-7

LOADING AND UNLOADING COST PER TONNE FOR 30,000 DWT BULK CARRIERS

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost (US$/day)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time, Loading, and Unloading (days)	Total Time (days)	Loading, Unloading, and Harbor Cost (US$/tonne)
				Design Rate (TPH)	Loading Time (days)	Design Rate (TPH)	Unloading Time (days)			
Bulk carrier	30,000	27,900	11,985	500	3.3	150	15.5	0.7	19.5	8.38
						300	7.8		11.8	5.07
						750	3.1		7.1	3.05
						1,000	2.3		6.3	2.71
						2,000	1.2		5.2	2.23
				1,000	1.7	150	15.5		17.9	7.69
						300	7.8		10.2	4.38
						750	3.1		5.5	2.36
						1,000	2.3		4.7	2.02
						2,000	1.2		3.6	1.55
				1,500	1.1	150	15.5		17.3	7.43
						300	7.8		9.6	4.12
						750	3.1		4.9	2.10
						1,000	2.3		4.1	1.76
						2,000	1.2		3.0	1.29
				2,000	0.8	150	15.5		17.0	7.30
						300	7.8		9.3	4.00
						750	3.1		4.6	1.98
						1,000	2.3		3.8	1.63
						2,000	1.2		2.7	1.16

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Table C-8

LOADING AND UNLOADING COST PER TONNE FOR 40,000 DWT BULK CARRIERS

Vessel Type	Nominal Cargo Carrying Capacity (tonnes)	Effective Cargo Carrying Capacity (tonnes)	Capital and Operating Cost (US$/day)	Loading with 70 Percent Efficiency		Unloading with 50 Percent Efficiency		Harbor Time, Loading, and Unloading (days)	Total Time (days)	Loading, Unloading, and Harbor Cost (US$/tonne)
				Design Rate (TPH)	Loading Time (days)	Design Rate (TPH)	Unloading Time (days)			
Bulk carrier	40,000	37,200	13,733	500	4.4	150	20.7	0.7	25.8	9.52
						300	10.3		15.4	5.69
						750	4.1		9.2	3.40
						1,000	3.1		8.2	3.03
						2,000	1.6		6.7	2.47
				1,000	2.2	150	20.7		23.6	8.71
						300	10.3		13.2	4.87
						750	4.1		7.0	2.58
						1,000	3.1		6.0	2.22
						2,000	1.6		4.5	1.66
				1,500	1.5	150	20.7		22.9	8.45
						300	10.3		12.5	4.61
						750	4.1		6.3	2.33
						1,000	3.1		5.3	1.96
						2,000	1.6		3.8	1.40
				2,000	1.1	150	20.7		22.5	8.31
						300	10.3		12.1	4.47
						750	4.1		5.9	2.18
						1,000	3.1		4.9	1.81
						2,000	1.6		3.4	1.26

Table C-9

VESSEL REQUIREMENTS FOR ALL ROUTES CONSIDERED IN SECTION 5
(Options 1 and 2)

Route Number	Round-Trip Time (days)	Vessel Type and Size[a]	1988 Annual Transport Requirements (MMTPY)	1988 Number of Vessels Required	1991 Annual Transport Requirements (MMTPY)	1991 Number of Vessels Required	1994 Annual Transport Requirements (MMTPY)	1994 Number of Vessels Required
1	9.6	10,000 B	1.00	2.8	1.00	2.8	1.00	2.8
2	10.4	10,000 B	0.67	2.0	0.71	2.2	0.95	2.9
3	7.9	10,000 B	0.93	2.2	1.09	2.5	1.09	2.5
4	9.1	10,000 B	0.27	0.7	0.67	1.8	0.84	2.2
5	12.7	10,000 B	0.30	1.1	0.40	1.5	-	-
6	6.3	10,000 B	0.19	0.4	-	-	-	-
7	4.8	10,000 BC	0.69	1.0	1.82	2.8	4.56	6.9
8	5.3	20,000 BC	-	-	0.30	0.3	0.36	0.3
8A	7.7	10,000 B	-	-	0.30	0.7	0.36	0.8
9	14.4	10,000 B	-	-	1.03	4.4	1.37	5.8
10	4.2	10,000 BC	-	-	0.08	0.1	0.34	0.5
11	9.4	20,000 BC	-	-	-	-	0.97	1.4
12	8.8	40,000 BC	-	-	1.71	1.2	1.95	1.4
13	6.5	40,000 BC	-	-	1.09	0.6	1.09	0.6
14	10.1	40,000 BC	-	-	1.43	1.1	2.34	1.9
15	6.1	40,000 BC	-	-	-	-	4.56	2.2
I	0.8	Tug	-	-	1.00	0.2	1.00	0.2
	3.1	10,000 B	-	-	1.00	0.9	1.00	0.9
II	0.6	Tug	-	-	2.20	0.4	2.04	0.4
	2.9	10,000 B	-	-	2.20	1.9	2.04	1.7
III	1.4	Tug	-	-	-	-	0.97	0.4
	3.5	10,000 B	-	-	-	-	0.97	1.0
IV	1.2	Tug	-	-	1.03	0.4	1.37	0.5
	3.5	10,000 B	-	-	1.03	1.1	1.37	1.4
V	0.3	Tug	-	-	-	-	4.56	0.4
	2.6	10,000 B	-	-	-	-	4.56	3.5

(a) B = barge, BC = bulk carrier

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Table C-10

VESSEL REQUIREMENTS FOR OPTION 1, ORGANIZED BY LOADING PORT[a]

Loading Port	Routes Served	1988			1991			1994		
		10,000 B[b]	10,000 BC[b]	20,000 BC	10,000 B	10,000 BC	20,000 BC	10,000 B	10,000 BC	20,000 BC
Linding	1	2.8	-	-	2.8	-	-	2.8	-	-
Tanah Merah	2	2.0	-	-	2.2	-	-	2.9	-	-
	3	2.2	-	-	2.5	-	-	2.5	-	-
	4	0.7	-	-	1.8	-	-	2.2	-	-
	5	1.1	-	-	1.5	-	-	-	-	-
	6	0.4	-	-	-	-	-	-	-	-
Vessels for Tanah Merah		6.4			8.0			7.6		
Tanjung Batu	7	-	1.0	-	-	2.8	-	-	6.9	-
Tanjung Bungalun	8	-	-	-	-	-	0.3	-	-	0.3
	11	-	-	-	-	-	-	-	-	1.4
Vessels for T. Bungalun										
Tenggarong	9	-	-	-	4.4	-	-	5.8	-	-
Lunsuran	10	-	-	-	-	0.1	-	-	0.5	-
Total Number of Vessels Required		9.2	1.0	-	15.2	2.9	0.3	16.2	7.4	1.7

(a) See Section 5
(b) Deadweight tonnes; B = barge, BC = bulk carrier

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Table C-11

VESSEL REQUIREMENTS FOR OPTION 2, ORGANIZED BY LOADING PORT[a]

Loading Port	Routes Served	1988			1991				1994			
					10,000 B				10,000 B			
		10,000 B[b]	10,000 BC[b]	40,000 BC	Tug	Barge	10,000 BC	40,000 BC	Tug	Barge	10,000 BC	40,000 BC
Linding	I	-	-	-	0.2	0.9	-	-	0.2	0.9	-	-
	1	2.8	-	-	-	-	-	-	-	-	-	-
Vessels for Linding		2.8	-	-	0.2	0.9	-	-	0.2	0.9	-	-
Tanah Merah	II	-	-	-	0.4	1.9	-	-	0.4	1.7	-	-
	2	2.0	-	-	-	-	-	-	-	-	-	-
	3	2.2	-	-	-	-	-	-	-	-	-	-
	4	0.7	-	-	1.8	1.8	-	-	2.2	2.2	-	-
	5	1.1	-	-	-	-	-	-	-	-	-	-
	6	0.4	-	-	-	-	-	-	-	-	-	-
Vessels for Tanah Merah		6.4	-	-	2.2	3.7	-	-	2.6	3.9	-	-
Tanjung Batu	V	-	-	-	-	-	-	-	0.4	3.5	-	-
	7	-	1.0	-	-	-	2.8	-	-	-	-	-
Vessels for Tanjung Batu			1.0	-	-	-	2.8	-	0.4	3.5	-	-
Tanjung Bungalun	III	-	-	-	-	-	-	-	0.4	1.0	-	-
	8A	-	-	-	0.7	0.7	-	-	0.8	0.8	-	-
Vessels for Tanjung Bungalun		-	-	-	0.7	0.7	-	-	1.2	1.8	-	-
Tenggarong	IV	-	-	-	0.4	1.1	-	-	0.5	1.4	-	-
Lunsuran	10	-	-	-	-	-	0.1	-	-	-	0.5	-
Balikpapan	12	-	-	-	-	-	-	1.2	-	-	-	1.4
	13	-	-	-	-	-	-	0.6	-	-	-	0.6
	14	-	-	-	-	-	-	1.1	-	-	-	1.9
Vessels for Balikpapan		-	-	-	-	-	-	2.9	-	-	-	3.9
Kotabaru	15	-	-	-	-	-	-	-	-	-	-	2.2
Total Number of Vessels Required		9.2	1.0	-	3.5	6.4	2.9	2.9	4.9	11.5	0.5	6.1

(a) See Section 5
(b) Deadweight tonnes; B = barge, BC = bulk carrier

RR:6549a