# PLANNING FOR INDUSTRIAL DEVELOPMENT IN INDONESIA

Chapters I - VII

## Policies and the General Strategy

## CURRENCY EQUIVALENTS

| | | |
|---|---|---|
| US $ 1.00 | = | Rp 378 |
| 1 rupiah | = | US $ 0.003 |
| 1 million rupiahs | = | US $ 2,646 |

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## BASIC DATA

| | |
|---|---|
| Area: (Sq. Km.) | 1,904,639 |
| Population (million) | 121.1 |
| Estimated annual growth rate (1965-70) | 2.5% |
| Density (per sq. km). For the country | 64 |
| For Java | 592 |
| Political Status: Unitary republic, member U.N. and the Association of South-East Asia Nations (ASEAN). | |
| GDP (1970) | Rp 3,328 billion |
| Contribution of manufacturing to GDP | 6.8% |
| Composition of value-added by manufacturing | |
| - Food, beverages and tobacco | 39.7% |
| - Textiles | 17.5% |
| - Clothing and footwear | 1.6% |
| - Wood products | 10.3% |
| - Paper and paper products | 0.6% |
| - Printing and publishing | 1.9% |
| - Leather products | 1.3% |
| - Rubber products | 1.7% |
| - Chemicals, and petroleum and coal products | 7.6% |
| - Non-metallic mineral products | 2.6% |
| - Basic metals | 2.0% |
| - Metal products | 13.2% |
| | 100.0% |
| Per capita GDP (Equiv. US $) Official (1970) | 73 |
| Estimated (1970) | 90 |
| Exchange Rate | |
| 1 US $ = | Rp 378 |
| 1,000 Rupiah = | $ 2.646 |

| Foreign Exchange Reserves | Dec. 1969 | Dec. 1970 |
|---|---|---|
| Gross (US $ million) | 119 | 157 |
| Net (US $ million) | (86) | (51) |
| Price Index (1966 = 100) | 575 | 611 |

| | Dec. 1969 | Dec. 1970 |
|---|---|---|
| **Money Supply** | | |
| Total (Rp billion) | 180 | 243 |

| Public Sector Operations (Rp billion) | 1969 Actual | 1970/71 Est. Act. | 1971/72 Est. Bud. |
|---|---|---|---|
| Government current receipts | 244 | 344 | 416 |
| Government current expenditures | 216 | 310 | 364 |
| Official development expenditures | 119 | 135 | 195 |

FY? or CY

| Balance of Payments (US $ million) | | | |
|---|---|---|---|
| Exports of goods and services | 1,039 | 1,196 | 1,420 |
| Imports of goods and services | 1,443 | 1,612 | 1,926 |
| Current account surplus (deficit) | (404) | (416) | (506) |

| Commodity concentration of exports (1970/71) | |
|---|---|
| Oil | 37% |
| Rubber | 22% |
| Timber | 7% |

## SUMMARY


1. Over the past several years the economy of Indonesia has been relatively stabilized and growing. Yet, compared to other countries of similar size and per capita income Indonesia's industrial sector is underdeveloped, and there are distortions and gaps in the structure of industry. At the present time industry originates 7% - 8% of the GDP, whereas for the level of per capita income and the market size, one would expect a contribution to GDP about 50% higher. Moreover, distortions in the structure of industry are revealed by the underdevelopment of certain industries relative to other industries in the economy. The greatest lack of capability exists in metals, machinery and chemicals. Indonesian industrial development will need to be accelerated and the major gaps in the structure corrected if this sector is not to hold back the development of the economy as a whole.

2. There are several possible paths for industrial development and two polar cases are identified; one involves a "continuing lag". Although growth in the sector may occur, it continues to lag behind in the percent of the GDP originating in industry. The second path foresees a "catching up" by 1980 to the more normal or expected percent of GDP originating in industry. It is reasonable to expect a growth rate for industry falling somewhere between the two polar cases; the second case in particular might impose too many pressures on resources and institutions in the near future. A growth rate in the range 13% - 15% for industry is probably feasible and would support a growth rate of GDP of about 7% - 8%. A disaggregation of the industrial sector reveals that some industries, notably the three mentioned in the previous paragraph, must grow at substantially higher rates than the average, if a correction of distortions is to occur. These rates of growth, in certain cases, exceed 20%.

3. The general strategy for industrial development is relatively flexible and includes the following: (a) a commitment to an accelerated rate of growth of industry; (b) correction of major distortions in the structure, primarily through emphasis on the engineering or machinery industries, base metals, and chemicals; (c) immediate initiation of full feasibility studies of major projects that are shown in this report to have rates of return in the range of 15% - 20%. These major projects include: a direct reduction steel project; a petrochemicals core of plants; a timber-based complex of plants to produce a range of products. Also special programs to change the orientation of the automobile industry and to stimulate engineering industries in mobile equipment, stationary equipment, shipbuilding, and electrical equipment are required. (d) Special emphasis on light and medium scale plants in the engineering supplier (component) industries and in consumer goods is also needed. Recommendations for institutional actions that can be taken now to activate the program are included in detail in Chapter II.

4. The incentive system introduced since 1967 has stimulated foreign and domestic investment in Indonesian manufacturing but undesirable side effects, biases and burdensome economic costs of the incentive system itself are apparent. The major problems, gaps and administration of the incentive system should be re-examined and an appropriate mix of policies and institutional arrangements introduced. The following programs and measures appear to be required:

(a) Special assistance to light industries such as: (i) a program of prefeasibility and market studies to attract investment; (ii) assistance to establish an industrial project evaluation and studies unit in the Ministry of Industry as a means of upgrading the analytical and conceptual skills there; (iii) establishment and wide distribution amongst potential investors of a list of priority products and product lines which the Government wants to encourage; (iv) expansion of investment promotion activities, with a re-examination of tax, tariff, and other incentives to differentiate and sharpen the impact of the incentives; (v) special financial, marketing and technical assistance to new and expanded enterprises during the early operational stage; (vi) special financial incentives, including favorable loan terms and conditions of eligibility, possible direct equity participation and investment insurance.

(b) There is a need to re-examine the present investment licensing system; free market access upon registration would eliminate the automatic official presumption in favor of granting tax holidays, import duty exemption and other incentives and the implicit commitment of the Government to shield local enterprise from competition.

(c) There is a need to reconsider the cumbersome and costly administrative, institutional and procedural aspects of the present incentive system and technical assistance should be provided to examine the policies, rules, regulations, licenses, procedures and other controls and institutional arrangements affecting foreign and domestic investment in order to estimate the economic costs involved and to recommend reforms.

(d) The problem of "legal" and "illegal" smuggling should be considered with the aim of instituting practical reforms and measures to reduce, if not eliminate, the serious competitive impact on finished consumer goods industries. A set of measures will probably be required to combat smuggling on a wide front: (i) downward revision of high tariffs, especially on the principle smuggled goods, to reduce the incentive to evade duties; (ii) strengthen the customs administration and enforcement of penalties in ports and harbors (iii) increase investment in coastal patrol craft and deploy them more efficiently; (iv) joint cooperation in coastal patrols to control illegal trade with Malaya, Singapore and the Philippines.

(e) While reform of import duties and taxes now under discussion, in the Ministry of Finance seems to be generally in the right direction, estimates of the rates of "effective protection" should be made in order to avoid over or underprotection of value-added.

(f) Some easing of the tax burden on the revaluation of fixed assets is probably desirable in order to improve debt-equity positions, encourage joint venture arrangements and improve the incentive to invest.

(g) Technical assistance should be provided to undertake a broad study of the financial, economic and non-economic factors affecting the export of manufactures in order to establish the most effective set of measures the Government might adopt.

(h) In view of the growing concentration of industry and population in Djakarta and Java generally, consideration should be given to establishing an industrial location policy aimed at creating new and strengthening incipient resource-based growth poles outside of Java, such as a wood products industry in Kalimantan. Inter-island and international shipping costs, especially from the larger islands, should be examined to ascertain their impact on private location decisions.

(i) The present incentive system appears biased against employment-creation and should be re-examined from this point of view. Duty-free imports of capital goods, high depreciation allowances, severe restrictions on discharging employees after 90 days of service and other labor legislation and financial arrangements tend to encourage labor-saving investment.

(j) There is a need to strengthen the weak and inadequate system of industry planning, project evaluation, feasibility studymaking and collection of essential industrial planning data within the Ministry of Industry and outside.

5. The provision of finance for industrial expansion seems to be working reasonably well. In particular, the medium-term investment credit program has been expanded, but certain changes would make it more effective. At present, three-quarters of the loans are for over Rp 100 million and clearly go to larger scale industry. Specific attention is required to the needs of the smaller scale plants. Also, it is suggested that this investment credit program be expanded to include some of the stronger private banks, all of whom are now excluded. They should be encouraged to provide funds to smaller industries through a limit on the size of loans and through other measures. If the banking system is to expand its share of investment funds, in comparison to that supplied by the central bank, some changes in the

structure of interest rates will probably have to be effected possibly through a lowering of deposit rates. Certain other changes in preferential interest rates may also be desirable.

6. There are various plans for the expansion of industrial estates; private investors have expressed a definite interest in participating in Pulo Gadung and Tjilatjap. They are not in a position to undertake full financing of an estate and joint promotion with the Government seems clearly indicated. The IBRD has indicated a willingness to consider financial support, if a Government authority is established to be the channel for such funds, as well as to undertake the promotion and supervision of them. The lack of such an authority, with certain key powers and responsibilities, appears to be a primary impediment to the success of the program. There are other deficiencies in the program, such as lack of provision for space for smaller scale industries, but these are fairly easily correctable.

7. Indonesia has negotiated a number of concession agreements for the exploitation of mineral and timber resources. Many of these agreements were exceedingly generous to the concessionaires in terms of preferential treatment on taxes and other payments, and conditions of performance. A review of selected agreements indicates that the terms for the division of net revenues and benefits, the stipulations as to the rate of development and production, and the specification of tests of performance unduly favor concessionaires. Suggestions are made in the report and in referenced material for tightening the provisions in each of these areas, so that the agreements will better support the development objectives of the country.

8. Approximately $20 million is earmarked for nominal research and development activities in the Government budget and about 10% of this is directed toward industrial needs. Unfortunately there is a proliferation of research institutes, most of which have too small a professional staff and a research program that is not focused on the pressing industrial problems, which are concentrated in the medium and small scale industries in engineering products and consumer goods. It is suggested that an improvement could be effected through a consolidation of research institutes, a redirection of their R&D programs, and, as a priority program, it is suggested that an initial effort be made to strengthen the staff, budget, and programs of the Metals Industries Development Center and the Institute of Technology at Bandung.

9. Although in the past there have been plans for the establishment of a steel industry in Indonesia, the one specific project at Tjilegon has not been completed. The extremely large size necessary for a conventional plant probably forbids consideration for some years, until the market grows substantially. However, an analysis of the market and of a newer type of direct reduction process that is economical at a scale of 400,000 tons, makes a plant of this type appear very attractive. A prefeasibility study concludes that the economic rate of

return would be about 18% and all technical, marketing, and other factors are favorable. It is recommended that a full feasibility study leading to a project proposal be undertaken immediately.

10. Petrochemical development is a natural opportunity for Indonesia because of the abundant supplies of oil and gas; yet the risks and uncertainties, both in markets and production, are serious. A rather detailed mathematical programming model for analyses of potential development of petrochemicals has been prepared. It analyzes the rates of return and investment required under different assumptions about demand, market prices, costs, and other factors. About eighteen different runs of the model were made, yielding investment levels ranging from $90 million to $350 million, and covering the period from 1977 to 1984 in stages. The study indicates that a large petrochemical core facility would be an attractive addition to the economy of Indonesia. A staging of the development is indicated - the selected initial facility costing $186,000,000 would be expanded to a $320,000,000 facility between 1977 and 1984. The initial facility would yield a 16% rate of return and this could be increased in later stages. It is recommended that a detailed feasibility study be undertaken; concurrently, efforts should start to attract technically competent and expert market oriented foreign equity participants for the project.

11. The engineering industries are underdeveloped, even by the standards of the developing countries of Asia. The situation calls for carful planning and strategic programs that will utilize the limited local resources in the most effective way possible; a suggested strategy calls for parallel developments in the following industries: (a) mobile equipment industries, (b) stationary equipment industries, (c) shipbuilding industry. Within each industry, the desirable direction of development is indicated, with special emphasis on the development of the supplier sector. The mobile equipment industries cover the motor vehicles and heavier equipment such as construction equipment. In the motor vehicle industry, it is suggested that the development emphasis should be shifted from passenger cars to light trucks and buses. In the other mobile equipment industry, the establishment of a nucleus enterprise is suggested. The viability of the enterprise will depend on the selection of a compatible product mix; an enterprise with a sample product mix is analysed. The stationary equipment industries favored for development are farm equipment and the light industrial electrical equipment. The key product in farm equipment is judged to be the irrigation pumps; program feasibility will hinge on the availability of quality castings at a competitive international price. The electrical equipment industry should be very attractive to develop, but the direction of development of this industry will depend largely on the electric power situation which is not clear at this time. In the shipbuilding industry, the case for building inter-island ships is relatively well established; however, the future direction of development will be shaped by whether or not a commitment is made to build ocean-going ships (general cargo vessels); the feasibility of the latter proposition is analysed.

12. Indonesia is endowed with one of the most important forest resources in the world. Save for teak forests in Java they were very lightly exploited until 1967. In the last three years the volume of timber felled has increased very rapidly and value of exports reached more than US $86 million in 1970. Yet timber-based industries are not now important elements in the country's development. The Foreign Capital Investment Law and the Basic Forestry Law, together with a surge in demand for logs in Japan, Korea, and other countries, were instrumental in the rapid increase of forest exploitation. The liberal policy embodied in these laws and several Government regulations has resulted in the granting of concessions covering 12 million Ha. of forest land. Concession agreements contain clauses on the obligation to build processing plants, but this obligation is conditioned on the plants being found technically and economically feasible by the concessionaires. Many concessions are too small to allow for their exploitation under sustained-yield management. There is therefore no assurance that this approach will maximize long-term benefits for the country, and for the concessionaires themselves. On the contrary, it is conceivable that it will result in unused capacity, unproductive investment, lower value added and misallocation of human financial and physical resources. An alternative approach suggested in the report is to develop integrated timber manufacturing operations. A prefeasibility study on such a complex, requiring a fixed investment of about US $94 million to process 1.6 million $m^3$ of logs, pulpwood, and forest waste (such as limbs and culled trees), could attain an internal economic rate of return of 20% per year. The complex as envisaged would be located in East Kalimantan. The complex proposed consists of a sawmill with annual capacity for about 175,000 $m^3$ of sawnwood; a 225,000 $m^3$/yr plywood plant, by-product plants; a 500 tpd pulp mill and 300 tpd paper mill. The complex is a very attractive project and shows an economic rate of return of about 20%. These findings justify a recommendation for carrying out detailed feasibility studies, leading to firm project proposals, in which alternative capacities and locations could be examined. These studies should be initiated without delay.

13. The minerals industries have provided Indonesia with much of her export receipts and in other ways have contributed specially to investment and development. The state enterprises responsible for the hard mineral areas have had a mixed experience in recent years. The tin mining enterprise has shown apparently high levels of net income, though accounting practices in use cause some doubts as to the actual levels. This enterprise could become more profitable if its production methods and employment practices would be revised. Difficulties have also been encountered in the rehabilitation of equipment and the operation of the smelter. It is suggested that technical assistance is required to help the enterprise achieve its potential. In coal mining there are two main deposits that are promising. The Bukit Asam deposit is now losing money, but it is a very good grade of steam coal. There are several alternatives for development that the report examines: (a) development for export only; (b) development for production of electric power generation

at the mine-head with the potential major customer a second aluminium smelter (in addition to the one now contemplated in conjunction with Asahan power); or (c) a combination of the previous two. Each alternative involves different costs, benefits, and institutional arrangements. Before a final decision is made, the alternatives should be investigated. A project for developing Ombilin coal is under way, and two private firms have prepared preliminary investment plans and a proposed contract of work. An analysis of the proposed contract of work reveals that it is highly unfavorable to Indonesia, and a recommendation is made that it be rejected. As to the proposed plans for the project, they now indicate a program for rehabilitating a railroad and development of a new port. An analysis of the costs and revenues indicates a very low rate of return. An alternative is to substitute a pipeline and associated facilities for the railroad and many of the port facilities. An analysis of this alternative seems to indicate that investment costs could be cut at least in half, and it is recommended that the pipeline case be more thoroughly evaluated before a final decision is made.

# FOREWORD

The ~~first~~ Industrial Mission to Indonesia visited the country in April and May, 1971. Its objectives were two-fold: to help articulate the framework and the issues for the preparation of a plan of industrial development for the next few years, and particularly provide a starting point for the work on the next five-year plan; and, to identify specific project opportunities and to prepare reasonably detailed prefeasibility studies of them, so that decisions can be made in the appropriate cases to undertake the further work necessary for firm project proposals.

The mission was composed of the following members:

Frederick T. Moore, Chief of Mission

Edward P. Holland, Economist
Industrial Structure and Projections

Wolfgang Kaupisch, Industrial Economist
Iron and Steel

Antonio S. Tarnawiecki, Industrial Economist
Timber-based Industries

Kenneth G. Brown, Chemical Engineer (Consultant)
Petrochemicals

Harry Y. Choi, Industrial Engineer (Consultant)
Engineering Industries

Walter Pajalich, Mining Engineer (Consultant)
Mineral Industries

James D. Theberge, Economist (Consultant)
Industrial Incentives.

# CHAPTER I

## THE PRESENT STATE OF INDUSTRIAL DEVELOPMENT

1.1 Compared to other countries of similar size and per capita income either now or in the past, Indonesia has a relatively undersized industrial sector. Although the statistics are very weak, this backwardness of industrial development seems to exist in each main branch of manufacturing production as well as in the aggregate. Moreover, in those branches that have been examined in detail, the variety of products is more limited than would be expected in a dynamic industrial sector. Even allowing for a large margin of possible error in the statistics, it must be concluded that Indonesian industrial development will need to be accelerated and certain gaps in its structure filled in, if this sector is not to hold back the development of the economy as a whole.

1.2 In the rest of this chapter, we will briefly sketch a few of the past events that have significantly affected the present state of industry and describe some of the features of the existing structure, making comparisons to other countries and to statistical norms.

### Historical Influences on Indonesian Industrial Development

1.3 The report of an Industrial Mission is not the place for an extensive review of Indonesia's economic history. However, knowledge of some aspects of that history can be very helpful in understanding the present state of the economy and of the industrial sector. The next few paragraphs summarize briefly those historical influences that seem to be most relevant for that understanding. A more comprehensive summary of recent events can be found in the IBRD economic report of 1968, supplemented by those of 1969 and 1970.1/

1.4 The experiences through which Indonesia has passed in the course of its history have inhibited the development of the manufacturing sector, so that that sector is presently neither as large nor as advanced technically as would normally be expected in a country of Indonesia's size and level of income. During the Dutch colonial period up to World War II, the main emphasis was on production of primary goods for export. During most of that era, industry was developed only to the extent necessary to provide and maintain equipment for the plantations of coconut, rubber, cacao, tea, and so on, and to keep mining operations and transportation systems functioning. Petroleum companies in Indonesia as in other underdeveloped

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1/ Report Nos. AS-132a February 12, 1968
EAP-5a May 16, 1969
EAP-10a November 27, 1969
EAP-19a November 27, 1970

countries, imported most of their requirements. A few fairly large engineering firms got established, mainly to repair machinery and ships. No wide variety or large volume of metal goods or electrical equipment were manufactured. The ideas of manufacturing consumers' goods for the domestic market, or of developing industries to make machinery or equipment for industrial use, instead of importing it all, were not thought to be appropriate. Of course such basic industries as food processing and clothing manufacture developed to a degree, but they tended to be mainly small-scale operations with traditional technologies.

1.5 Toward the end of the Dutch colonial period, some domestically-oriented industries were established, such as production of glass, cement, textiles, and a number of other goods, but their scale was quite limited. During the Japanese occupation (1942-45) and the subsequent struggle for independence (1945-49), there was little opportunity for development of these or other manufacturing industries. Thus the colonial pattern tended to persist and overall growth of industry continued to lag.

1.6 Independence was expected to change all that. However, the national leaders found it hard to get started toward the development of a modern economy. As in many other new nations, there was a period of floundering and confusion while debates went on about political, social, and economic philosophy and doctrine. Then there was a rebellion (1956-61) to be dealt with, and some territorial disputes, leading to Indonesia's withdrawal from the United Nations in protest against the seating of Malaysia in the Security Council (1965). This cut Indonesia off from both technical and financial assistance that might have helped solve some of the problems of getting development started.

1.7 There was, evidently, some growth in the economy during the first fifteen years of independence (1950-1964), but much of it was mere extension of agriculture and basic necessities to keep up with the growth of population. Some significant infrastructure and industrial projects were undertaken, but nothing resembling a self-generating process of growth got started, especially in the manufacturing sector. Mining, petroleum, and lumbering for export were far more attractive than manufacturing, both from the viewpoint of expected profits and from that of the nation's balance of payments. With a fairly continuous inflation going on, moreover, it was clearly more prudent for an investor to speculate in commodities than to undertake long-term plant construction.

1.8 Government policies during the period were not effective in establishing a solid basis for long-run growth. It is true that two development plans were formulated, at different times in this period, but implementation fell far short of the targets. Little effort was

made to mobilize domestic finance, either through taxation or encouragement to increase private savings. Balance of payments policy, aside from what appeared to be deliberate efforts to discourage any inflow of capital, consisted mainly of restricting and rationing imports when external inflows and export earnings diminished. The weakness of the system was clearly apparent when (largely because of a decline in world rubber prices) export earning went down by one third between 1958 and 1963, and the value of the currency began to get out of control. The restriction of imports in the face of scarcity of foreign exchange throttled domestic industries that used imported materials. As manufacturing output sagged, maintenance and replacement were neglected. But in spite of import restrictions, foreign exchange reserves were exhausted and service payments on the foreign debt could not be kept up. The formerly tolerable rate of inflation accelerated into hyperinflation, with the Djakarta cost-of-living index more than doubling each year from 1961 to 1964, then rising by a factor of 4 in 1965 and 12 in 1966[1]. National product may have grown slowly during this period (the statistics are not good enough to be sure), but probably not as fast as the 2½ percent annual population growth.

1.9 Since 1966, the stabilization program has been remarkably effective. The Djakarta cost-of-living index in 1967 was about 2.7 times that in the previous year; the corresponding factor for 1968 was 2.25; for both 1969 and 1970, 1.2[2]. In 1969 a Five-Year Development Plan was promulgated, and there are indications that investment and output have begun to pick up. The Five-Year Plan put primary emphasis on investment in agriculture and in industries and infrastructure closely related to agriculture. Nevertheless, many other industries were in a position to expand their output with relatively little investment because they were operating far below capacity. A relaxation of import restrictions made it possible to step up output in industries that use imported materials. In others, demand was the determining factor. There is no reliable basis for estimating the growth of industrial output in the aggregate, and for many branches of industry there are no statistics that can be used for year-to-year comparisons, but most of the specific products for which data exist were produced in increasing volumes during 1969 and 1970, compared with the lows reached between 1966 and 1968.

## - Characteristics of the Industrial Sector

1.10 As explained in the note at the end of this chapter, the statistics and estimates from various sources concerning the industrial

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1/ Statistical Pocketbook of Indonesia 1964-1967 Biro Pusat Statistik, Djakarta, Table Q-1.

2/ Based on IBRD Report EAP-19a, Table 9.1, plus Monthly Bulletins of Biro Pusat Statistik to complete the year 1970.

sector disagree and are widely recognized to be subject to large margins of uncertainty. The figures used here to present a quantitative description are correspondingly open to error. Nevertheless, they represent what seem to be the most plausible estimates available and, moreover, they could be considerably altered without changing the qualitative characterizations and conclusions that are associated with them.1/

Relative Size

1.11 Most measures indicate that Indonesia's industrial sector is smaller, relative to the overall economy, than would be expected in a country of Indonesia's size and level of income. There are several ways to judge what would "normally" be expected. One is by comparison to other countries believed to be similar. Table 1.1 presents data from the IBRD Socio-Economic Data Bank, comparing the proportion of GDP that originates in the industrial sector (either including or excluding construction) for several countries whose income per capita is in the same low range as Indonesia's. Since Korea and the Philippines are now significantly more prosperous, figures are given for those countries for earlier years (1961 and 1962) when per-capita income was lower. Malaysia was included because it has many cultural and economic similarities to Indonesia, even though its per-capita income level is much higher and its population much smaller. Whether it is actually relevant for this comparison is open to question.

1.12 Various comparative studies have indicated a strong tendency toward proportionately larger industrial sectors in larger countries (measured by population) and in countries at higher levels of per-capita income. Table 1.1 includes countries that are both larger and smaller than Indonesia, and both higher and lower on the income scale, with the populations and per capita incomes listed.

1.13 It will be noted that, when construction is excluded, four countries have manufacturing sectors smaller in relation to GDP than Indonesia's. (Ceylon, Malaysia, Nigeria, and Uganda). Of these, three are relatively small countries, having less than 10 percent of Indonesia's population, and small countries, according to other studies, tend to have smaller industrial sectors. The fourth, Nigeria, while half as big in population as Indonesia, is at an even lower income level, and that is another factor strongly correlated with the size of the manufacturing or industrial sector in intercountry studies.

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1/ These comments are not intended to disparage the extremely valuable work of Dr. Wilhelm Boucherie, whose estimates we have used with a minimum of modification as explained at the end of the chapter. Nevertheless. even the most diligent research by the most competent individual working alone cannot entirely make up for the absence of any recent census of manufacturing firms or properly designed, executed, and analyzed surveys.

Table 1.1

SHARE OF MANUFACTURING IN GDP, VARIOUS COUNTRIES

| | POPULATION (million) | GNP PER CAPITA (U.S.$) | MANUFACTURING (Percent of GDP) | MANUFACTURING AND CONSTRUCTION (Percent of GDP) |
|---|---|---|---|---|
| Indonesia (1970)1/ | 116.0 | 89 | 7.1 | 9.8 |
| Ceylon | 11.4 | 150 | 6.0 | 12.2 |
| India | 498.7 | 70 | 13.4 | 17.4 |
| Kenya | 9.6 | 120 | 10.9 | 15.2 |
| Korea | 29.1 | 130 | 15.8 | 19.5 |
| Korea (1961) | (25.4) | (100) | (11.7) | (14.9) |
| Malaysia | 9.7 | 320 | 3.9 | 13.1 |
| Nigeria | 59.7 | 80 | 6.1 | 11.2 |
| Pakistan | 117.0 | 100 | 10.6 | 14.5 |
| Thailand | 31.7 | 150 | 10.6 | 16.6 |
| Uganda | 7.7 | 120 | 4.3 | 6.0 |
| Philippines (1962) | 29.3 | 140 | 16.6 | 19.5 |

Source: for all except Indonesia: Socio-economic Data Bank, I.B.R.D.
for Indonesia: Bouchcric (modified; see Annex to Chapter 1).

Note: Data are for 1966 unless noted.

1/ % of GNP

When construction is included as part of the industrial sector, only a single country, Uganda, remains below the level of Indonesia. It is the smallest of the countries in the comparison, and its economy is strongly biased toward agricultural exports. Thus, in comparison to a variety of other low-income countries, Indonesia has a relatively small industrial sector.

1.14 Another, perhaps more scientific way of comparing one country's data with a norm based on other countries is by subjecting the data on other countries to statistical regression analysis and then using the regression formula as a standard of reference. In the next chapter is an explanation of a study made by Chenery and Taylor in which regression formulae were established for the "normal" proportion of GDP generated in manufacturing and construction, expressed as a function of per-capita income and country size (population). For Indonesia's size and income, the formulae call for a proportion of 14 to 15 percent, whereas the actual proportion in Indonesia now is less than 10 percent. Even if a wide margin of error in the Indonesian data is allowed for, this approach, nevertheless, corroborates the conclusion indicated by the simple comparison -- that Indonesia's industrial sector is relatively undersized.

Structure of the Industrial Sector

1.15 Within the overall industrial sector, which seems to be undersized for a country of Indonesia's population and per-capita income level, it might be supposed that somebranches of industry would be more developed than others. To investigate whether this is so, it is necessary to have some standards of reference to indicate what proportions among different branches of industry could be considered "normal". Again two approaches are found possible: comparison with other individual countries and comparison with formulae derived from statistical analysis of many countries. Taking Boucherie's estimates for value added (with the modifications explained at the end of this chapter) as the best for Indonesia, both kinds of comparison have been made.

1.16 Data on the value added in different branches of industry were found in individual country studies for four Asian countries in a collection of papers from a conference convened by the UN Economic Commission for Asia and the Far East (ECAFE)[1]. These figures, expressed as percentages of GDP, are tabulated in Table 1.2, together with figures on the Philippines, from a 1969 IBRD report[2] and on Indonesia from Boucherie's study. It is to be noted that the data for the other countries is for a time eight or ten years earlier than that for Indonesia.

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1/ Industrial Development in Asia and the Far East (Documents from 1965 ECAFE conference in Manila), United Nations, 1966. Studies were included for a good many other countries, but only for the five were data included that could be used for this comparison.

2/ EAP - 7, 1969.

TABLE 1.2

SHARE IN GDP OF PRINCIPAL BRANCHES OF MANUFACTURING, VARIOUS COUNTRIES

(Value added as % of GDP)

| | Philippines (1962) | Korea (1960) | Iran (1962) | China (Taiwan) (1962) | Thailand (1960) | Indonesia/1 (1970) |
|---|---|---|---|---|---|---|
| Branch of Manufacturing | | | | | | |
| Food, Beverages and Tobacco | 6.7 | 4.4 | 3.2 | 4.1 | 6.3 | 2.8 |
| Textiles | 0.7 | 2.4 | 2.2 | | 0.3 | 1.2 |
| Clothing and Footwear | 1.2 | 0.4 | 0.3 | 0.3 | 0.5 | 0.1 |
| Wood Products, Furniture, and Fixtures | 1.0 | 0.4 | 0.2 | 1.0 | 1.0 | 0.7 |
| Paper and Paper Products | 0.3 | 0.2 | 0.1 | 0.8 | - | - |
| Printing and Publishing | 0.5 | 0.4 | 0.1 | 0.3 | 0.2 | 0.1 |
| Leather Products | - | 0.2 | 0.1 | - | 0.2 | 0.1 |
| Rubber Products | 0.6 | 0.3 | 0.1 | 0.4 | 0.4 | 0.1 |
| Chemicals, Petroleum and Coal Products | 1.2/2 | 0.8 | 8.7 | 2.6 | 0.8/2 | 0.5 |
| Non-metallic Mineral Products | 0.6 | 0.5 | 0.2 | 1.4 | 0.5 | 0.2 |
| Basic Metals | n.a. | 0.3 | - | 0.5 | - | 0.1 |
| Mechanical Industries | 2.5 | 0.8 | 2.0 | 1.9 | 0.9 | 0.9 |
| Miscellaneous | 1.3 | 0.2 | 0.1 | 0.2 | n.a. | n.a. |
| Per Capita GNP (U.S. $) | 140 | 100 | 210 | 150 | 100 | 89 |
| Population (Million) | 29.3 | 24.7 | 22.8 | 11.3 | 26.4 | 116.0 |

\- Indicates value less than .05

n.a. Indicates figures not available

/1 % of GNP.

/2 Includes chemical and chemical products only.

/3 Included in metal products.

/4 Includes basic metals, but excludes electrical machinery.

/5 Metal products electrical and non-electrical machinery, and transport equipment

Source: For all except Indonesia and Philippines, Industrial Development in Asia and the Far East (Documents from 1965, ECAFE Conference in Manila), United Nations, 1966; for Indonesia, Pouchorie (with modifications explained in [illegible]) for Philippines, IBRD Report EAP-7, 1969, and IBRD Socio-Economic Data Bank.

This serves to reduce the difference in income levels; nevertheless, Indonesia still has the lowest per-capita income.

1.17 Compared to the other countries in one branch of industry after another, Indonesia ranks either lowest or near the low end of the range in most. Only in combination of "wood products, furniture, and fixtures" is the figure for Indonesia nearly up to the average of the other countries. Unfortunately, we do not have information for the subdivisions of this category for the other countries, to compare with Indonesia, where "furniture and fixtures" accounts for almost three-quarters of the total. In the category we have called "mechanical industries" comprising metal products, machinery, and transport equipment, Indonesia appears on a par with two other countries and considerably below the other three.

1.18 Turning from individual country comparisons to the statistical approach, Chenery and Taylor[1/] made regressions from main branches of the industrial sector in the same way as they did for the sector as a whole. Their article presents the regression formula for the proportion of GNP generated in each of the industry groups as a function of population, per capita income, the investment ratio, and the ratios of primary and manufactured exports to GNP. From these formulae the "normal" value-added proportions have been calculated and are shown in Table 1.3, together with the proportions that are estimated to exist in Indonesia in 1970.

1.19 The proportions of GNP for different industries as derived from the Chenery-Taylor formula give a rather different picture than that obtained from looking at specific countries. Most noteworthy, perhaps, is that the standard set by this reference is almost met by Indonesia in the first two categories, food, beverages, and tobacco, and textiles. The reference level based on the statistical analysis is much lower than the value for most of the countries of Table 1.2 for food, beverages, and tobacco, and is below their average for textiles, although within the range of variation. The explanation, of course, is that the five countries in the individual-country comparison do not form a sample with characteristics closely comparable to those of Indonesia, and the statistical analysis has shown that some of the charactertistics that differ have significant effects. The Chenery-Taylor formula, in other words, has taken into account and made allowances for these characteristics.

1.20 One of the principal differences is the size of the country. According to the statistical study, the relative size of industries are significantly correlated with population. Where the formula

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1/ H.B. Chenery and L. Taylor, "Development Patterns: Among Countries and Over Time", The Review of Economics and Statistics, November 1968

Table 1.3

SHARE IN GNP OF PRINCIPAL BRANCHES OF MANUFACTURING, COMPARISON WITH REGRESSION FORMULA

(Value added as % of GNP)

| Branch of Manufacturing | Chenery-Taylor Formula | Indonesia (1970) |
|---|---|---|
| Food, Beverage, Tobacco | 3.2 | 2.8 |
| Textiles | 1.4 | 1.2 |
| Clothing and Fibres | 0.2 | 0.1 |
| Wood Product, Furniture and Fixtures | 0.4 | 0.7 |
| Paper and Paper Products | 0.2 | - |
| Printing and Publishing | 0.2 | 0.1 |
| Leather Products | 0.2 | 0.1 |
| Rubber Products | 0.1 | 0.1 |
| Chem. & Petrlm. Products | 0.9 | 0.5 |
| Non-Metallic Minerals | 0.4 | 0.2 |
| Basic Metals | 0.5 | 0.1 |
| Mechanical Industries | 1.3 | 0.9 |

indicates 2.8 percent of GNP for the food, beverage, and tobacco industries in a country with Indonesia's characteristics, it yields a value of 3.6 if the population is changed from 116 million (Indonesia's) to 25 million (comparable to most of the countries in Table 1.2) with no change in any other parameters. Other characteristics that are taken into account explicitly in the Chenery-Taylor formula and thereby affect the comparison are the level of per capita income, exports (two categories), and the ratio of investment to GNP.

1.21 With all of these factors taken into account in establishing the reference levels, Table 1.3 still shows most Indonesian industries below "normal", with the exception of the first two, as already noted, and the composite group, wood products, furniture, and fixtures. The meaning of the apparently high level of this composite is not clear, in the absence of a more detailed examination. It would be useful to have a separate reference figure for "wood products" alone. It might also be useful to know more about the Indonesian "furniture and Fixtures" industries, which overshadow the wood products category in a ratio of almost three to one. Neither of these desiderata seems to be attainable, however, without considerably more research than is justified for the present purpose of getting an overview of the structure of Indonesian industry. Regardless of this statistical comparison, there is evidence of a great potential for expansion of the wood products industries on the basis of natural resource endowment and export markets, and this will be examined carefully and in detail in a later chapter.

Geographical Distribution of Industry

1.22 Both population and industrial activity are very unevenly distributed among the various islands and island groups that make up Indonesia. Sixty-five percent of the total population live in Java (the Java administrative region including Madura), which constitutes only seven percent of the country's land area. In these two islands the population density is over 1,400 persons per square mile, while the other islands have densities ranging from 20 to 100. The gross regional product in different regions varies from about $75 per capita in Java to about $1400 per capita in Sumatra, primarily because of differences in agricultural productivity and in the location of natural resources such as timber, petroleum, and minerals. The industrial component of value added is quite small in every region and has little or nothing to do with the variations in regional product per capita. In the main islands it contributes from 6% to 8% of gross regional product, and about half as much in the smaller islands. The distributions are shown in Table 1.4

1.23 These statistics indicate a concentration of industrial activity parallel to the concentration of poulation. Java, with 65 percent of the population, produces 61 percent of the industrial value added. The only regions in which the share in industrial

Table 1.4

GEOGRAPHICAL DISTRIBUTIONS, POPULATION AND PRODUCT

| Region | Population (millions) | GRP/1 per capita U.S.$ | Industrial/2 Val. added per capita U.S.$ |
|---|---|---|---|
| Java | 75.0 | $ 75.0 | 5.9 |
| Sumatra | 18.6 | 140.0 | 9.5 |
| Kalimantan | 4.9 | 90.0 | 5.2 |
| Sulawesi | 8.4 | 100.0 | 6.3 |
| Others | 9.1 | 90.0 | 3.2 |
| All of Indonesia | 116.0 | $ 89.0 | $6.3 |

Regional Shares in Each Total

| Region | Population | GRP | Industrial value added |
|---|---|---|---|
| Java | 65% | 55% | 61% |
| Sumatra | 16 | 25 | 24 |
| Kalimantan | 4 | 4 | 4 |
| Sulawesi | 7 | 8 | 7 |
| Others | 8 | 8 | 4 |
| All of Indonesia | 100% | 100% | 100% |

/1 Gross Regional Product.

/2 Not including construction, and with the adjustment explained at the end of the chapter.

Source: Wilhelm Boucherie; paper in preparation, 1971.

value added is notably different from the share in population are Sumatra (with proportionately more industry) and the miscellaneous smaller islands (with less).

1.24 Sumatra's larger share of industrial value added does not indicate a higher ratio of industry to other activities. As the upper half of the table shows, the per capita regional product is higher than the national average by a slightly greater margin (57%) than the per capita industrial product exceeds its national average (51%). Thus, as the lower part of the table shows, Sumatra's share in industry and GNP are about equal. The "other" islands, including the Moluccas, the Lesser Sundas (Nusa Tenggara) and various smaller groups, are less industrialized, as indicated by their contribution of only four percent to industrial value added, while their share in GNP and in total population are both eight percent. Java has the peculiar distinction of contributing to total industrial product almost in proportion to its share of population while falling much lower in its share of product in other activities. Presumably this is an indication of low per capita agricultural output, associated with high population density.

1.25 For many years, Indonesian leaders have talked about the desirability of encouraging people to migrate out of Java to the other islands. Perhaps the policy of encouraging migration of people needs to be complemented by a policy of encouraging industrial development in the less densely inhabited regions.

Size of Industrial Firms

1.26 To get any picture of the distribution of industrial establishments according to size, it is necessary to go back to the industrial census of 1964. Since that date there has been no census, and even the registration of firms, supposedly required by law, has not been kept up. At the present time, there are apparently many unregistered firms, as well as many that have ceased operating but are still carried on the official lists.

1.27 Attempts to survey the industrial sector by questionnaire have encountered very poor rates of response, in addition to the complete omission of the many non-registered firms. Thus any estimates of changes since 1964 are only estimates and, considering how some of them are made, not reliable. The pattern of 1964 is the latest that has been observed. Although levels of total output and employment have undoubtedly changed since the 1964 census, it seems unlikely that there have been significant changes in the relative proportions of different sized firms within the various branches of industry. Hence the 1964 figures may be assumed to give a reasonably good picture of the present pattern.

1.28 The census classified industrial establishments as large, medium, and small on the basis of the number of employees and whether

they did or did not use powered machinery. One of the tables at the end of the chapter (Table 1.12) summarizes the numerical data in terms of the establishments in each size group and the corresponding numbers of employees, for each branch of industry. From that basic information, the figures in Table 1.5 have been calculated to bring out the proportions in relative terms.

1.29 In the first three columns, Table 1.5 shows the distribution of each industry group's total employment among the different sized establishments. The other three columns show the average size of the establishments in each class, in terms of the number of employees. Of course, the definitions put limits on the possible range of numbers in the small and medium classes, but it is notable, for example, that small firms in the tobacco processing industry average nearly five persons compared with two or less in a number of other industries. It is also of some interest to know how large the "large" establishments are, there being about a four-to-one range in that class.

1.30 As to the size distribution itself, it is remarkable how much of what is classified as "industry" or "manufacturing" is conducted in small scale establishments. Half of the industrial branches listed have more than 50% of their total employment in small-scale firms. Of course, the number of industrial branches is not a proper measure, since some of them are much bigger than others. But, looked at in another way, 70 percent of employment in all branches of industry combined is in small-scale establishments averaging about two persons each (from the totals in Table 1.5). That does not mean that 70 percent of production or of value added occurs in small plants. Very likely the productivity per person is higher in larger plants, but reliable data are lacking for value added and the comparison has to be in terms of employment.

1.31 Food processing, the largest industry[1/] seems to have a polarized distribution, with more employees in large than in medium-sized establishments although the vast majority are in small ones. The large firms are evidently very large (averaging over 300 employees each), and are probably producing different types of products than the small ones.

1.32 Categories in which small "firms" predominate even more than in food processing are clothing and footwear, wood and wood products, furniture and fixtures, non-metallic mineral products, and miscellaneous manufacturing. The small firms in these activities average about two employees, suggesting that many one-man operations are included along with those employing more than two. It has to be recognized that the definition of "industry" in general use for statistical purposes does not mean only modern mechanized factory industry, but includes cottage industries and individual artisans as well. If we were able to compare the modern industry sectors of different countries (which we have not found feasible in the present study) we might get a somewhat different picture. Although there is no reason to doubt that most economies in which

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1/ in terms of Boucherie's estimates of value added.

Table 1.5

SIZE DISTRIBUTION IN VARIOUS BRANCHES OF INDUSTRY (1964)

| Branch of Industry | % of Total Employees Who Are Employed in Establishments of Each Size | | | Average Number of Employees Per Establishment | | |
|---|---|---|---|---|---|---|
| | Small | Medium | Large | Small | Medium | Large |
| Food | 77 | 9 | 14 | 2.3 | 14 | 323 |
| Beverages | 26 | 46 | 27 | 3.0 | 15 | 173 |
| Tobacco | 49 | 18 | 34 | 4.9 | 26 | 243 |
| Textiles | 41 | 38 | 21 | 2.0 | 17 | 206 |
| Clothing and Footwear | 94 | 4 | 3 | 1.6 | 19 | 100 |
| Wood and Wood Products | 96 | 3 | 1 | 1.7 | 14 | 108 |
| Furniture and Fixtures | 86 | 13 | 1 | 2.1 | 14 | 83 |
| Paper and Paper Products | 24 | 34 | 41 | 2.0 | 27 | 231 |
| Printing and Publishing | 11 | 38 | 51 | 4.7 | 17 | 130 |
| Leather and Leather Products | 38 | 35 | 27 | 1.8 | 17 | 82 |
| Rubber Products | 15 | 22 | 64 | 3.0 | 25 | 186 |
| Chemical and Chemical Products | 28 | 27 | 46 | 3.6 | 19 | 218 |
| Non-Metallic Mineral Products | 85 | 10 | 6 | 2.3 | 18 | 128 |
| Metal Products | 72 | 14 | 14 | 2.4 | 15 | 141 |
| Machinery (Non-electrical) | 9 | 24 | 67 | 1.8 | 17 | 204 |
| Electrical Machinery and Equipment | 54 | 13 | 33 | 2.3 | 16 | 125 |
| Transport Equipment | 62 | 23 | 16 | 1.6 | 15 | 107 |
| Miscellaneous Manufacturing | 82 | 11 | 7 | 1.7 | 17 | 115 |
| TOTAL | 70 | 14 | 16 | 2.1 | 17 | 215 |

Derived from Table 1.12

the per capita income is in the neighborhood of $100 include a great deal of cottage industry, there might be differences worth identifying in their small modern sectors, which are due to play a significant role in their future development. Clearly in the categories listed above, with 80 to 96 percent of employment in establishments averaging less than two employees, there cannot be much of a modern industrial base.

1.33 At the other end of the size-distribution spectrum are a few branches of industry in which large or large-and-medium sized establishments predominate. With from one-half to two-thirds of employment in large-scale firms and only nine to fifteen percent in small-scale ones are printing and publishing, rubber products, and non-electrical machinery. Not quite so skewed, but still with over 40% in large-scale firms and about a quarter in small-scale are paper and paper products and chemicals (including refinery products and pharmaceuticals). All of these activities are ones in which the technology calls for organized, more or less modern establishments which tend to have a minimum size in the medium-scale category, and in many of the specific sub-industries economies of scale favor larger sizes. With the exception of chemicals, none of these industries produces as much as two percent of total industrial value added; the chemical industry is the only one of the set that is a sizeable component of the industrial sector, with seven percent of industrial value added. All five of these industries together account for only five percent of employment in the industrial sector.

1.34 It might be supposed that the same considerations that were mentioned above as favoring large sized establishments in the industries just discussed would apply in the same way to the mechanical industries other than just the non-electrical machinery branch. It is a bit surprising, then, to find metal products, electrical machinery, and transport equipment all with more than half of their employment in small-scale establishments. A large part of this phenomenon is believed to be accounted for by the existence of many one-man machine shops, making parts on contract for larger firms or replacement parts directly for the ultimate users. In addition, it should be noted that the machinery and transport equipment categories include repair as well as manufacture. The one-or-two-man shops under "transport equipment" do not build automobiles, but there are a very great number servicing them and repairing them. The same applies to other kinds of machinery and equipment. Thus, these "industries" are not engaged entirely in manufacturing in the assembly-line sense of the word, and this fact should be remembered when looking at any aggregated statistics for these industries.

## RECENT TRENDS IN PRODUCTION

1.35 Not only did the Indonesian economy run into serious trouble in the middle 1960s, so also did the statistical system. As explained

in the annex to this chapter, the attempts to produce numbers without adequate basic data since 1964 have led to the publication of national income accounts that are very unreliable estimates. Especially shaky, in the judgement of the World Bank's statistical mission, are year-to-year differences or implicit trends in the value-added figures for industry, either in toto or by branches. The methods by which the annual figures are estimated unquestionably bias the trends.

1.36 In the absence of reliable aggregate data, it is still possible to get some indications of the changes in manufacturing activity from statistics on the output of specific products. Tables 1.6, 1.7, and 1.8 present such statistics mainly for products of state enterprises, obtained from two or three sources, as noted. Where figures from different sources for overlapping years do not agree, both are shown. For most items the different sets of figures agree or differ only slightly. Occasionally, however, we find major differences, some of which result from the peculiar custom, described in the statistical note below, of omitting the output of newer plants and reporting that of the old ones as if it were the total. (The data on paper production are described in the annex. It has not been possible to explore the reasons behind all of the anomalies, however).

1.37 While the pattern differs for different products in degree and to some extent in timing, it is notable that for a great many items, production was declining in the middle sixties, hit a minimum in 1967 (or 1968 in a few cases), and then began to recover. The decline was drastic in some instances (an 83% drop in one year for electrical wire), much gentler in others for cement, a maximum one-year drop of 17% with a total decline of 38% in five years, from the peak of 500,000 tons in 1962[1] to 312,000 in 1967). The rate of recovery also varied markedly among the different products, but it is quite clear there has been an upward trend in most of the activities shown.

1.38 The set of activities included in the three tables is far from a representative sample of the manufacturing sector. It is strongly biased toward state enterprises. The private sector could, theoretically, have been following a somewhat different pattern, but it is generally believed that it was not much different. From production statistics on specific goods it is not easy to make a good estimate of value added for the sector as a whole. The last general economic report of the World Bank says:

> "By mid-1969 industrial production has on the whole reached 1963 levels, and by mid 1970 it had in general exceeded them, though some industries were still lagging."[2]

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1/ A.R. Soehoed, "Manufacturing in Indonesia" in Bulletin of Indonesian Economic Studies, Canberra, October 1967.

2/ IBRD report EAP-19a, The Indonesia Economy: Development Trends and Foreign Aid Requirements, 1970-72, November 27, 1970, Volume III, para 3.

Table 1.6

BASIC INDUSTRIES

Production Figures for Some Particular Products

| Product | Units | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | Sources |
|---|---|---|---|---|---|---|---|---|
| Storage Batteries | '000s | 33.7 | 31.2 | 21.0 | 28.6 | 32.0 | 56.2 | 1, 2 |
| Radios | '000s | 42.3 | 92.9 | 216.0 | 319.8 | 363.5 | 393.1 | 1, 2 |
| TV Sets | Single units | 536.0 | 1,448.0 | 500.0 | 1,200.0 | 4,500.0 | 4,752.0 | 1, 2 |
| Light Bulbs | Millions | 7.5 | 6.0 | 7.8 | 5.9 | 8.2 | 5.1 | 1, 2 |
| Electric and Telephone Wire | '000 meters | 1,460.2 | 250.0 | 210.0 | 572.0 | 1,000.0 | | 1 |
| Water Pumps | Single units | 391.0 | 201.0 | - | 600.0 | 900.0 | | 1 |
| Hullers | Single units | 794.0 | 539.0 | - | 900.0 | 2,300.0 | | 1 |
| Galvanized Iron Sheets | '000 tons | - | - | - | 8.1 | 8.5 | 34.4 | 1, 2 |
| Structural Iron | '000 tons | - | - | - | - | 4.5 | 4.5 | 1, 2 |
| Water Pipe and Union Pipe | '000 tons | 2.2 | 3.1 | 1.2 | 1.2 | 2.0 | | 1 |
| | | | | | | 1.9 | 2.5 | 2 |
| Road Rollers | tons | - | - | 200.0 | 200.0 | 200.0 | | 1 |
| Sprayers | '000s | - | - | - | 5.0 | 20.0 | | 1 |
| Dry Batteries | Millions | 4.2 | 2.6 | 1.2 | 4.4 | 4.5 | 4.5 | 1, 2 |
| Sewing Machines | '000s | 6.0 | 10.8 | 5.5 | 4.0 | 14.0 | 13.4 | 1, 2 |
| Automobiles | '000s | 2.2 | 2.2 | 1.2 | 2.4 | 5.0 | 2.9 | 1, 2 |
| Motorcycles | '000s | - | - | 0.8 | 6.2 | 21.4 | 31.1 | 1, 2 |
| Engine and Spare Parts for Mining, Textile and Agricultural Estates | '000 tons | 1.4 | 1.5 | 1.1 | 1.9 | 2.4 | | 1 |

Sources: 1. Pelaksanaan Tahun Pertama Repelita as reported in IBRD, EAP-19a, Vol. III, Table 1.3 (through 1969).
2. Department of Industry, unpublished (1969, 1970).
1, 2. Indicates both sources agree for the overlapping year, 1969.

Table 1.7

CHEMICAL INDUSTRIES

Production Figures for some Particular Products

| Product | Units | 1960 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | Source |
|---|---|---|---|---|---|---|---|---|---|---|
| Fertilizer | '000tons | | | | | | 95.2 | 84.2 | 100.6 | 1,2 |
| | | | | 94.1 | 93.0 | 93.3 | 95.5 | 84.2 | | 5 |
| Cement | '000tons | 386.4 4/ | 438.6 | 389.5 | 323.4 | 312.0 | 411.0 | 534.0 | | 1,3 |
| | | | | | | | | 535.4 | 545.0 | 2 |
| | | | | 389.5 | 338.7 | 322.0 | 411.0 | 534.0 | | 5 |
| Paper | '000tons | 8.7 | 8.5 | | | | 11.3 | 15.8 | | 1 |
| | | | | | | | | 15.6 | 18.4 | 2 |
| | | | 11.4 | 11.1 | 9.9 | 7.4 | 8.8 | | | 3 |
| | | | | 11.2 | 10.0 | 7.6 | 11.3 | 14.3 | | 5 |
| Tires and Tubes | '000 | | | | | | | | | |
| Tires for motor vehicles | | 89.5 | 84.8 | | | | 238.9 | 359.0 | | 1 |
| | | 534.0 4/ | | 226.1 | 222.1 | 232.4 | 238.9 | 368.0 | 370.0 | 2,5 |
| Tubes for motor vehicles | | 87.7 | 63.3 | | | | 157.8 | 227.0 | 237.0 | 1,2 |
| | | | | 129.7 | 187.2 | 148.0 | 134.9 | 222.1 | | 5 |
| Tires for bicycles | | 3800 4/ | | 2869.0 | 2376.3 | 2703.8 | 2184.8 | 2216.4 | 2011.9 | 2,5 |
| Tubes for bicycles | | 3900 4/ | | 4594.9 | 4152.1 | 3184.4 | 277.0 | 129.7 | | 1,5 |
| | | | | | | | | 146.8 | 182.3 | 2 |
| Glass and Bottles | '000tons | 12.7 4/ | 7.0 | 9.0 | n.a. | 2.1 | 5.8 | 9.6 | | 1,3 |
| | | | | 19.0 | 10.4 | 5.7 | 8.9 | | | 5 |

continued on next page

Table 1.7 -- continued

| Product | Units | 1960 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | Source |
|---|---|---|---|---|---|---|---|---|---|---|
| Caustic Soda | tons | 750.0 | 686.0 | | | | 1019.0 | 1113.0 | | 1 |
| | | | | | | | | 445.0 | 708.8 | 2 |
| | | | | 1550 | 1550 | 1250 | 1050 | | | 5 |
| Salt | '000 tons | 196.7 | 53.0 | 252.0 | n.a. | 100.0 | 23.3 | 160.0 | | 1 |
| | | | | | | | | 194.4 | 68.4 | 2 |
| Carbon oxide | tons | 872.0 | 641.0 | 620.7 | 473.5 | 249.7 | 361.0 | 514.0 | | 1,5 |
| Oxygen | million $m^3$ | | | 2.1 | 1.6 | 1.5 | 1.8 | 2.1 | 2.6 | 1,2,3,5 |
| Hydrochloric acid (35%) | | | | | | | | 562.6 | 368.8 | 2 |
| | | | | 580.0 | 640.0 | 430.0 | 380.0 | | | 5 |
| Liquid Chlorine | tons | | | | | | | 15.0 | 38.0 | 2 |
| Bleaching Liquor | tons | | | | | | | 696.6 | 2494.0 | 2 |
| Bleaching Powder (30%) | tons | | | 450.0 | 500.0 | 460.0 | 250.0 | | | 5 |
| Sodium hypochlorite | $m^3$ | | | | | | | 400.0 | 527.1 | 2 |
| Pharmaceuticals: Tablets | million | | | 3048.0 | 2314.0 | 2642.0 | 2658.0 | 2950.0 | | 5 |
| Capsules | million | | | 45.0 | 32.0 | 38.0 | 40.0 | 53.8 | | 5 |
| Ampule/Vial | million | | | 46.5 | 36.5 | 39.0 | 41.2 | 43.0 | | 5 |
| Liquid drugs | million liter | | | 19.0 | 15.0 | 12.0 | 12.0 | 14.0 | | 5 |

Sources: 1. Pelaksanaan Tahun Pertama Repelita as reported in I.B.R.D., EAP-19a, Vol III, Table 1.3 (1960, 64, 68, 69)

2. Department of Industry, unpublished (1969, 1970)

3. Bank Negara Indonesia Reports for 1966-67 and 1968 (1964 through 1968)

4. Bulletin of Indonesian Economic Studies, Oct., 1967, article by A. R. Soehoed

5. Industrial Development in Indonesia 1960-1970, prepared for Second Asian Industrial Conference, Tokyo, 1970, by Department of Industry

(1,2) indicates the sources agree for overlapping years; similarly for 1,3 etc.

Table 1.8

OTHER INDUSTRIES

Production Figures for some Particular Products

| Product | Units | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Textiles | | | | | | | | | | | | |
| Spinning | '000 bales | | | | 42.7 | 77.6 | 46.0 | 93.1 | 129.7 | 160.3 | | 5 |
| Weaving | million meters | 374.0 | 307.4 | 268.3 | 236.6 | 456.0 | 250.0 | 225.0 | 316.5 | 415.0 | | 5 |
| Batik | million meters | | | | | | | | 64.0 | 96.0 | | 1 |
| Soap | '000 tons | | | | | | | | 200.0 | 250.0 | | 1 |
| | | | | | | | | | | 133.7 | 130.9 | 2 |
| Coconut Oil | '000 tons | 217.1 | 108.8 | 109.4 | n.a. | 215.6 | 244.8 | 221.4 | 208.0 | 249.8 | 257.2 | 1,4,2,5 |
| Cooking Oil | '000 tons | | | | | | | | 23.5 | 28.1 | 26.5 | 1,2 |
| Matches | million boxes | 470.0 | 359.0 | 415.0 | n.a. | | | | 238.0 | 262.9 | 290.0 | 1,2,4 |
| Toothpaste | million | | | | | | | | 13.0 | 16.0 | 25.3 | 1,2 |
| Cigarettes | billion | 25.4 | 23.1 | 31.6 | n.a. | | | | | 10.9 | 13.4 | 2,4 |
| Kretek Cigarettes | billion | 13.3 | 36.0 | 36.7 | n.a. | | | | | 18.8 | 19.1 | 2,4 |

Sources: Same as Table 1.7

Another World Bank report on the longer-run perspective says:

> "Estimates by the Central Bureau of Statistics put the growth of GDP in 1969/70 at approximately 5 percent in constant prices. Incomplete and also not fully reliable production data indicate that the growth of GDP in 1970/71 may have been approximately 8 percent. In 1970/71 the most significant growth of output appears to have been in mining, construction, and manufacturing.1/

However, a comment later in the report suggests that in the past five years the most rapid growth has not been in manufacturing but in mining.2/ These various statements in combination indicate that the manufacturing sector has been recovering from its pre-1967 decline and that the general trend is upward. In view of the scarcity of data and the unreliability of such data as do exist, there is nothing more that can be said about the trend of manufacturing production in the aggregate.

## UTILIZATION OF INDUSTRIAL CAPACITY

1.39 The capacity of an industry is not always a clearly defined or measurable concept. It is most meaningful for a specific process in which specialized machinery is required and is the limiting factor, as in the manufacturing of cement. It is more nebulous when applied to an aggregate of miscellaneous activities using general-purpose tools and part-time labor, as in artisan shops or in small-scale production of clothing. The concept of capacity of the industrial sector in the aggregate or even of a branch of industry, like chemicals, is open to serious question. One line of production in a composite industry may be at its limit while others using only a fraction of their facilities. Thus a discussion of capacity, to be meaningful, has to refer to rather narrow product groups rather than broad sectoral concepts.

1.40 Because of uneven development in the past and the general slowdown of economic activity in the middle 60's, some industries in Indonesia are producing at levels far below their nominal capacities. A survey of industries in the Jogjakarta region, and a later follow-up, yielded the estimates shown in Table 1.9 for the years 1966, 1967 and 1969 for a number of particular products. The low percentages of capacity utilized are striking, even for 1969 when, for most but not all products, there had been some degree of recovery from the bottom of the decline.

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1/ IBRD report EAP-22, Indonesia: Investment and Growth Perspectives in the 1970's -- A First Report March 25, 1971, para. 3 .

2/ Ibid. para. 43.

1.41 Another set of estimates, this time for the country as a whole and for a different list of products, was provided by the Department of Industry and is shown in Table 1.10. Here again, considerable underutilization of capacity is indicated, although not so much as appears in the figures for Jogjakarta in 1969.

1.42 These capacity utilization figures cannot be taken at face value or without some interpretation. It appears that the "Design Capacity" figures of Table 1.10 for some products may include some new plants that are still actually in the process of getting ready to produce. Moreover it is understood that some manufacturing plants that have cut back from previous higher output levels have failed to maintain their machinery, and would have difficulty increasing production now without some investment for rehabilitation. In some industries (e.g. textiles) either the technology or the kind of product being demanded have changed so that much of the "idle capacity" consists of machinery that is now obsolete. Nevertheless, it is evident that, for many lines of manufacturing, at least part of the facilities for higher levels of production exist, and the investment necessary for rehabilitation or replacement of machinery would be significantly less than what would be required to build whole new plants for a given increase in production. Thus, in any macro-economic attempt to estimate investment requirements for expanding output in the near future, it would be misleading to apply a capital-output ratio of conventional magnitude. A more appropriate approach would be to use a relatively low capital output ratio at first, gradually increasing it as the slack was taken up in one line of production after another. These generalizations, of course, will not apply to all specific industries, and for planning purposes it will be necessary to examine the state of affairs at a more detailed level.

Table 1.9

Estimated Capacity Utilization, Selected Industries:

Jogjakarta Region, 1966, 1967 and 1969

| | Percentage of Capacity Utilized | | |
|---|---|---|---|
| | 1966 | 1967 | 1969 |
| Batik | 12.5 | 10-15 | 25 |
| Weaving/Spinning | 10 | 10 | 35 1/ |
| Flour | 65 | 50 | 40 |
| Soft drinks | 10 | 10-15 | 15 |
| Ice making | 80 | 50 | 40 |
| Candy | n.a. | 30 | 30 |
| Kretek cigarettes | n.a. | 30 | n.a. |
| Cigars/Tobacco | 60 | 40 | 40 |
| Soap | 20 | 15 | 20 |
| Timber (wood cutting) | 50 | 50 | 30 |
| Printing or stencilling | 45 | 15-20 | 35 |
| Silver work | 30 | 20 | 15 |
| Concrete and cement floor tiles | 10 | 10 | 25 |
| Bicycle assembling | 10 | 10 | 35 |

1/ Includes spinning and weaving mills and handlooms. In 1969, these were reported as operating at 60 per cent, 70 per cent and 10 per cent of capacity respectively. The 'capacity' of the handloom sector is reported to be four times that of machine operated looms.

Sources: Mubyarto and Atje Partadiredja, "An Economic Survey of the Special Region of Jogjakarta" in Bulletin of Indonesian Economic Studies (Canberra) Oct. 1968, and Mubyarto, "Economic Developments in D.I. Jogjakarta", same Bulletin, Nov. 1970.

Table 1.10

Utilization of Capacity for Various Manufactured Products:

All of Indonesia, 1970

| Kind of Products | Design Capacity | Actual Production 1970 | Actual Production as % of Design Capacity |
|---|---|---|---|
| Cement | 615,000 ton | 560,595 ton | 91.2 |
| Fertilizer | 355,000 ton | 98,407 ton | 27.7 |
| Oxygen | 4,260,000 M3 | 3,098,500 M3 | 72.7 |
| Paper | 42,600 ton | 25,290 ton | 59.4 |
| Matches | 828,000,000 box | 284,000,000 box | 34.3 |
| a. Tires | 617,230 pieces | 603,183 pieces | 97.7 |
| b. Tube | 544,680 " | 315,977 " | 59.2 |
| a. Bicycle tires | 4,870,000 " | | |
| b. Tubes (Bicycle) | 4,234,000 " | | |
| Textiles | 900,000,000 " | 598,355,000 Meter | 66.5 |
| Soap | 333,000 ton | 130,910 ton | 39.3 |
| Coconut Oil | 776,000 ton | 257,184 ton | 33.1 |
| Cooking Oil | 113,000 ton | 26,503 ton | 23.5 |
| Tooth Paste | 82,000,000 tube | 22,000,000 tube | 26.8 |
| Kretek Cigarettes | 30,000,000,000 | 19,103,000,000 | 63.7 |
| Cigarettes | 41,000,000,000 | 13,914,000,000 | 33.9 |
| Storage Batteries | 69,956 | 56,150 | 80.3 |
| Bulb | 10,000,000 | 5,090,405 | 50.9 |
| Dry Battery | 42,800,000 | 4,502,400 | 10.5 |
| Radio | 3,000,000 | 393,211 | 13.1 |
| Television | 55,000 | 4,752 | 8.6 |
| Motorcar/Truck | 4,500 | 2,908 | 64.6 |
| Sewing Machine | 67,000 | 13,443 | 20.1 |
| Salt | 300,000 ton | 68,412 ton | 22.8 |
| Soda Ash | 3,000 ton | 708 ton | 23.6 |

Source: Department of Industry (unpublished).

## ANNEX TO CHAPTER I

### A Note on Sources and Quality of Industrial Data

Some of the Problems: One indisputable fact about industry in Indonesia is that quantitative information about it is pitifully inadequate. In addition, some of the information that is officially published is undoubtedly misleading. In the fall of 1970, at the request of the Indonesian Government and the IBRD Resident Mission in Djakarta, a four-person Statistical Review Mission from the IBRD headquarters spent about six weeks in Djakarta studying the methods in use for data collection and processing, and evaluating the quality of the resulting statistics. Their report (which also goes into management and organizational matters and proposes changes in the agencies responsible for statistical work) is still in draft at the time this is written, but certain relevant parts of the draft can be quoted in order to clarify the data problem. For example, in the Summary Findings, it is stated:

> "With some exceptions, the statistical output of almost all agencies of government, including that of the CBS (Central Bureau of Statistics), fails to meet minimum standards of reliability."

and

> "The national income accounts, which should normally provide an indispensable basis for economic planning and analysis, are in Indonesia largely unusable for these purposes and may, indeed, be misleading. This is true of both the absolute level of the major estimated aggregates and their implicit trend over time."

To a large degree these problems result, not from ineptitude of the staff but from lack of appreciation of the need for a good statistical system on the part of past governmental leaders, with a consequent weak organization and meager budgetary allocations for statistical purposes. Although the attitude has changed, and efforts are being made to establish a good statistical system and organization, much of the data that was not collected, pertaining to the past decade, can never be recaptured.

These statements about deficient data are not just complaints about errors of a few percent in magnitude. They concern quite large ranges of probable error and, perhaps even more significant, an almost total absence of meaningful information on year-to-year changes, except in the output of a few specific products (with some tricky pitfalls even in these apparently straightforward statistics).

A deceptively promising source of information on the economy as a whole and by sectors, including the aggregate manufacturing sector and major branches within it, was the recently published National Income

Accounts for 1960-68[1/]. The many tables included in this report appeared to offer a great deal of useful information on the numbers of people engaged in different economic activities, the gross value and value added in each activity, and many other aspects of the economy. For the industrial sector there are tables for large and medium-sized firms in each two-digit ISIC branch of production, giving, for a series of years, the gross value of production, number of employees, intermediate inputs, capital consumption, and gross value added. It would seem that these data include most of what we need to know about the size of the industrial sector and of its various branches and even their recent rates of growth.

Unfortunately, the figures in these accounts are not based on any thing like an adequate foundation of factual information, and the procedures that were used for making estimates in lieu of statistics are such that any year-to-year comparisons or apparent trends are sure to be misleading.

There has been no census of manufacturing establishments since 1964, and only a one percent sample of the data collected then has been processed. For more recent years, estimates of output and value added by branches of manufacturing and by the manufacturing sector as a whole are derived from the 1964 census figures (referring to 1968 production) on the basis of estimated year-to-year ratios. The ratios, in turn, are ratios of the variables within firms that responded to a questionnaire in each of the two years. No allowance is made for any increase or decrease in the number of firms in the industry. These methods are used for medium-and-large-scale establishment. Estimates by branch of manufacturing have not been made for small-scale establishments, and their contribution to the sectoral total is estimated by methods even cruder than that just described.

To what degree the conditions within the relatively small number of firms responding to two successive questionnaires are representative of any given branch of manufacturing is a debatable question. Another matter, not debatable at all, is the fact that if business conditions are bad and firms are going out of existence, this method will underestimate the rate of decline for the sector. Conversely, when new firms are entering and altering the market shares of existing firms, the rate of growth will be underestimated. The effects of firms that are in and remain in business but do not answer the questionnaire cannot, of course, be ascertained, but it cannot be taken for granted that their abstention does not bias the results.

After considering the methods by which the national income estimates were put together, the IBRD Statistical Mission concluded that the magnitudes themselves were probably subject to large errors, while the implied trends or year-to-year differences were even more unreliable.

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1/ Pendapatan Nasional Indonesia (National Income of Indonesia) 1960-68, Biro Pusat Statistik (Central Bureau of Statistics)Djakarta, 1970.

Even when it comes to data on the output of specific products from small numbers of state-operated enterprises, there are serious difficulties in ascertaining which "official" figures are most likely to be correct. An example is afforded by information on the paper industry as found in various different sources. This is a much simpler industry than many, from the point of view of gathering data; there are only seven significant paper mills in Indonesia. In 1965 there were only four; two more came into operation in 1968 and another in 1970. Nevertheless it seems that some of the statistical series that have been disseminated as "production of the paper industry" have not always included all plants. Among the series encountered by this mission, the most authoritative are the following:

Paper Production (Metric tons)

| Source | | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 |
|---|---|---|---|---|---|---|---|
| Bank of Indonesia | (1) | 11120 | 9870 | 7710 | 9290 | (4 plants only) | |
| Bank of Indonesia | (2) | | | | | 15900 | 20700 |
| Dept. of Industry | (3) | 11190 | 10050 | 7660 | 11270 | 14330 (six) | |
| Dept. of Industry per Japanese Study | (4) | 11120 | 9870 | 8680 | 11310 | 14850 | 18980 (prel.est |
| IBRD | (5) | | | | 11270 | 15760 | |
| Dept. of Industry, Dir. Chem. Industries | (6) | 11190 | 10050 | 8480 | 9460 | 14850 | 21730 |
| Dept. of Industry | (7) | | | | | 15560 | 18450 |

Sources:

(1) Bank Indonesia Report for Year 1968 (latest).
(2) Bank of Indonesia information to mission; not yet in print.
(3) Paper for Asian Development Conference in Tokyo, Sept. 1970, prepared by Dept. of Industry.
(4) Dept. of Industry, as reported in Report on Development of Pulp and Paper Industry, prepared by Japanese Survey Team, Nov. 1970.
(5) IBRD report EAP-19a, 1970 vol. III, Table 1.3.
(6) Furnished to mission, by Directorate of Chemical Industries, Dept. of Industry.
(7) Furnished to mission by Bureau of Planning, Dept. of Industry.
(8) Furnished to mission by Bureau of Planning, Dept. of Industry.

Depending on which series one happened to have, it could be concluded that the increase from 1967 to 1968 was 20%, or 47%, or 30%, or 11%. Or, distrusting one-year differences, the average rate of increase from 1967 to 1970 could be calculated and found to be anything from 28% to 44%.

Another example of the unreliability of any set of figures that is not carefully verified and cross-checked is in the figures given in the March 1971 monthly bulletin of the Central Bureau of Statistics[1] for cement production. Production from three plants is tabulated on a month-by-month basis through all of 1969 and nine months of 1970. The figures given for monthly output of the Padang plant range from just under 200,000 tons to almost 400,000 tons, although information from other sources puts the capacity of the plant at 120,000 tons per year. Whereas the production of this one plant for the year 1969 is given in the Bureau of Statistics publication as 3,368,729 tons, data from the Department of Industry and the Bank Indonesia are almost in agreement on a figure for cement production from all sources of about 535,000 tons. Apparently, the fact that figures appear in an official publication is no guarantee that any one has checked even their gross order of magnitude.

## Estimates by Wilhelm Boucherie

A careful and painstaking effort to overcome the deficiencies in data on the industrial sector has been carried out during the past three years by Dr. Wilhelm Boucherie of the Harvard Development Advisory Service with the objective of establishing a basis for planning further development. He found that there were some statistics in regional and local government offices that had never been collected by the Central Bureau of Statistics, and he obtained them. In addition he personnally interviewed entrepreneurs and managers of about 400 industrial firms, some Indonesian and some foreign, and he derived further data from various feasibility studies. His evaluation of what he has collected is:

> "The quality of the gathered data is far from excellent. Even after serious evaluation of the figures, substantial doubt remains about their reliability. Furthermore, because these data have been collected on the basis of availability and the willingness of government officials, entrepreneurs and others to provide information, rather than with respect to the requirements of proper statistical sampling, the data obtained are subject to severe bias. In spite of these obvious deficiencies inherent to the data, it is felt that the estimates could yet serve a useful purpose; critical comments will probably point to discrepancies between reality and estimates which then could be used to correct the latter.[2]

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1/ Indikator Ekonomi, Monthly Statistical Bulletin, March 1971, Biro Pusat Statistik.

2/ Boucherie, Wilhelm, unpublished draft of May 1971

In spite of the sampling biases and other sources of unreliability pointed out by Boucherie, his data are without doubt the best presently available picture of the structure of Indonesian industry. His generosity in making these data available to the Industrial Mission before he had completed his own analysis and technical paper in which they are used, and his willingness to take time to explain and discuss them with us as well as to give us the benefit of his knowledge of many related matters were great contributions to the success of the Industrial Mission, and our deep appreciation is hereby recorded.

In general, the categories in which Boucherie classified his data correspond to the "two-digit" categories of the International Standard Industrial Classification. He has also combined them in ways to match the categories used in the Chenery-Taylor analysis. Boucherie's estimates are presented in Table 1.11, with one modification, explained below, in the figures for wood products. Table 1.13 shows the degree to which Boucherie's estimates (for 1970) differ from those (for 1966) in the National Income Accounts for large and medium-sized establishments. To avoid the problems of exchange-rate valuation at two different times in a period of inflation, the two sets of figures have been converted to percentages of GNP. Although there may have been some changes in economic structure between the two years involved, such changes could not have been as great as the differences shown in Table 1.13. Mainly, the differences must be ascribed to differences in data and in its analysis. The differences in the estimates are not small.

One problem with aggregate data of this sort is to understand what it really represents. As Boucherie points out, much of the small-scale activity in some sectors (especially in the mechanical industries) is more in the nature of services than manufacturing.1/ In the case of Indonesia's metal products, machinery, and vehicle industries (lumped together in some listings simply as "metal products", which is somewhat misleading), Boucherie's figures show 89 percent of the combined value added coming from the category "Manufacture and Repair of Transport Equipment". They show, further, that 60 percent of that subtotal is generated in small scale establishments. The 1964 Census showed about 62% of employees in the "Transport Equipment" category worked in "small-scale establishments" with an average of 1.6 workers per establishment. Obviously, this category must include many independent solitary workers and "establishments" made up of one head man and a helper. Undoubtedly, much of their activity consists of repair services on automobiles, wagons, trucks, and tricycles (betjaks). Nevertheless, the same small-scale category probably includes one-man, one-machine shops which are typical of Asian cottage industry and which do manufacture replacement parts for machinery. Since it is impossible to separate

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1/ See also the discussion of this question in Belassa and Hughes, Statistical Indicators of Levels of Industrial Development, IBRD Economics Working Paper No. 45.

the services from the manufacturing activities, and since the same sort of mixture probably exists in other low-income countries with which comparisons are to be made, no attempt has been made to adjust the figures as estimated by Boucherie. It must be kept in mind that much of the activity in this sector does not correspond to the modern factory operations often associated with the word "industry".

For one branch of industry--wood products--another kind of problem existed, and we did, in this case, undertake to make an adjustment to Boucherie's figures. In the wood products industry, as recorded in the 1964 census, 96% of the manpower was in small-scale operations, averaging less than two workers per "establishment". A large proportion of these operations involved not only sawing logs into boards and making articles (other than furniture) out of wood, but also the extraction of timber from the forest, done by the same people. The lumbering operation, of course, should not be counted in the manufacturing sector, and we have made an estimate of its magnitude and deducted it.

Approximately three million cubic meters of logs went into the wood products industry (not including furniture making) in 1970. It is estimated that, of the value added in the combined logging and processing activities, 61 percent is added in logging and 39 percent in processing (mainly sawing the logs into boards). Therefore, Boucherie's value-added figure for this industry was reduced by 61 percent on grounds that that portion belonged in "forestry" rather than in "manufacturing". The resulting estimate for the wood products branch (without furniture) is $19.8 million, instead of Boucherie's $50.2 million[1/]. This is the only category in which Boucherie's figures were adjusted for this report.

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1/ The $19.8 million amounts to $6.60 per cubic meter, which is close to the figure for the wood-products industry in the Philippines.

Table 1.11

Industrial Structure, Indonesia, 1970

Estimates by Wilhelm Boucherie, May 1971

| Industry | Value added in million US $ | Share of small scale industry in % of value added | Value added of small scale industry in million US $ | Value added of of larger scale industry million US $ |
|---|---|---|---|---|
| 1. Food, beverages a. tobacco | | | | |
| 1.1 Food | 207.1 | 60 | 124.3 | 82.9 |
| 1.2 Beverages | 15.3 | 50 | 7.6 | 7.6 |
| 1.3 Tobacco | 68.8 | 30 | 20.6 | 48.2 |
| Subtotal | 291.2 | 52 | 152.6 | 138.7 |
| 2. Textiles | | | | |
| 2.1 Spinning | 7.6 | - | - | 7.6 |
| 2.2 Weaving | 118.1 | 45 | 53.2 | 65.0 |
| 2.3 Dyeing and finishing | 2.6 | - | - | 2.6 |
| Subtotal | 128.3 | 41.4 | 53.2 | 75.2 |
| 3. Clothing and footwear | | | | |
| 3.1 Clothing | 10.1 | - | - | 10.1 |
| 3.2 Footwear | 1.9 | - | - | 1.9 |
| Subtotal | 12.0 | - | - | 12.0 |
| 4. Wood products | | | | |
| 4.1 Wood manufacturing | 19.8 1/ | 80 | 16.0 | 3.8 |
| 4.2 Furniture and fixtures | 56.1 | 50 | 28.1 | 28.1 |
| Subtotal | 75.9 1/ | 58.0 | 44.1 | 31.9 |
| 5. Paper and paper product | 4.4 | 10 | .4 | 4.0 |
| 6. Printing and publishing | 13.6 | 50 | 6.8 | 6.8 |
| 7. Leather products | 9.6 | 75 | 7.2 | 2.4 |
| 8. Rubber products | 12.4 | 40 | 5.0 | 7.4 |

Table 1.11 continued

| Industry | Value added in million US $ | Share of small scale industry in % of value added | Value added of small scale industry in million US $ | Value added of of larger scale industry million US $ |
|---|---|---|---|---|
| 9. Chemicals, petroleum and coal products | | | | |
| 9.1 Chemicals | 46.8 | 40 | 18.7 | 28.1 |
| 9.2 Pharmaceuticals | 4.5 | 10 | .4 | 4.0 |
| 9.3 Refinery products | 3.8 | - | - | 3.8 |
| 9.4 Others | .6 | 100 | .6 | - |
| Subtotal | 55.7 | 35.5 | 19.8 | 35.9 |
| 10. Non-metallic mineral products | | | | |
| 10.1 Stone a. clay product | 6.1 | 50 | 3.1 | 3.1 |
| 10.2 Glass products | 3.0 | 10 | .3 | 2.7 |
| 10.3 Cement | 8.6 | 10 | .9 | 7.7 |
| 10.4 Others | 1.6 | 90 | 1.4 | .2 |
| Subtotal | 19.3 | 29.4 | 5.7 | 13.6 |
| 11. Basic metals | 14.4 | 35 | 5.0 | 9.3 |
| 12. Metal products | | | | |
| 12.1 Fabricated metal products exc. machinery a. equipment | 6.7 | 60 | 4.0 | 2.7 |
| 12.2 Manufacture a. repairing of machin. exc. electr. mach. | 2.3 | 50 | 1.2 | 1.2 |
| 12.3 Manuf. a. repair. of electr. machinery, apparatus, appliances and supplies | 1.5 | - | - | 1.5 |
| 12.4 Manuf. a. repairing of transport equip. | 85.8 | 60 | 51.5 | 34.3 |
| Subtotal | 96.4 | 58.7 | 56.6 | 39.7 |
| Total 1 - 12 | 733.0 1/ | 48.5 | 356.2 | 376.8 |

1/ Figures in these rows have been adjusted by IBRD estimate to eliminate logging from "Wood manufacturing".

Table 1.12

Number of Establishments and Workers in Each Size Class, in Various Branches of Industry (1964)

| Branch of Industry | Number of Establishments | | | Number of Workers[1/] | | |
|---|---|---|---|---|---|---|
| | Small | Medium | Large | in Small Establishments | in Medium Establishments | in Large Establishments |
| Food | 326,561 | 6,372 | 424 | 747,000 | 90,500 | 136,900 |
| Beverages | 817 | 299 | 15 | 2,500 | 4,400 | 2,600 |
| Tobacco | 31,631 | 2,166 | 437 | 155,300 | 55,500 | 106,400 |
| Textiles | 87,135 | 9,125 | 421 | 170,400 | 159,400 | 86,700 |
| Clothing and Footwear | 67,804 | 230 | 29 | 110,200 | 4,300 | 2,900 |
| Wood and Wood Products | 289,254 | 1,247 | 37 | 497,700 | 16,900 | 4,000 |
| Furniture and Fixtures | 26,082 | 581 | 6 | 54,700 | 8,400 | 500 |
| Paper and Paper Products | 1,120 | 116 | 16 | 2,200 | 3,100 | 3,700 |
| Printing and Publishing | 681 | 614 | 109 | 3,200 | 10,700 | 14,200 |
| Leather and Leather Products | 1,353 | 132 | 22 | 2,500 | 2,300 | 1,800 |
| Rubber Products | 3,893 | 678 | 265 | 11,600 | 16,700 | 49,200 |
| Chemical and Chemical Products | 2,741 | 507 | 76 | 10,000 | 9,700 | 16,600 |
| Non-metallic Mineral Products | 79,742 | 1,186 | 93 | 184,200 | 21,100 | 11,900 |
| Metal Products | 24,581 | 752 | 80 | 57,800 | 11,300 | 11,300 |
| Machinery (non-electrical) | 333 | 93 | 22 | 600 | 1,600 | 4,500 |
| Electrical Machinery | 1,430 | 49 | 16 | 3,300 | 800 | 2,000 |
| Transport Equipment | 18,052 | 753 | 71 | 29,700 | 11,000 | 7,600 |
| Miscellaneous Manufacturing | 26,718 | 344 | 34 | 45,500 | 5,800 | 3,900 |
| Total | 989,928 | 25,244 | 2,173 | 2,088,700 | 433,600 | 466,700 |

Source: Sensus Perindustrian, Tahun 1964 (1964 Industrial Census) volumes IIA and XI, Biro Pusat Statistik, Djakarta, 1969 and 1970.

1/ In the Census terminology for medium and large establishments this "persons engaged" -- a more inclusive term than "employees"; for small establishments the term used is "workers", and it includes part-time as well as full-time workers, both paid and otherwise.

# CHAPTER II

## PROSPECTIVE PATTERNS OF GROWTH AND A STRATEGY FOR INDUSTRIAL DEVELOPMENT

2.1 The foregoing chapter was concerned with the existing structure of Indonesian industry. The present one looks at its possible future evolution. This is not an attempt at forecasting the exact picture of the future economy nor the precise sequence of events leading thereto. It is, rather, an analysis and a series of judgements, based on comparisons with other countries (both individually and by statistical techniques) as to what pattern of growth rates of different branches of industry is likely to be conducive to smooth and efficient development of the economy as a whole.

2.2 After analyzing some of the alternatives for aggregate industrial growth and the distribution of output among industries in the sector, a general strategy for industrial development is presented. This is followed by recommendations for specific actions that could be taken in the immediate future to prepare feasibility studies of major projects that are analyzed later in this report, plus some programs for the support of medium and smaller scale industry.

2.3 Using a multi-sectoral macroeconomic model, a recent World Bank study[1/] produced some projections that are plausible and consistent as targets for development planning in the period up to 1980. Boucherie's more recent and detailed work probably offers better estimates of absolute values as of 1970, and we have retained those figures as our starting point, while turning to the World Bank study for projected rates of growth of GNP and population as well as some other parameters for the analysis below. With this combination we have arrived at the following figures as a general context within which to consider the development of the industrial sector.

| | Level in 1970 | Level in 1980 | Average rate of growth |
|---|---|---|---|
| Population (millions) | 116 | 147 | 2.4% p.a. |
| Gross National Product at market prices (billion US$) | 10.33 | 22.0 | 7.9% p.a. |
| GNP per capita (US $) | 89 | 150 | 5.4% p.a. |

### Growth of Industry as a Whole

2.4 Economic development is not a process of equiproportional growth. It entails different growth rates for different sectors and for different

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1/ Indonesia: Investment and Growth Prospects in the 1970's Report No. EAP-22, March 25, 1971, Chapter 4.

activities within each sector, bringing about a transformation in the structure of the economy along with increasing average income. Analysts of the process, from Colin Clark onward, have noted the increasing share of industrial product in the total economy as income increases, either in tracing one country through time or in comparing countries at different income levels at the same time.

2.5 Economies, like people, have their own individualities, and no rigid pattern can be identified as universal. But, like people, they tend to develop more or less along what can be regarded as "normal" paths of evolution. While bearing in mind the likelihood of individual deviations from the normal, we can still get some guidance from the experiences of other countries. Essentially all analysts of the process agree that development entails growth of industry at a much more rapid pace than the rest of the economy. Some types of industries seem to be more likely to accelerate early in the process, others later. Human needs and wants are such that demand for food, beyond some very low income level, tends to grow less rapidly than demand for other goods and services, and hence less rapidly than total expenditure. The first increase in demand occurs in goods that supply the basic necessities. But few countries have ever developed very far purely on the basis of a comparative advantage in agriculture, even with food-processing industries added,[1] and most have found industrialization an important part of their development process.

2.6 Studies of India's industrial growth during three successive Five-Year Plans[2] show growth rates for manufacturing more than twice as great as for GNP. Similar ratios have been observed in various other countries as well. However, the scarcity of reliable, comparable and relevant historical data on more than a few countries, as well as the wide variability of individual country circumstances make it difficult to generalize from case studies.

2.7 Taking another approach, quantitative analysts have relied heavily (though not exclusively) on statistical analysis of the "cross-section" variety, i.e. using a large number of countries at different stages of development to infer what the "normal" path of development might be. Two attempts to relate the growth of industry to that of GNP in terms of a statistical formula were made some years ago on the basis of data for the period 1938 to 1958, compiled by the UN in its compendium

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1/ Perhaps New Zealand and Denmark have done rather well that way, but they <u>are</u> exceptional, and dependent on exceptional markets.

2/ See, for example, Raj, K.N., <u>Indian Economic Growth, Performance and Prospects</u> Allied Publishers, 1965; Ahmad, Jaleel, "Import Substitution and Structural Change in Indian Manufacturing Industry" in <u>The Journal of Development Studies</u>, April 1968; Desai, Padma, "Growth and Structural Change in the Indian Manufacturing Sector: 1951-1963" in <u>The Indian Economic Journal</u> October-December, 1969.

"Patterns of Industrial Growth".[1] One study is reported in a UN report.[2] The other is in a book by Alfred Maizels.[3] Both applied conventional statistical regression analysis to the data, assuming the main explanatory variables to be per capita income and country size (measured by population or total GNP). Both reported regression formulae that may have been valid in the middle income range, but fitted poorly in the income range where Indonesia is at present ($90-100 per capita). It seems likely that they erred in assuming (as is common in regression work) a log-linear relation between the industry share and per capita income, and log-linear "size-of-country" effect, without looking hard enough at the evidence for nonlinearity.

2.8 Later on, Chenery and Taylor made a study with similar objectives, using more recent data and postulating a curvilinear variation of industrial share with per capita income (both in log terms).[4] The effect of country size was handled partly by separting countries into "large" and "small" categories (the dividing line being 15 million population). In addition, however, population is still an explanatory variable in the regression equation for each group of countries, and is treated linearly (in log form) in each group. To further account for differences in country characteristics, investment, primary exports, and manufactured exports (all as ratios to GNP) were also included as explanatory variables.

2.9 One of the Chenery-Taylor alternative regression formulae (Large Country, Regression A) explicitly takes into account all five of the factors mentioned above, while another (Large Country, Regression B) accounts for only per capita income and population, leaving the effects of investment and export ratios implicit. (Both formulae include a quadratic relation in log form for the effect of income). If we use Formula B as a norm, we are in effect implying that investments and exports should be expected to follow a pattern that is "average" or "typical" for the set of countries in the sample. With Regression A on the other hand, we are able to specify whatever values we consider appropriate for the additional parameters.

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1/ UN Statistical Office, Patterns of Industrial Growth, 1938-58, United Nations, 1959.

2/ UN Department of Economic and Social Affairs, A Study of Industrial Growth, United Nations, 1963.

3/ Maizels, Alfred, Industrial Growth and World Trade, Cambridge University Press, 1963.

4/ Chenery, Hollis B. and Lance Taylor, "Development Patterns: Among Countries and Over Time" Review of Economics and Statistics, November 1968.

2.10 The variables included under Regression A and Regression B were used to compute hypothetical variations of the share of "industry" (manufacturing and construction, as defined by Chenery and Taylor) in GNP over a range of per capita income levels from $89 (the estimated level for Indonesia in 1970) to $200.1/ The results are shown graphically in Figure 2.1, where it is evident that the outcome is approximately the same by either approach. The asterisk at $89 per capita income and just over 10 percent on the vertical scale represents the situation of Indonesia as of 1970. This is another way of viewing a fact that we already encountered in Chapter I - that even for its low level of per capita income, Indonesia is underindustrialized. Our interest now is in where the industrial sector is likely to go in the future.

2.11 The Chenery-Taylor study also considered this question for countries on which some trend data were available and which did not fall on the "normal" curve to begin with. Their finding was that in some cases there was a tendency to converge toward normal patterns, but that in many other cases, the trend was parallel to the normal curve, suggesting the continued existence of some systematic causes for the deviation. For our purposes, it would seem advisable to explore two possibilities: (a) that the Indonesian industrial sector would grow fast enough to reach the "normal" proportion for its per capita income by 1970, and (b) that the ratio of industry to GNP would increase as income grew, but only enough to keep it at its present distance from the normal curve. These two hypotheses will be labeled, for convenience in future discussion as: (a) "catching up" and (b) "continued lag." They are illustrated in Figure 2.2.

2.12 The slope of the regression line (the "normal" variation) in Figure 2.2 implies that when per capita income grows, the per capita product (value added) of the industrial sector would be expected to grow at a rate at least 50% higher. For example, if the growth rates listed at the beginning of this chapter occurred, industrial value added (in order to reach 15% of GNP by 1980, when per capita income would be $150) would grow at about 13% per year, compared with 7.9% for GNP. Maizels and the U.N. study both arrived at growth elasticities of roughly this order of magnitude also.

2.13 If instead of the "continuing lag" assumption, we postulated that the industrial share of GNP would climb up to the "normal" level by 1980, with a per capita income of $150, then the rate of growth of industry would have to be 17 percent per year. It seems reasonable to assume that a desirable growth rate for industry, with the economy as a whole growing about 8% per year, would be at least 12% and probably significantly higher, though probably not so high as 17% per year.

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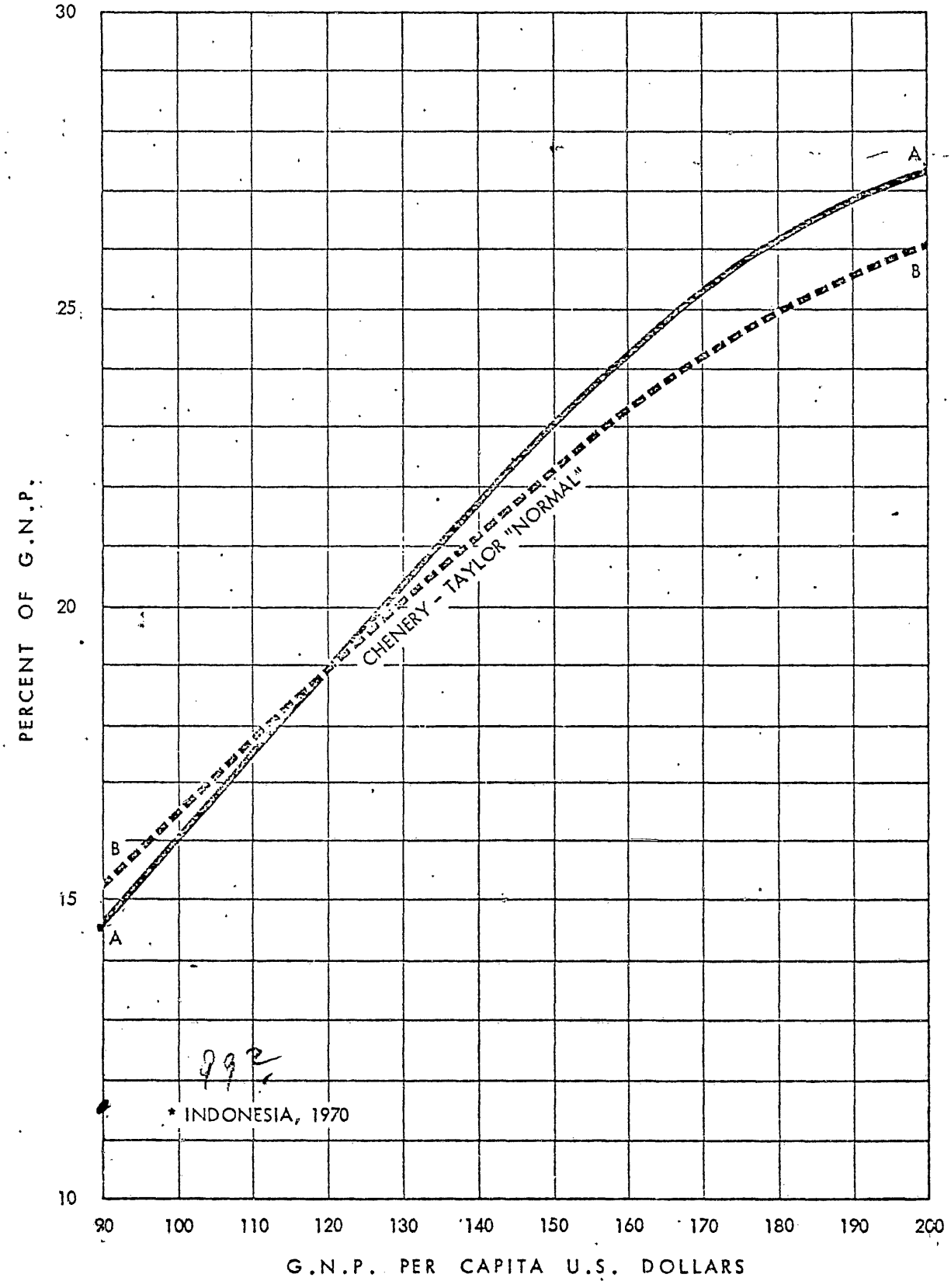
1/ The GNP and population growth rates tabulated in the first part of this chapter were applied over the whole range to the $200 income level for the sake of defining the curve.

FIGURE 2.1

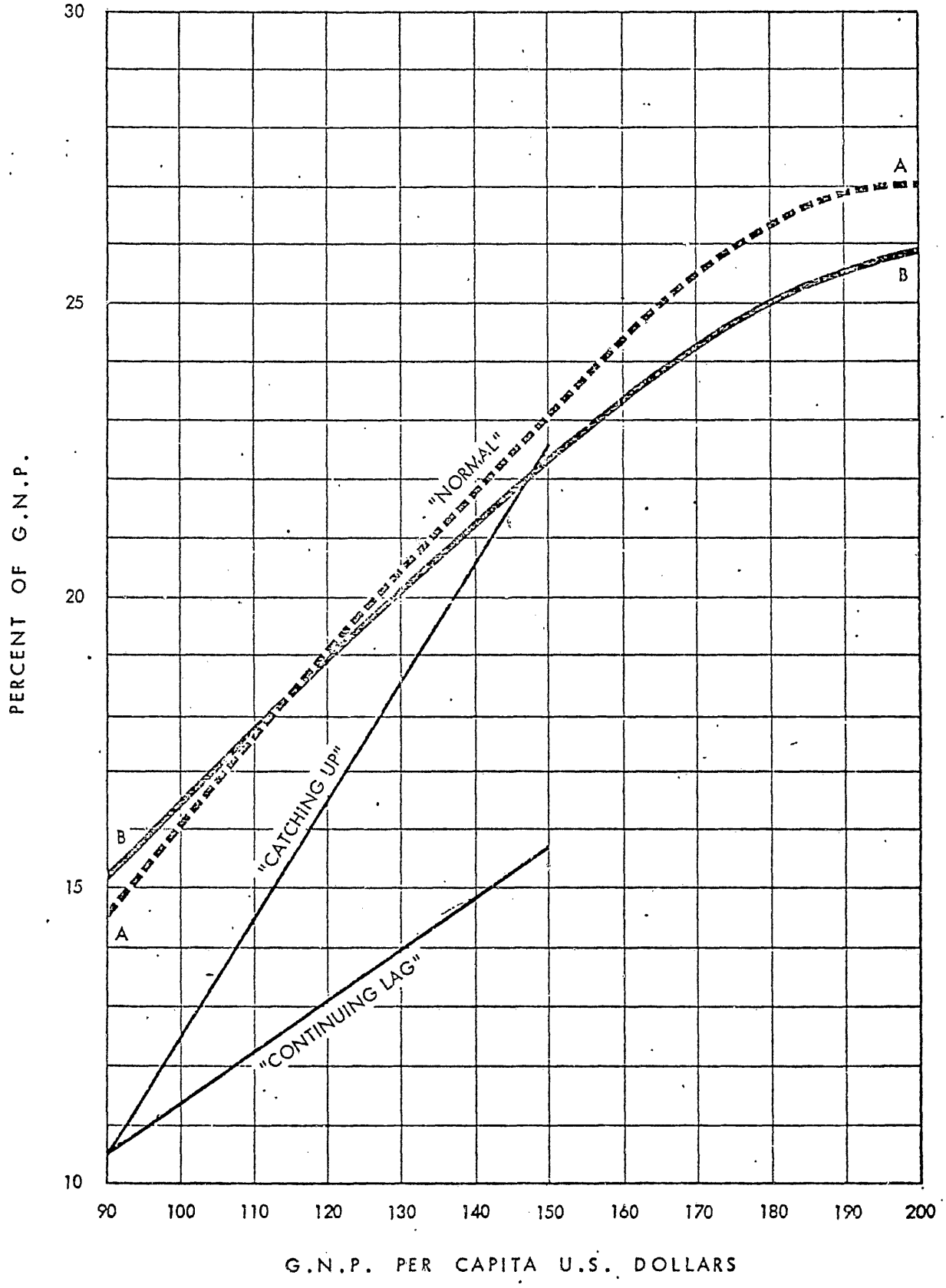
# INDUSTRIAL SHARE IN G.N.P.
## (INCLUDING CONSTRUCTION)




IBRD - 6091

FIGURE 2.2

# INDUSTRIAL SHARE IN GNP
## (INCLUDING CONSTRUCTION)




IBRD - 6092

These are rapid rates of growth, but it should be recalled that they refer, not to capacity but to output (value added), and that some advantage can be taken of the idle capacity referred to in Chapter I. In general one may calculate that for income to grow at 7% - 8% per year, the industrial growth rate will have to be about 13% to 15% per year.

## The Industrial Sector Disaggregated

2.14 Projecting the growth of industry as an aggregate helps us to recognize the importance of this sector, but is of limited value for planning, which ultimately has to come down to the level of specific projects. It is useful, however, to consider different branches of industry, how they interact, and how, in the experience of other countries, they have grown relative to each other.

2.15 Hirschman, with his concepts of interindustry "linkages," offers some ideas on how the growth of well selected industries might induce accelerated growth of others. 1/ The idea was treated more formally by Rasmussen 2/, who contributed the label "key industries" for those which add what he called "high powers of dispersion"--i.e., strong interactions with other industries. Chenery and Watanabe ranked industries according to their linkage effects, based on empirical input-output coefficients 3/, and Hazari applied the Rasmussen technique, with some variations, to the economy of India 4/. All of these analyses, except Hirschman's were based on static input-output matrices and thus missed some possible linkages operating through investment and the demands for capital-goods inputs. Nevertheless, they offer some partial insight, and the knowledge of how different industries rank in terms of the input-output linkages may be, as Hirschman puts it, a useful addition to the economist planner's set of criteria.

2.16 Both the Chenery-Watanabe analysis and that of Hazari indicated strong linkage effects for the metals industries, paper, petroleum products

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1/ Hirschman, A. O. The Strategy of Economic Development, Yale University Press, 1958, Chapter 6.

2/ Rasmussen, P.N., Studies in Intersectoral Relations, North-Holland Publishing Co., 1952.

3/ Chenery, H. B. and T. Watanabe, "International Comparisons of the Structure of Production". Economatrica October 1958.

4/ Hazari, Bharat R., "Empirical Identification of Key Sectors in the Indian Economy" in Review of Economics and Statistics August 1970.

and chemicals. As Hirschman points out, the machinery and transport equipment industries are underrated because their outputs are largely treated as final demand. A less formal and more dynamic approach was the concept of "leading sectors" as propounded by Rostow[1], who conceived of the development process as being propelled by first one and then another very rapidly growing industry -- suddenly become profitable for technological or other reasons --whose linkage effects induced growth in other industries and thence in the economy as a whole. While Rostow tended to think of the history of the presently-advanced countries as the model for newly developing ones, Hirschman has brought out the possibilities for a different process of development in a world where developed countries already exist. In addition to the technology that is ready to be applied, there is the advantage of being able to start production of final goods using imported intermediate goods, and then building up the intermediate-goods industries later. Others believe a development program should start with exploitation of a country's natural-resource advantages. Obviously there is no single, simple recipe for building a modern industrial sector.

2.17 A more pragmatic approach is to analyze the industrial structure of other countries at different levels of income, looking for "average" relationships and hoping to draw inferences as to which industries are likely to be the fast-growing ones in a dynamically growing economy. This was done by Chenery and Taylor as another part of the study already discussed[2]. For various branches of industry (mostly corresponding to the two-digit standard international classifications, but with some categories further aggregated), they made a regression analysis similar to the one that they did for industry as a whole. The result was a set of formulae expressing the value added in each branch of industry either per capita or as a share of GNP) as functions of per capita income, country size (population) and the two kinds of exports.

2.18 From the shapes of the resulting regression lines, Chenery and Taylor classify industries as early, middle, and late, according to where in the range of GNP per capita they rise rapidly, and where they tend to level off. Since these classifications depend significantly on change in slope at income levels above $200 per capita, they are not ideal for present planning in Indonesia, where getting up to $150 is the target for nine years hence. Instead, we have examined the relations in the region around $100 per capita income and have grouped the industries according to their income-elasticities of expansion, as follows:

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1/ Rostow, W.W., The Process of Economic Growth, Oxford University Press 1953 or The Stages of Economic Growth, Cambridge University Press, 1960.

2/ Chenery and Taylor, op. cit.

Proportional growth industries
(which grow at about the same proportationate rate as income):

Food, beverages, and tobacco
Leather products.

Medium growth industries
(which grow about 60% faster than income):

Textiles
Wood products

High growth industries
(which grow from 2.0 to 2.4 times as fast as income):

Basic metals
Machinery industries (electrical and non-electrical)
Rubber products
Non-metallic minerals
Chemicals (particularly plastics and synthetic products)
Pulp and paper products.

2.19 As the examination of linkages suggested, industries concerned with metals and metal products, paper, and chemical products are among those that may be expected to grow much faster than the economy as a whole. Presumably, any lag in the growth of these industries would be likely to impede the growth of other industries because of the linkages. They should get a good bit of emphasis in development planning and policy. Other industries for which the linkages did not appear so strong but which show up as fast-growing sectors (in the income range relevant for Indonesia) are oriented more to final demand and also may be important either as investment goods or as consumer goods, neither of which can be neglected without inviting other problems.

2.20 Although wood products do not rank extremely high either in terms of linkages or as a fast-growing industry in the multi-country statistical analysis, they offer special opportunities for Indonesia as a source of foreign exchange based on a comparative resource advantage. The industry has high priority for these reasons.

Alternative Growth Patterns

2.21 On an industry-by-industry basis, as for the sector as a whole, we can consider two hypotheses to define a range of likely growth rates: the "continuing lag" hypothesis and the "catching-up-by-1980" hypothesis. From the Chenery-Taylor formula for each branch of industry, the "normal" share of that industry in GNP was computed for the assumed population and GNP levels of 1970 and 1980 (as tabulated at the beginning of this chapter). The ratio of actual to normal product obtaining in 1970 was assumed to persist through 1980 for the "continuing lag" case. The growth rates thus determined for each industry are shown in the second column of Table 2.2. For the "catching-up" case, the "normal" levels were assumed to be

reached in 1980, and the rates of growth necessary to reach them, starting from actual 1970 levels, are shown in the third column of Table 2.2. Although this does not constitute a prescription for a development plan, it does suggest the desirability of emphasis on certain industries -- essentially the same ones that have been mentioned.

Implications for Investment

2.22 It would be quite unrealistic, at this stage, to guess at a capital-output ratio for each branch of industry and (after allowing for idle capacity on some basis or other) to specify a volume of investment for each. Aside from the impossibility of estimating idle capacity and the costs of rehabilitating it without getting down to a much finer degree of disaggregation, the difficulties of the capital output ratio approach are very significant. Unless investment requirements are to be estimated on the basis of particular kinds of projects within each industry, any estimates should be recognized as rough orders of magnitude and might as well be made at the level of the manufacturing sector as a whole. It is unlikely that anything would be gained by doing it for each branch of industry separately.

2.23 For the sector as a whole, the IBRD macroeconomic model[1/] relates gross investment in manufacturing to growth in that sector's value added through a capital-output ratio of 2.5 (except for extra investment that is undertaken specifically for import-substitution, where a value of 3.0 is applied). For the construction industry a capital-output ratio of 1.0 was assumed. If we assume the value of 2.5 is appropriate for the broadly-defined industrial sector (construction and manufacturing), then the total investment (gross) in that sector associated with the ten-year period with the continuing-lag hypothesis would be $3,780 million, (Rp 1,430 billion, if the present exchange rate remains in effect). The corresponding figures for the catching-up case would be $6,845 million (Rp 2,590 billion) of investment in construction and manufacturing. Distributing these outlays over time, with a rising trend similar to that of the assumed sectoral output, would yield the following time paths.

Gross Investment

(Rp billion) in Manufacturing and Construction

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Continuing lag | 70 | 127 | 226 |
| Catching up | 95 | 216 | 475 |

These are, of course, only rough order-of-magnitude figures, to give a preliminary idea of the investment implications of the alternative growth paths previously discussed. For actual planning purposes, of course, much more detailed study, at a disaggregated level, will be required.

1/ EAP-22 op. cit. Chapter 4

Table 2.1

STRUCTURE OF MANUFACTURING WITH ALTERNATIVE HYPOTHESES FOR 1980

Value added, as % of GNP

| | For 1970, Y/N = $ 89 | | For 1980, Y/N = $150 | |
|---|---|---|---|---|
| | Chenery-Taylor Formula | Actual | Continuing lag | Catching up |
| Branch of Manufacturing | | | | |
| Food, Beverages, Tobacco | 3.2 | 2.8 | 2.6 | 3.0 |
| Textiles | 1.4 | 1.2 | 1.2 | 1.3 |
| Clothing and Footwear | 0.2 | 0.1 | 0.1 | 0.3 |
| Wood products, Furniture and Fixtures | 0.4 | 0.7 | 0.5 | 0.5 |
| Paper and Paper Products | 0.2 | - | 0.1 | 0.2 |
| Printing and Publishing | 0.2 | 0.1 | 0.2 | 0.4 |
| Leather Products | 0.2 | 0.1 | 0.1 | 0.1 |
| Rubber Products | 0.1 | 0.1 | 0.2 | 0.2 |
| Chemicals, Petroleum Products | 0.9 | 0.5 | 0.8 | 1.3 |
| Non-Metallic Minerals | 0.4 | 0.2 | 0.3 | 0.8 |
| Basic Metals | 0.5 | 0.1 | 0.4 | 1.3 |
| Mechanical Industries | 1.3 | 0.9 | 2.0 | 2.7 |

Table 2.2

TWO POSSIBLE PATTERNS OF GROWTH OF

INDONESIAN MANUFACTURING, 1970 - 1980

| Branch of Manufacturing | Gross Value Added, 1970 | Avg. Growth Rate, 1970-80 Case I Continuing lag | Avg. Growth Rate, 1970-80 Case II Catching up |
|---|---|---|---|
| Food, Beverages, & Tobacco | $291 Mn. | 7.2% P.A. | 8.5% P.A. |
| Textiles | 128 | 7.8 | 8.7 |
| Clothing & Footwear | 12 | 10.6 | 18.9 |
| Wood Products & Furniture | 76 | 2.9 | 2.9 |
| Paper & Products | 4 | 12.5 | 29.5 |
| Printing & Publishing | 14 | 13.1 | 19.6 |
| Leather Products | 10 | 4.1 | 12.0 |
| RubberProducts | 12 | 13.9 | 14.9 |
| Chemicals & Products of Petroleum & Coal | 56 | 11.5 | 17.3 |
| Non-metallic Mineral Products | 19 | 15.0 | 25.2 |
| Basic Metals | 14 | 19.6 | 35.6 |
| Metal Products, Machinery & Trasnport Equipment | 96 | 16.3 | 20.0 |

Statement of a General Strategy for Industrial Development

2.24 The analysis in the prior sections has described alternative growth rates for industry under different assumptions about the over-all share of industry in the gross national product. The aggregate growth rate has also been decomposed to show the implications for disaggregated industries within the sector, although the degree of disaggregation is modest and does not show details for important product-groups or individual industries. Based on this analysis, and other material contained in later chapters of this report, it is now possible to present the outlines of a general industrial strategy for Indonesia. We stress the fact that it is an outline, with only a few major points, and not a systematic plan covering each industry. That task must be undertaken during the preparation of the next five year plan, the preliminaries of which will start shortly. However, the general directions for industrial development should be reasonably clear from the outline that is presented.

2.25 The aggregate growth rate for industry might reasonably be in the range of 11% to 17%. This is based not only on the previous statistical analysis of what constitutes a normal or average pattern for countries in this stage of development, but also on the basis of the results of the macroeconomic model that has been referred to earlier, plus the mission's own work on the potential development of major individual industry groups in the economy. A growth rate near the lower end of the range would be consistent with growth of the GNP, roughly on the order of 6% if the agricultural sector growth is maintained at a level of at least 4%. This may be regarded as a satisfactory outcome overall, but it would represent a case where industry continues to lag in terms of other country experience. If industrial growth lags, it is likely to be much more difficult to sustain the GNP growth rate in the future, unless conditions in the other sectors continued to be very favorable.

2.26 A somewhat higher growth rate is achievable and would be likely to result from a program such as the one suggested here that emphasizes development in metals and machinery industries that are starting from a very low, or almost non-existent, base. These industries are relatively capital-intensive and require a scale of operation that is fairly large. Thus units of output are apt to come into the market, in certain cases, in substantial amounts. It is neither feasible nor desirable to try to pinpoint a specific rate of growth as in some sense the best or the optimal rate for these industries. Reliance for performance rests largely on the private sector and that means that government policy must operate through appropriate provision of incentives and maintenance of favorable economic conditions in the economy, rather than through direct public investment.

2.27 As a guideline to private industry or an indicator of government intent and objective, it would be helpful to establish some projected rate of growth for total industry, in the middle of the range of growth discussed above, even though it is realized that the actual outcome would probably diverge from the projection. The mission does not believe that a detailed development path for industry (or for the economy) can

sensibly be formulated at present given the present state of information (statistical and otherwise) about the sectors. For the immediate future some rougher guidelines will have to be accepted, but they can nonetheless be effective in moving the economy in desirable directions.

2.28 Of equal, or perhaps greater, importance to industrial development is the need to correct the serious distortions in industrial structure that now exist. In spite of recurrent difficulties and problems there are some industries - mainly in light consumer goods - that have progressed, but there are others that are retarded. These are also the ones of greatest importance for establishing a firm base for future growth. They include, above all, the machinery or engineering industries that are described in Chapter IX, and not far behind in degree of retardation are basic metals and chemicals. These are the industries that should be given special attention and encouragement in the next few years. Several specific steps are suggested in the following section of this chapter for beginning their development. There has, to date, been some considerable emphasis on rehabilitation of foundries and while these efforts are both necessary and productive, the focus is far too narrow to accomplish what is needed. Foundries are an integral part of the engineering industries, but their development alone is insufficient stimulus to the development of the whole spectrum of these industries.

2.29 In part II of this report, which covers individual projects and industries, a number of large major projects in metals, machinery, chemicals, and wood-based products are individually analyzed and generally shown to be economically feasible. The work is at a preliminary stage, but the initial results are quite encouraging. It is recommended that these projects be specifically included in the list of those that are to be assessed in the immediate future. These projects typically have the property that their linkages backward to other supplying industries are quite strong. Their development could, and should, be one of the means for stimulating the development of industries producing components, sub-assemblies, and similar items that have some end-uses (e.g. pumps) as well as being important ingredients into more complex machinery end-items. The mission regards these linkages as one of the more significant reasons for accelerating the development of these projects, given that their economic rates of return are attractive.

2.30 A special effort should be made to stimulate the development of the abovementioned component and sub-assembly product lines in the engineering industries. Most of these will be in medium to smaller scale plants. Because of the almost total lack of facilities for producing these items, Indonesia must start practically from scratch. This means that studies must be prepared testing the feasibility of investments in these products; stremuous investment promotion work will be required to interest potential investors in them; special financial incentives making investment attractive will be required both in the initial phases of the projects and during the first few years of operation. These efforts are necessary in unison and must be planned as a package. The institutional steps for carrying them out are briefly described in the next section.

2.31 There is a similar need for development of medium and small scale industry in products primarily of a light consumer-good type. This should be part of a program to broaden the base of industry, and, because many of the production methods are relatively labor-intensive, there are distinct opportunities for expanding employment. The Government has taken one step in this direction by identifying some thirty-seven product lines that are provisionally closed to foreign investment and reserved to domestic investments. The detailed listing is shown in Chapter III and includes items such as paints, bakery goods, bicycles, matches, certain glass and pottery goods, clothing, food products and similar goods. These are judged to be products for which the technology is relatively simple and well known, the size of investment is generally modest, and the scale of efficient operation is sufficiently small to admit a number of productive units to the market. It is appropriate to expand production in these goods for the consumer market. But it is probably not sufficient simply to identify them and leave it to private initiative to undertake all of the preliminary work. Many of the new entrepreneurs in Indonesia must be drawn from merchants who have made their money in trade and commerce, particularly during the inflationary period. They typically have quite limited information about industrial needs, opportunities, or techniques. It is necessary to prepare pre-feasibility studies showing the potential profitability of investment and incidentally demonstrating that the Government looks favorably on expansions in these products. Financial and technical support and promotional activities must also be a part of the package of support, just as in the case of the component engineering industries mentioned above, though the effort required for the consumer goods industries will probably be less difficult and less intense. Nevertheless, the types of developmental assistance are similar for both classes of products.

2.32 The general strategy for industrial development provides a framework for a detailed program that could be prepared beginning almost immediately. It is a quite unrestrictive framework; there is latitude for working out variations in particular programs, but in summary the strategy includes: (a) a commitment to an accelerated rate of growth for industry; (b) correction of major distortions in the structure, primarily with emphasis on the engineering or machinery industries, base metals, and chemicals; (c) immediate attention to the major projects described in later chapters of this report; (d) special stimulation to component and sub-assembly product lines in the engineering industries; and (e) similar encouragement to light industries to broaden the base of industry and minister to consumer needs. A large commitment of public resources is not required to implement the overall programs, but a commitment to an activist program of promotion and stimulation is definitely needed. It might be said that it is a continuing commitment, but in a new direction, since the Government's policies, as evidenced in the foreign and domestic investment laws, for example, have been to encourage industrial investment.

2.33 The statement of the general strategy has been characterized as requiring an activist policy for industry. It is useful to explore the implications of an apparently different kind of strategy which might

be called the case of the "calculated neglect" of industry in the overall economic program. This type of strategy could be characterized by primary emphasis on development of the agricultural sector and on raising the rate of growth of agricultural output and productivity (hence raising income). Foreign exchange requirements to meet the needs of development would be met by expanding "traditional" exports, which are primarily agricultural products and minerals (including petroleum). Thus, internally the emphasis is on agriculture and external needs are to be met by the traditional products. There are two main strands to this strategy, and industry is more or less cast in a passive or follower role. It is expected to develop to the extent dictated by the needs of the two main driving forces in the economy. There is an implicit or unstated belief that industrial expansion may, under these conditions, be quite modest. Some will read this brief characterization of the strategy as portraying the development philosophy of Indonesia in the last few years. It remains to be seen whether the implications of this strategy for industrial development are, in essential respects, different from the generally activist program that has been outlined previously.

2.34 With this strategy for development, income should rise and the demand for all products will similarly increase; however, it is generally recognized that the demand for manufactured products will rise more rapidly than income even for low levels of income. As basic needs are met, an increasing proportion of income is directed to manufactured products so that for Indonesia the income elasticity of demand may be on the order of 1.5. Unless domestic production can increase to keep pace with this demand, there will be a rise in the leakages to imports which may affect the balance of payments adversely, unless in turn traditional exports can rise to close the gap. Although it is entirely possible that exports may initially grow very rapidly, there are some limitations on the growth that may be expected. Generally speaking, the demand for agricultural exports may not be strong; for example, exports of natural rubber are facing increasing competition from synthetic rubber. There is also some evidence in international trade that the terms of trade tend to move against agricultural products. For products such as tin, there are also international agreements that may limit the ability of individual countries to expand its exports. Consequently, reliance on a very rapid and sustained expansion of traditional exports may be dangerous. If exports are to grow, new product lines must be found among manufactured with a lesser reliance on traditional exports.

2.35 It is entirely possible that as development persists there will be increasing pressure on the balance of payments. Any of several things may occur; one result may be increased inflationary pressure in the country or, it may be necessary to reduce the rate of growth, or an increased amount of external aid may be necessary. Most probably some combination of all of these could occur. The prospect of inflationary pressure is particularly distressing, but it is not unreasonable to expect that if such pressures do begin to emerge businessmen and traders will come to expect further inflation and will act in such a way as to make inflation a self-fulfilling prophecy.

2.36 If domestic output of manufactured goods can be expanded rapidly enough these undesirable effects may well be avoided, but it is not at all

certain that this will happen. It is generally not possible to plan everything so well that expansion of output of manufactured products occurs smoothly. For example, if some end-items are expanded, they will initially rely on imported components and raw materials and it is too much to expect that the component and sub-assembly industries will be expanded pari passu with the end-items. Moreover, in order for such expansion to occur, imports of capital goods normally will rise very rapidly. In the short run this will further exacerbate balance of payment problems. There is an institutional lag between the emergence of profitable opportunities for domestic products and the new investment and output to satisfy the demand. As mentioned earlier, many of the new entrepreneurs in industry must be drawn from trade and commerce and to persuade them to undertake such investment will take time. Of course foreign investment will fill a part of the need but certainly not all of it. Consequently, one may expect that inflationary pressures and balance of payments difficulties could occur together if there is a lag in the response of manufacturing outputs. The mission believes that these institutional constraints are apt to be particularly significant in Indonesia.

2.37 In the longer run a lag in manufacturing output also acts as a deterrent to the development of the mass distributive trades which offer one of the major hopes for expansion in employment opportunities for a growing population. The primary employment outlet tends to be agriculture and that usually means the perpetuation of under-employment in that sector.

2.38 In general, agriculture tends to be the classic case of a diminishing returns industry; it becomes increasingly difficult to maintain a high rate of growth in agriculture over a long period of time. To do so may require massive capital investments which will similarly evidence diminishing returns. Over the long run reliance on agriculture as the leading sector will tend to lead to a regression of the rate of growth of gross national product to the maximum level that can be sustained in agriculture, and that is not likely to be more than 4 to 5 percent.

2.39 In short, it appears that pursuance of this kind of strategy without a rapid increase in industrial output, could lead to serious problems in the economy. If, however, the private sector can be helped to perceive the profitable opportunities for investment quickly, and act on them equally quickly, many of these problems may well be avoided.

2.40 The World Bank macroeconomic model, which has been referred to earlier in this chapter, presents a case similar to the one just described. The major driving forces in the economy are growth in the agricultural sector and an expansion of traditional exports. A rate of growth of agriculture is set exogenously at 4 to 4½ percent over the next ten years. In one case a high growth rate for exports has also been stipulated which should lead to roughly a doubling of such exports in the next five years with a somewhat lower rate thereafter. It is useful to show the implied effects on industrial development as a result of these two factors.

2.41 A summary of the most significant results are shown in Table 2.3. It can be observed that even in the context of this strategy manufacturing

TABLE 2.3

INDUSTRIAL SUB-MODEL

Case 1: High export growth; high agricultural growth

(Billions of Rp.)

| Item | 1970 | 1975 | 1980 |
|---|---|---|---|
| 1. GNP at factor cost | 3254 | 4569 | 6794 |
| a. Mining | 161 | 305 | 460 |
| b. Manufacturing | 331 | 544 | 1028 |
| (1) Domestic uses | 331 | 537 | 945 |
| (2) Import Substitutes | 0 | 7 | 83 |
| c. Construction | 115 | 217 | 385 |
| d. Percent: mfg. | 10 | 12 | 15 |
| 2. Exports (Total) | 455 | 753 | 1100 |
| a. Mining (including oil)* | 198 | 393 | 559 |
| b. Manufacturers | 10 | 24 | 77 |
| c. Percent: min. & mfg. | 46 | 55 | 58 |
| 3. Imports (Total) | 635 | 1052 | 1424 |
| a. Use in mining* | 67 | 132 | 185 |
| b. Mfg. goods for con. | 97 | 138 | 243 |
| c. Industrial raw materials | 99 | 163 | 308 |
| d. Investment goods | 204 | 385 | 680 |
| 4. Investment (Total) | 458 | 869 | 1540 |
| a. Mining | 57 | 81 | 82 |
| b. Mfg., domestic uses | 63 | 146 | 283 |
| c. Mfg., import sub. | 0 | 6 | 62 |
| d. Construction | 27 | 39 | 50 |
| e. Percent: mfg. | 14 | 17 | 22 |
| 5. Consumption (Total) | 3158 | 4356 | 6120 |
| a. Mfg. goods | 1071 | 1667 | 2898 |
| b. Percent of total | 33 | 38 | 47 |
| 6. Other Measures | | | |
| a. Investment/GNP | 14.1 | 19.0 | 22.7 |
| b. ICOR | 2.4 | 2.6 | 2.8 |
| c. Exports/GNP | 14 | 16 | 16 |
| d. Imports/GNP | 19 | 23 | 21 |

*Specified outside of the Model. Imports not counted in total imports.

output does in fact rise very rapidly. The share of manufacturing in GNP rises from 10 to 15 percent in a decade while the rate of growth of GNP is slightly over half of the industrial growth rate. It can also be observed that to achieve this expansion imports of investment goods must rise rapidly from 32 percent of total imports in 1970 to 48 percent in 1980. The percent of investment in manufacture also increases by over 50 percent during the decade. In the result the expansion of domestic manufacturing industry is able to meet a large percentage of the increased demand; even so the balance of payments tends to worsen during this period.

2.42 There many caveats to the interpretation of the actual numbers in the model results. This was a first attempt to construct a macroeconomic model for Indonesia and many of the data had to be derived by analogy to experience in other countries. Yet it does show what happens to industrial output within a consistent framework. A significant fact is that even with primary emphasis on agricultural output and a high level of traditional exports there is an inevitable need for very rapid expansion of the industrial sector, but certain characteristics of the model must be kept in mind. First of all, if demand for manufacturing output rises, the model attempts to meet this through expansion of domestic capacity and also through increase in imports. The model does not show the possibility of adverse price changes and inflationary pressures such as those that have been mentioned earlier. Moreover, the model assumes instantaneous (within a year) or smooth expansion of manufacturing output in response to demand, but it is not able to present a case of institutional lag and inertia in the response of output. Yet, in the actual circumstances it is recognized that there are such lags and poor response and that in order to overcome them it will be necessary to have a program to stimulate and accelerate industrial development.

2.43 The results of the macroeconomic model simply confirm the fact that even starting from an apparently different strategy of development the implied results are the same; in fact this should not be a surprising result. The activist program that has been outline earlier is one that is aimed primarily at overcoming institutional difficulties and correcting distortions within the industrial sector. Since the model contains only a single sector called "manufacturing" it is not able to show the difficulties and the distortions that actually occur or that exist within the sector. In short, there is no real difference between the two strategies. Both imply a greatly accelerated industrial development which is the first point in the strategy we have outlined. The remaining points in the recommended strategy for industrial development emphasize the need for giving attention to major projects that are important in terms of their linkages as a basis for development and also emphasize the desirability of the promotion of the engineering and consumer goods industries as a step toward broadening the basis of industrial development.

## Specific Institutional Steps

2.44 There are several specific steps that could be taken immediately to implement the further development of industry and to establish a pattern and direction for the future. Most of the points summarized here

are discussed at greater length in succeeding chapters, but they are presented to round out the picture of the development strategy for industry and to reduce it to some specific actions.

2.45 This report presents fairly detailed analyses of several major projects, notably a direct reduction steel plant, a core of a petrochemical complex, a wood-products complex and several machinery projects (e.g. electrical equipment, construction equipment, and shipbuilding). Suggestions are also made for alternative potential uses or plans for developing two major coal deposits. These analyses are of pre-feasibility grade, and the results are rather encouraging. Economic rates of return for several of the projects range roughly from 15% to 20%, which indicate that the projects are very attractive. Moreover, those projects have other desirable characteristics, in the form of strong linkages to other industries that could be developed, large foreign exchange earning possibilities, increasing the domestic value added from processing natural resources, and efficient substitution for imports.

2.46 It is recommended that steps be taken immediately to initiate full feasibility studies of these projects, to subject the pre-feasibility analyses of costs and benefits to close scrutiny and to prepare specific technical and financial project plans as appropriate. There is an inevitable lag of several years from the initiation of full feasibility studies to the actual beginning of operations. For major projects of this type the lag is approximately five years, comprising up to one year for the feasibility study itself, a second year for review and final submission to international lending agencies and to potential private investors, and several more years for final approval and actual construction. The feasibility studies themselves might cost on the order of $500,000 to $1 million, and it cannot be expected that private industry will be prepared, at this stage, to undertake the studies themselves, though they should participate to some degree. External assistance, both financial and technical, will be required. The ultimate investment cost of these projects typically would range upwards of $100 million.

2.47 Unless the full feasibility studies are started soon, the projects will not mature even within a minimal five-year period, and the potential development benefits to the country will be delayed and, in some cases, the opportunities may be lost. Prudent long-range planning for industrial development should have a horizon of at least five years. The studies of these projects are deemed an appropriate step in the right direction.

2.48 It is also recommended that the Government initiate a package program of financial, technical, and other support to stimulate the development of medium and smaller-scale industries in two main areas: (1) component, sub-assembly and related products in the engineering industries; and (2) light consumer-goods industries. This could be accomplished by the following actions. First, establish a

unit in the Ministry of Industry to undertake the prepartion of pre-feasibility studies of projects and products. These should demonstrate to investors the likely costs and revenues that would be realized in a particular case, analyze the markets and the risks, and present the results. Many potential investors are ignorant of basic industrial information and cannot take the time or incur the cost of an investigation. Technical assistance should be sought to start this unit. Second, greatly strengthen the investment promotion activities of the Investment Board in these areas. The experience of other countries, such as Singapore, may suggest types of promotional activities that have been successful. Third, provide financial assistance for both investment and working capital to these industries on favorable terms. Among other things this means modification of the present investment credit program now operating through the state banks to extend credit to smaller industries. Provisions on interest rates, collateral requirements, and down payments may have to be suitably modified to encourage the small investor. Some of these matters are discussed in Chapter IV. The financial institutions to serve these needs might include: a special "window" at a re-invigorated Bapindo; creation of investment subsidiaries of the state banks; inclusion of the stronger private banks in the credit programs now reserved to the state banks; private development banks that are lagging behind in commencing operations. Fourth, establish a technical assistance unit to help new businesses to start and to assist them with production, financial, marketing, labor, and similar problems during their first few years. Such a unit might be attached to the Ministry of Industry, or Bapindo, or be established independently. Foreign technical assistance would be required. It is an essential part of the package program. Fifth, consider establishing "risk insurance" on these investments, possibly operating through the Kredit Assuransi. It might involve adding a percentage point or two on the interest rate charged. Generally speaking, it is the down payment and the collateral requirements that limit smaller investors and not a small change in interest rates. If each of the above steps are taken in concert and coordinated, an effective program for stimulating investments in these industries probably could be achieved.

2.49 There are a number of policy issues that may involve making changes in current practice at some time in the future. It is suggested that, within the planning machinery of the Government, some attention be directed toward an examination of these issues to determine the policies that will best serve the development interests of the country.

(1) The present licensing system for private investment in comparison to a system of free access to the market after registration. A licensing system often implies or is explicit with respect to future protection for the new industry. This can, and indeed has, led to supplying protection to industries that are inefficient. A registration

system would make it plain that the investor takes the risks of the market, and should not result in protection of quasi-monopolistic positions.

(2) Incentives to foreign investment. There is some slight evidence that the flow of foreign investment may decline in the next few years. This may be regarded as desirable in the longer run for various reasons, but for the immediate future such a development could seriously impair the rate of growth. On the other hand, the conduct of certain investment projects has not been in the best interests of the industry or the country. It is probable that as the better investment opportunities are taken up, the incentives to go into other lines of activity may become weaker. A study of the likely future flow of investment, into which industries, and under what kinds of incentives, should be an essential part of future planning.

(3) Tax on the revaluation of fixed assets. There is evidence that the present tax is inhibiting desirable mergers, placing domestic industry at a disadvantage in joint ventures, and impairing efficient business activity. It is suggested that the Government consider modifying, softening, or removal of this tax.

(4) Taxation of open and closed (family) corporations. At some time in the future it will be desirable to consider altering the corporate tax schedules to encourage open corporations. The time is not now. Because of the shortage of funds that might be used to buy stocks, the height of the return that can be earned on other investments (notably the time deposit interest rate), and the lack of a capital market apparatus, it would be premature to initiate this step, but it would be appropriate to examine the experience of other countries such as Korea, and to make tentative plans for the future. In the course of this analysis proposals for strengthening the capital market should emerge and might be acted upon.

The institutional actions outlined above are recommended in the belief that they constitute an important ingredient in an industrial development program for Indonesia.

# CHAPTER III

## THE INCENTIVE SYSTEM FOR INDUSTRIAL DEVELOPMENT

### The Present Incentive System

3.1 In the mid-1960's the Government of Indonesia began to devise a new framework of incentives aimed at stimulating domestic and foreign investment in the underdeveloped and lagging industrial sector. The highly protectionist and statist policy framework which contributed to Indonesia's small-scale, technologically-backward, poorly-managed and undercapitalized manufacturing industry has been substantially modified since 1967 and gradually is being replaced by a new, more liberal system of industrial investment incentives.

3.2 The Government has made considerable progress in replacing the old policy framework with a system of tax, tariff, and other incentives more conducive to industrial investment, growth, and efficiency. Policies which successfully stabilized prices and exchange rates and established close relations with the international financial community, also share responsibility for the improvement in the investment climate. However, excessive protection, the tax structure, bureaucratic obstacles, inadequate infrastructure, scarcity of management and skilled workers, and competition from illegally traded goods still hampers the rapid growth of a balanced and efficient manufacturing sector in Indonesia.

3.3 There has been a rapid increase in both the number and value of foreign and domestic investment applications approved under the investment laws, particularly since 1969. To date, the rate of actual investment expenditures compared to planned investment approvals has lagged somewhat as a result of administrative problems and, more recently, investor uncertainty. However, the impact of investment expenditures on the structure and growth of the manufacturing sector is already discernible and should increasingly affect the pattern and rate of industrial development over the next few years.

### A. Foreign Investment Law (Act No. 1 of 1967)[1/]

3.4 The Foreign Investment Law of 1967 sets forth the basic principles governing Government policy towards foreign private capital investment; it provides the basic legal framework for encouraging and regulating foreign investment in Indonesia; and it expresses the Government's conviction that foreign capital, technology, and skills, adequately regulated to promote the mutual interests of the Indonesian people and the foreign investor, can make a significant contribution to Indonesia's economic development without creating an excessive dependence on foreign countries.

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1/ The description of the Foreign Investment incentives is indebted to the report by Donald W. Hoagland "Investment in Indonesia Today: A Revised Guide to Laws and Procedures for Foreign Investors" (Mimeo) February, 1971, Djakarta.

3.5 Under the Foreign Investment Law, foreign capital investment is defined as direct investment for the purpose of establishing a new enterprise or expanding a foreign subsidiary. The concept of "foreign capital" includes: (i) foreign exchange, commodities or rights to technology purchased with foreign exchange not a part of Indonesia's foreign exchange reserves (ii) that part of profits which can be legally transferred abroad but which instead is reinvested in Indonesia.

3.6 The kinds of investments which enjoy special fiscal incentives under the Law (and subsequent amendments) are:[1] (i) investments which will increase foreign exchange earnings (mining, tourism, primary and manufactured exports); (ii) investments which substitute domestic production for imports; and (iii) investments which yield rapid returns increases employment opportunities, and introduces new technology which raises productivity in a sector.

(a) Positive Investment Incentives

3.7 The Foreign Investment Law provides the following positive investment incentives:

Tax Incentives

Approved investments are exempt from the stamp tax otherwise applicable to capital transfers, and exempt from import duties and (import) sales tax on certain essential starting-up imports such as machinery, equipment, and supplies. In addition to these exemptions, the corporation tax offers a period of four years for the carry-forward of losses, giving losses taken during the first six years of production an unlimited period of carry-forward; authorizes accelerated depreciation; and establishes an investment allowance for the new investment beyond that originally planned. The investment allowance is a deduction from taxable corporate income of 20 percent of the amount of the additional investment spread over four years. In addition, investors are offered exemption from the tax on dividends for a period of two years after the start of production.

3.8 New enterprises may also be granted up to six years of exemption from income tax at the company level ("tax holiday") after commencing actual operations. The availability and extent of the exemption will depend on a number of factors relating to the development priority that the Government attaches to the project. Article 16 of the Foreign Investment Law (as amended in August, 1970) provides that newly established enterprises which invest in projects in priority sectors established by the Government may be granted a two-year tax holiday (i.e. income generated during the first two years after the enterprise starts production

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1/ Cabinet Presidium decree No. 06/EK/IN/1/1967

is free of corporate income tax). An additional year of tax exemption up to a maximum of six years can be granted providing: (i) The investment significantly increases or saves foreign exchange for the Government; (ii) the capital is invested outside heavily populated Java; (iii) the project requires the investor to make a large investment in infrastructure or involves other extraordinary risks; and (iv) the investment coincides with other special priority objectives of the Government.

These exemptions are available for domestic as well as for foreign investors, and the Government exercises broad discretion to grant further incentives of this kind for investments urgently needed for the development of the Indonesian economy.

Transfer of Earnings

3.9 The rights of transfer of profits, debt payments, and depreciation are specifically granted. At present Indonesia has one single rate of exchange (378 Rupiah to one US dollar); although prior to 1970, Indonesia's system of foreign exchange controls was complex, it was simplified on April 17, 1970, at which time the Government completed the dismantling of the system of multiple exchange rates started in 1967 and established a single rate of exchange (general foreign exchange rate or GFE) set by market forces. Except for a special rate for aid funds, all other transactions are unrestricted and employ the general foreign exchange or free market rate.

3.10 Under specific provisions of the Foreign Investment Law, foreign enterprises are granted the right to transfer in the original currency of the invested capital at the prevailing exchange rate for: (i) accrued profits after subtracting taxes and other financial obligations to Indonesia; (ii) costs relating to the employment of foreign personnel working in Indonesia; (iii) other costs to be determined by the Government in due course; (iv) depreciation of capital assets; and (v) compensation in the case of nationalization or proceeds of the sales of existing shares to Indonesians.[1/]

Management Freedom

3.11 Under Chapter 4 of the Foreign Investment Law, the owner of foreign capital enjoys full authority to appoint his own management. On the other hand, except in instances where eligible Indonesian management and technical personnel are not available, firms are required to employ Indonesian manpower. All foreign enterprises are required to organize and provide regular and systematic training facilities in Indonesia or abroad in order to progressively replace foreign employees by Indonesian

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1/ Transfer permits will not be granted for repatriation of capital while the investor is enjoying certain tax incentives (notably the tax holiday).

nationals. The policy of these legislative requirements is reflected in the contracts negotiated by the various Ministries, and applicants for the benefits of the Foreign Investment Law are expected to present plans and make reasonable progress towards the training and development of Indonesian manpower for their staff at all levels of responsibility.

3.12 While the rules to be applied differ in various industries, a pattern has developed in the mining industry, for example, in which 75 percent of all employees in the enterprise at all levels are expected to be Indonesians within a 5 to 8-year period. This policy is administered through the work permit required by all foreign employees and issued by the Department of Manpower. The basic issue considered in granting a work permit to a foreigner is whether or not the foreigner in question is going to undertake tasks for which qualified Indonesians are available.1/ Although the Government takes a flexible approach to the numerical levels of Indonesians employed in the early years of operation, it expects its policy to be accepted in good faith and can exercise the necessary authority to insist on appropriate training programs.

Improved Land Rights

3.13 The Basic Agrarian Law of 1960 established the principle that all land in Indonesia is State-controlled but not State-owned. In densely populated areas most landholdings are private property. Land outside this category is directly controlled by the State and commonly called "State lands". The Basic Agrarian Law recognizes several types of rights in land, four of which are significant to the Foreign investor:

(i) the right of ownership: "hak milik"

(ii) the right of exploitation: "hak guna-usaha"

(iii) the right of building: "hak guna bangunan"

(iv) the right of use: "hak pakai".

These rights authorize the use of land in different ways. The right of ownership is the strongest hereditary right in land and is the exclusive right of Indonesian nationals and certain legal bodies designated by the Government, such as State-owned banks.

3.14 The policy adopted by Indonesia under the Foreign Investment Law is to offer to foreign investors those rights in land which are directly pertinent to the nature of the enterprise concerned, which include: (i) the right of exploitation (for agricultural estates); (ii) the right of building for industries and other building purposes; and (iii) the right of use for investors not requiring the other rights.

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1/ This inquiry has been made of all foreign work permit applicants since 1958, and the present practice is merely a continuation of that required under laws adopted in 1958.

3.15 Before the Foreign Investment Law was introduced in 1967, foreign companies were not entitled to obtain the rights of building or exploitation which they may now acquire. However, the duration of these three rights in land are limited: (i) the right of exploitation is valid for 25 to 35 years, depending on the type of enterprise, and at the Government's discretion another 25-year extension may be granted; (ii) the right of building is valid for 30 years, extendable by another 20 years at Government discretion; and (iii) the right of use may be for either a fixed period or for as long as the land is used for a particular purpose. Foreign investors who have obtained mining rights from the Minister of Mining or forestry-exploitation rights from the Minister of Agriculture automatically obtain use-rights for lands within the boundaries of their concessions and for purposes directly connected with the operations of the enterprise.

(b) Restrictions on Foreign Investment

3.16 Indonesia considers that foreign investment, to be successful, must not only be profitable but also serve mutual interests of the foreign investor and the Indonesian people. In order to insure that Indonesian national interests are served by foreign capital, the Foreign Investment Law contains certain restrictive and regulatory provisions, the purpose of which is also supported by laws and policies elsewhere in the Government system of regulation and control. The Indonesian Government believes that these provisions will provide a framework for the kind of mutuality that is more likely to produce successful, long-term investment in Indonesia. Specifically, the main regulatory and restrictive provisions of the Foreign Investment Law are: (i) restriction against investments in certain fields, (ii) restriction on the employment of foreign personnel, (iii) restrictions on foreign ownership and (iv) the 30-year limit for investment permits.

Investment Sector

3.17 According to the Foreign Investment Law (Article 6), industries which are considered vital to the national defense such as arms, ammunition, explosives, and war equipment, are closed to foreign capital investment. The Ministry of Trade also regulates trade and distribution, and presently domestic retail and export-import businesses are closed to foreign investors, unless they are closely related to domestic manufacturing. Other ministries, such as the Ministry of Industry, may also restrict certain kinds of investment to Indonesians or close certain industries to foreign investment because capacity (planned or actual) is adequate to satisfy domestic demand.

3.18 The Foreign Investment Law (Article 6) also closes certain activities to foreign capital investment and prevents foreigners from exercising full control over activities that affect the necessities of life or are otherwise of vital importance to the country. These include: (i) harbors, (ii) production, transmission and distribution of electric power, (iii) telecommunications, (iv) shipping, (v) aviation,

(vi) drinking water, (vii) public railways, (viii) atomic energy development, and (ix) the mass media. Foreign capital is not completely prevented from investing in these fields, but can enter only under arrangements with the Indonesian Government or Indonesian citizens. These arrangements must give the Government sufficient ownership and control to (i) assure the Indonesian public that national interests are adequately safeguarded; (ii) the necessities of life are available to all at a reasonable price; and (iii) the quality of the service provided is regulated in the public interest. The methods employed for limiting foreign control in these fields have not been specified by the Government, but joint ownership, sale, and lease-back of plant and equipment, management agreements involving profit sharing with a government entity, and other joint venture arrangements with Government enterprises are possible. Such arrangements have already been worked out in the fields of telecommunications and aviation.

3.19 In addition, the Directorate General of Light Industries and Handicraft has issued statements from time to time containing lists of light industries closed to foreign investment. At present[1/] there are 37 light industries closed to foreign investment (see Table 3.3) although the list is somewhat misleading since it gives the impression that all kinds of products that are covered by the general category of goods prohibited are, in fact, closed to foreign investment. This is not the case according to the Ministry of Industry; for example, not all paint products are closed to foreign investors, only some of them. There is, however, no way for the foreign investor to know this from the list.

Foreign Personnel

3.20 As noted above, although foreign investors are assured full authority to select their own management personnel, they are normally required to meet other manpower needs with Indonesian nationals. Foreign enterprises are specifically authorized to select and assign foreign managers and technicians to positions for which qualied Indonesian nationals are not available. Additionally, foreign enterprises are required to present plans and progressively train Indonesians for their staff at all levels, ultimately replacing most, if not all, foreign nationals in due course.

Foreign Ownership

3.21 It is the policy of the Government of Indonesia to encourage all foreign investors to join with local partners in manufacturing ventures in Indonesia in order to facilitate the transfer of management and technical know-how to Indonesian entreprenours. Foreigners investing a capital of US$ 2.5 million or more are not required to have local industrial participation initially, although joint ventures are strongly preferred by the Government. Foreign investments of less than US$ 2.5 million must provide for local participation either initially or at some time in the future.

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1/ June, 1971

3.22 Foreign investment applications are all expected to disclose a plan for the sale of some of the enterprise to Indonesian citizens as required explicitly in Article 27 of the Foreign Investment Law. The foreign investor is assured that the proceeds of the sales of existing shares in the foreign enterprise to Indonesian citizens can be repatriated in the original currency of the foreign capital investment. At present, what the Government requires is that provision be made by the foreign investor for the participation of local capital and not that a stated share of local ownership be required at any particular time. It is, of course, recognized by the Government that under present conditions, local capital is not likely to furnish much more than 10 percent of the equity requirements of a new venture; and therefore, no high or rigid levels of local capital participation is being established for joint venture projects. Foreign investors uncertain or concerned about the standards they will be required to meet by the Government are encouraged to formulate a plan for local participation and include it in their investment application.

30-Year Investment Permit

3.23 The Foreign Investment Law (Article 18) also establishes a 30-year maximum validity for an investment permit. The Government does not intend this 30-year limit to be understood as policy of explusion or forced acquisition of foreign investments at the end of 30 years. It merely establishes the maximum duration of the initial incentives and inducements to invest given to new foreign investors by the Government under the Foreign Investment Law. The Government has indicated that it will review the terms of the investment agreement shortly before the end of the 30-year period or alternatively establish objective standards to be met by foreign investors. If these standards are met, the 30-year period can be renewed at periodic intervals.

3.24 Such standards would include provisions concerning levels of production, the amount of increased investment, extent of land user rights, the percentage of Indonesian employment and ownership or other relevant considerations. No pattern of such objective standards are discernible at present since the Foreign Investment Law has only recently been established and put into operation. However, over the next several years some pattern will emerge to provide new and existing investors with a clearer notion of the functioning of the 30-year limit.

B. Domestic Investment Law (No. 6 of 1968)

3.25 The Domestic Investment Law of 1968 establishes the framework of government policy to promote domestic capital formation by Indonesian private and corporate parties. According to the Domestic Investment Law, an Indonesian or national company is defined as one in which at least 51 percent of the invested capital is owned by the State and/or Indonesian citizen. Foreign companies operating in the field of trade must have become domestic companies by December 31, 1977; and in the field of industry,

a 30-year limit is established for the validity of the foreign investment permit. Before the 30-year period expires, the foreign company must convert to an Indonesian or national company. However, as noted above, the Government's policy is a flexible one and envisages the possibility of renewal of the investment agreement at periodic intervals providing certain still-to-be specified conditions are met by the investor.

3.26 The law offers exemption from taxation on capital invested by Indonesian citizens and companies for the purpose of expanding or rehabilitating enterprises in the following fields: (i) plantation agriculture, (ii) forestry, (iii) fisheries, (iv) cattle breeding, (v) mining, (vi) industry, (vii) transportation, (viii) housing, (ix) tourism, (x) infrastructure; and (xi) other productive undertakings (as specifically allowed). In addition, capital invested in new enterprises in these same fields are also granted exemption from profit taxes (tax holiday) and shareholders' dividend tax for a period of two years from start of production. As in the case of the Foreign Investment Law, domestic investors can obtain an extension of the basic two-year tax holiday up to a maximum of six years of exemption providing the investment meets certain specified criteria established by the Government concerning the size, nature and location and foreign exchange impact of the investment. These criteria are the same that apply for foreign investment. (See paragraph 3.8 above). New and existing domestic enterprises operating in the priority fields mentioned above are also eligible for relief on import duties on equipment and materials required to initiate or expand production.

3.27 As in the case of foreign companies, domestic enterprise must also employ Indonesians in all posts except those which cannot yet be filled by Indonesian citizens, and make provision for the training and education of Indonesian manpower. The aim of both the Domestic and Foreign Investment Laws is to prevent the domination of the national economy by foreigners and yet encourage foreigners to help develop the country on mutually advantageous terms.

## C. Taxes on Manufacturing Enterprises

3.28 There are a number of basic taxes on manufacturing set out in Tax Ordinances, Tax Laws, Presidential and Ministerial Decrees and Decisions of the Director General and Directors of Taxes which affect the profitability and productivity of domestic and foreign investment in manufacturing. In general, the Tax Ordinances date from the pre-World War II period, while the Tax Laws and other regulations are of more recent date. As a consequence, the tax law is scattered in many regulations and decrees, making reference difficult and time-consuming, results in collection and assessment problems, and also makes difficult any analysis of the impact of the tax system on manufacturing enterprise.

### Corporation Tax

3.29 At the corporate level, the tax is contained in the Corporation Tax Ordinance of 1925, which has been frequently amended. Up to 1970, income above 1.5 million rupiah was taxed at 60 percent. The basic tax rate is now 20 percent with an addition tax of 25 percent making a total tax of 45 percent on taxable income over 5 million rupiah. It is a tax on

the profits of all kinds of business enterprises organized under Indonesian law, whether incorporated or unincorporated, with limited or unlimited liability, including partnerships, cooperatives, State enterprises, and mixed or joint ventures.

Capital Gains

3.30 Business income subject to tax includes not only earnings and profits but also capital gains, as long as they are not realized during a tax holiday. Gains from the sale or exchange of certain capital assets held for certain periods of time are taxed at a lower rate. However, the reductions are not equally applicable to all assets or taxpayers. Under the Corporation Tax Law, a capital gains tax of 20 percent is imposed on the sale or exchange of immovable property (real estate and fixed installations) that are held for at least four years. Otherwise, such gains are taxed at the same rate as corporate current income. This means that all gains made in less than four years are taxed as current income.

Tax Holidays

3.31 The Minister of Finance under the new provisions of the Foreign Investment Law (Article 16 as amended in August, 1970), may grant a basic two-year tax holiday for investments that fall with certain priority economic sectors and additional exemptions up to a maximum of six years from the start of production. The availability and extent of the exemptions granted depend on the development priority attached to the project by the Government. These exemptions are available to both foreign and domestic investors and the Government's criteria of eligibility have been described in paragraph 3.8 above and in Table 3.2.

Investment Allowances

3.32 The Foreign Investment Act amendments of 1970 introduced a new investment allowance as an incentive to existing companies as well as new investment projects not eligible for tax to make additional investments. Under the prior law, additional investments of going enterprises (expansion or modernization) were eligible for the same kind of incentives that were available for new enterprises. This authority proved administratively unworkable and was rarely used. The 1970 amendments allow a total of 20 percent of actual investments made in any one year to be subtracted from taxable profits in that year and three subsequent years, thereby providing an actual annual deductible allowance of 5 percent. The annual 5 percent investment allowance cannot be carried over to the next year if it is not used in a certain fiscal year.[1/]

3.33 The investment allowance is not applicable to initial investments by new enterprises for which a tax holiday was granted under

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1/ The 5 percent investment allowance can be added to a loss so that the overall total loss (the loss plus the 5 percent allowance) can be written off later.

Foreign and Domestic Investment Laws, even if the investment expenditure is made after the expiration of the tax holiday. In such cases, the investment allowance is granted only for additional investments after the initial investment has been made. On the other hand, when additional investment is undertaken prior to the expiration of the tax holiday, the tax relief provided under this investment incentive scheme can only begin after the tax holiday period has ended and only for the remaining portion of the annual investment allowance. .

Accelerated Depreciation

3.34 The 1970 amendment to the Foreign Investment Law established the principle of accelerated depreciation of fixed assets. The implementing decree of the Minister of Finance 1/ established a four-year depreciation period for companies enjoying the benefit of a tax holiday under the Domestic and Foreign Investment Laws. Capital expenditures on physical infrastructure (roads, bridges, electrical, telephone and telecommunication installations) and machinery, tools, and equipment undertaken by foreign and domestic companies may increase their normal depreciation by 25 percent in any selected year of the four-year period. A 10 percent accelerated depreciation is allowable on permanent goods such as land, buildings, and employees' housing. Companies benefiting from tax holiday legislation must start their four-year accelerated depreciation period in the year after the expiration of the tax holiday.

Interest, Dividend and Royalty Tax

3.35 This tax is a withholding tax at the rate of 20 percent and levied on payments of interest, dividends, or royalties. Formerly the 20 percent tax applied only to dividends, but the 1970 amendments to the Foreign Investment Law extended the coverage to interest and royalty payments. Income received, directly or indirectly, from the following sources are subject to the tax: (i) loans to individuals, enterprises or government entities domiciled or engaged in business, or issuing government bonds in Indonesia; (ii) securities of companies of all kinds domiciled in Indonesia whose capital is divided into shares; (iii) participation as a partner or member of companies not covered in (ii) above but subject to the corporation tax (mainly companies not domiciled in Indonesia but having a branch or permanent establishment there); and (iv) patents, copyrights, licenses, trademarks, know-how, and other such intellectual property rights and the lease of equipment and tools. The tax is due from the person, company or government unit making the taxable payment and constitutes an advance payment of income tax rather than a separate tax. This provision was largely aimed at closing the loophole whereby interest paid to foreign banks went untaxed.

3.36 The exemption from withholding tax for dividends on capital invested under the Foreign Investment Law of 1967 was modified in 1970. Originally, the exemption was good for five years. As amended in 1970, the tax exemption on dividends was reduced to two years and then only if the exempted income is not subsequently taxed by the foreign investor's home country. The exemption does not apply if it results in shifting the tax collection from Indonesia to the investor's country of origin.

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1/ Decree No. KEP. 630/MK/II/10/70 dated October 9, 1970.

D. Foreign Trade Taxes

(a) Import Duties

3.37 The existing structure of import duties and import sales taxes in Indonesia has the following functions: (i) encouraging the production of certain manufactured goods by protecting against import competition; (ii) restricting the imports of goods of a luxury or semi-luxury nature whose consumption the Government wishes to discourage; (iii) providing revenues for the Government budget; and (iv) altering the distribution of income.

3.38 The Indonesian tariff structure, based on the Geneva nomenclature1/, includes nine basic rates of duty applicable to imports (0, 5, 10, 20, 30, 40, 50, 70, and 100 percent), and these rates are supplemented by surcharges or exemptions in the form of percentage modifications of the basic rate. For example, a basic rate of 100 percent with a surcharge of 50 percent would have a total import duty of 150 percent.

3.39 The average rate of duty under the January 1970 tariff schedule2/ is 60.3 percent (on an unweighted basis). "A few basic consumption items (e.g. rice and wheat flour), some raw materials (e.g. coal, asphalt, analine dies, fertilizer, paper and pulp, newsprint, pig iron and unworked metals, generally), and a few finished items (e.g. airplanes, dredges, surgical instruments, navigating instruments) are free of duty. Raw materials are generally dutiable in a range from 0 to 70 percent, semi-finished products in a range from 30 to 120 percent, and finished products in a range from 30 to 300 percent. These are generalizations, of course, and there are numerous exceptions." 3/ From the viewpoint of the protective effect of the tariff system, protection in Indonesia, as in other countries, tends to increase from lower to higher stages of fabrication, with the exception of the relatively low duties on machinery and equipment.

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1/ With the assistance of the IMF, the Government of Indonesia is adjusting the existing tariff structure to conform to the newer Brussels Tariff Nomenclature, and this should be put into effect in 1972.

2/ This is the most recent schedule and it is still in force as of this this writing (June, 1971)

3/ Richard N. Cooper and Lawrence J. White, Some Proposals Regarding Indonesia's Tariff System, Harvard Development Advisory Service, August, 1970, Page 11. (Henceforth Cooper Report). The description of the tariff structure in this and subsequent sections is indebted to the Cooper Report.

3.40 Capital goods industries appear to be penalized by having to purchase protected inputs while enjoying little or no protection for their output. However, the exemption from import duties of certain capital goods as well as spare parts and components for priority industrial projects, makes it difficult to ascertain the real extent of protection on capital goods industries, or more generally, to foresee the long-term effects on the pattern of industrial development.

3.41 In January, 1970 the total import duties of some one hundred and twenty-five items, mainly finished consumer goods, were reduced. The average weighted duty on Indonesian imports declined in 1970 to 15.7 percent from 17.9 percent in 1969, as can be observed below. Customs enforcement procedures were probably better and in any event no worse in 1970 than in 1969.

TABLE 3.1

AVERAGE WEIGHTED DUTY ON INDONESIAN IMPORTS

| | 1969 | 1970 1/ |
|---|---|---|
| Imports (c.i.f) (millions US $) | 921.0 | 1,093.0 |
| Conversion rate (Rp/US $) | 325.0 | 378.0 |
| Imports (c.i.f) (billion Rp) | 299.3 | 413.2 |
| Customs Collections (billion Rp) | 53.7 | 64.7 |
| Averaged weighted duty | 17.9% | 15.7% |

Source: Imports from Bank Indonesia (Expenditures on Imports) Bulletin of Statistics, April 1971. Customs Collections for 1969 and 1970 from Customs Department, Ministry of Finance

1/ Preliminary

3.42 The restructuring of the tariff schedule must, however, take into account the effects on government revenues. At present tariffs and sales taxes on imports account for approximately 30 percent of ordinary revenues of the Government of Indonesia. Such heavy reliance on revenues derived from imports suggests the strict limits imposed by revenue needs on lowering of the tariffs and sales taxes in the pursuit of other objectives such as the reduction of tax evasion through smuggling, industrial promotion through tariff exemptions and employment creation. Alternative sources of revenues are not available at present to permit a sharp average reduction of import duties, although some downward adjustment of tariffs on finished consumer goods (beyond that undertaken in January, 1970 and noted above), capital and intermediate goods, and the import sales tax is being studied by the Ministry of Finance, along the lines of recommendations of the Cooper Report. This report recommended a large reduction in tariffs on finished consumer goods to a uniform level of 30 percent ad valorem; the establishment of a lower uniform ad valorem tariff of 50 percent on other imports; levying a uniform ad valorem tariff of 15 percent on capital goods (including those industries now exempted from import duties under the industrial promotion legislation); and a uniform 10 percent sales tax on imports and domestic production of raw materials and consumption goods on a value added basis.

3.43 A preliminary tariff schedule has already been drawn up with the assistance of the Harvard DAS that moves in the direction of implementing these general principles, but it has not yet received the official approval of the Ministry of Finance. The basic tariff rates can only be altered by an Act of Parliament and have not been changed since 1965, although surcharges and exemptions can be changed by decree of the Ministry of Finance. Major changes were made in March, 1969, September, 1969, and January, 1970. While these changes were necessary to adapt the tariff structure to support the development objectives of the Government, further modification of the system is required.

(b) Import Sales Tax

3.44 In addition to import duties (basic duties and surtaxes), most Indonesian imports are also subject to an import sales tax levied on the total of the c.i.f. value of the imported goods, plus import duty, surtax, and importer's profit margin ("retribution"). The current import sales tax (June, 1971) has four rates: 5 percent (on goods subject to a 5, 10, and 20 percent import duty); 20 percent (on goods subject to 50, 70, and 100 percent duties); and 50 percent (on high value luxury items). See Table 3.7 for details. The purpose of

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1/ Decree No. KEP 245/M/II/9/1968, Ministry of Finance, September 5, 1968.

the import sales tax is to protect domestic industry by establishing similar or equal tax treatment of the imported commodities also produced at home and subject to the domestic sales tax such as rubber tires, pedicycles, and bicycles[1]. In general, the import sales tax rates are consistent with the domestic sales tax rates, although there are some discrepancies. A lower, simplified and uniform sales tax on raw materials and consumer goods, combined with better enforcement, would ease the administrative burden of tax collection, likely increase revenues from this source, and still insure that domestic production was not discriminated against.

(c) Export Taxes

3.45 As part of the Government's stabilization and rehabilitation program, introduced in October, 1966, measures were taken to increase Indonesia's export earnings by providing exporters with greater incentives. Essentially, this was accomplished by giving exporters of manufactured and traditional goods a progressively increasing percentage of their export proceeds over the next several years. In April, 1970, exporters of manufactured products and handicrafts were granted the right to retain all (100 percent) of their export earnings and further simplification of export procedures and reduction in bank charges were also introduced to increase the incentive to export. The Ministry of Industry has also established a number of handicraft "sales emporiums" at the major tourist centers to promote the export of Indonesian handicrafts. In addition, the Ministry has made an effort to improve the quality and design of handicraft products aimed at the export market. In spite of these partial efforts to increase Indonesia's manufactured exports, only negligible amounts of manufactured goods, refined petroleum products aside, are being exported. These mainly consist of rudimentary and simple processed foodstuffs, cement, leather goods, tires, batik, textiles, and handicrafts, although in recent years a few assembled manufactured products and components have been added to the export line.

## E. Priority Areas for Foreign and Domestic Investment

3.46 The Foreign and Domestic Investment Laws emphasize that special priority and fiscal incentives are given to those industries which (i) save foreign exchange, (ii) earn foreign exchange, (iii) create substantial local employment, (iv) support agricultural development and (v) strengthen regional development (i.e. industrial growth outside Java). However, they do not set forth in specific terms the industry sectors the promotion of which are of special interest to the Government. The Ministry of Industry is responsible for establishing priority areas for foreign and domestic investment and for seeing that they are brought to the attention of potential investors. The Ministry of Industries has identified the following general priority economic sectors for foreign and domestic investment:

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1/ Decree No. KEP 245/M/II/9/1968, Ministry of Finance, September 5, 1968

TABLE 3.2

PRIORITY AREAS FOR FOREIGN AND DOMESTIC INVESTMENT

Economic Sectors

1. Agriculture, forestry and husbandry
2. Agribusiness (Industries that process the output or supply inputs to agriculture, forestry and husbandry)
3. Domestic resource-based industries
4. Domestic raw-material and intermediate-goods production
5. Basic industries
6. Infrastructure (transport, irrigation, power)
7. Fully integrated textile industries
8. Industries producing the nine essential products.[1/]

3.47 However, the Ministry of Industry has not taken an active role in the identification, preliminary evaluation, and promotion of specific investment opportunities within these broad priority areas, and each domestic and foreign investor must discover for himself what concrete projects are of interest to the Government and are able to receive special fiscal and other incentives. On the contrary, the Ministry of Industry has established a list of 37 "negative priorities" for light industry or light industries closed to foreign investment in response to pressure from local manufacturers of the products. (See Table 3.3). This list is employed to provide general policy guidance inside the Ministry (Directorate of Light Industry and Handicrafts) but is very misleading since product differentiation makes it impossible for an investor to know from looking at the list whether all or only some of the varieties of the product (e.g., paints or batteries) are prohibited.

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1/ Popular consumption items: rice, salted fish, frying oil, sugar, salt, kerosene, washsoap, cheap textiles and batik.

Table 3.3

## LIST OF LIGHT INDUSTRIES CLOSED TO FOREIGN CAPITAL INVESTMENT

| No. | Field of Industry | Remarks |
|---|---|---|
| 1. | Milk and other dairy products | Quota fulfilled |
| 2. | Batteries | " |
| 3. | Vetsin Monosodium glutamate | " |
| 4. | Cigarettes | " |
| 5. | Matches | " |
| 6. | Paint | " |
| 7. | Plastic and leather shoes, slippers, etc. | " |
| 8. | Patjol (hoe, speds) | " |
| 9. | Nail/wooden screws | " |
| 10. | Laundry soaps | Except Non soap detergents. |
| 11. | Coconut oil | Except other vegetable oils/edible oils but not from copra/coconut. |
| 12. | Flour milling | Quota fulfilled |
| 13. | Tooth paste | " |
| 14. | Biscuit & confectionary | " |
| 15. | Bicycle tire & Tubes | " |
| 16. | Boot polish | " |
| 17. | Plastic products (including formica sheets but excluding decorative plywood) | " |
| 18. | Printing | Except Lithographic Printing |
| 19. | Bicycle Assembling Plant | Except Bicycle Parts manufacturing. |
| 20. | Printing Ink | Quota fulfilled |
| 21. | Enamel works | " |
| 22. | Aluminum household ware | " |
| 23. | Candies | " |
| 24. | Soft drinks/beverages | " |
| 25. | Concrete tiles/porcelain tiles | " |
| 26. | Bricks & tiles | Except Refractory Bricks |
| 27. | Sewing machines assembling plant | Except Sewing machine parts manufacturing. |
| 28. | Ice Cubes | Except as a supplementary part of a nonimported. |
| 29. | Can making | Food stuff canning plant |
| 30. | Watch assembling | Quota fulfilled |
| 31. | Tooth brush | " |
| 32. | Mosquito coil incense | " |
| 33. | Corrugated card board | " |
| 34. | Instant noodle/spaghetti etc. | " |
| 35. | Zip fasteners | " |
| 36. | Tannery | " |
| 37. | Hair Wigs | " |

Source: Ministry of Industry, Directorate General of Light Industry and Handicraft, May, 1971

F. Administration and Procedures

3.48 The Government of Indonesia has established various administrative units, regulations, and procedures in connection with the industrial investment incentive system embodied in the Foreign and Domestic Investment Laws. Quite apart from the tariff and tax incentives offered to foreign and domestic investors, the nature, extent, and efficiency of the procedures and administration of the incentive system can be important incentives or disincentives to investment in themselves. Administrative controls and licensing can create waste, frictions, and inflict costs on the economy.

3.49 The prospective domestic or foreign investor seeking the benefits provided under the respective investment promotion laws must negotiate an investment agreement with the Government of Indonesia to obtain permission to establish a new plant or expand an existing enterprise. The principal Government bodies involved in the negotiations and discussions are the Capital Investment Board and the Ministry of Industry. The Capital Investment Board is divided into two sections (1) the Domestic Investment Board and (2) the Foreign Investment Board. The Capital Investment Board is a high-level, interdepartmental committee (including representatives of the Ministry of Finance, the Ministry of Industry, Bappenas, etc.) that insures that investment proposals are in conformity with the investment laws, government policies, and foreign exchange availabilities. President Suharto must approve investment projects, although in practice, the President has vetoed very few proposals.

3.50 Foreign investors normally approach the Foreign Investment Board and domestic investors approach the Domestic Investment Board for advice and guidance on their investment proposals. Neither of these committees has any executive authority, although they may intercede to advance a particular investment proposal when negotiations bog down in the Ministries. After preliminary discussions with the appropriate advisory committee, the prospective foreign investor must approach the Ministry of Industry (Departemen Perindustrian). Indonesian companies formed under the Domestic Investment Law do not negotiate tax and other concessions with the Ministry of Industry, but they do so with the Domestic Investment Board. The Ministry of Industry is divided into six departments or "Directorate Generals": (1) Basic Industry (2) Light Industries (3) Chemical Industries (4) Textile Industries (5) Maritime Industries and (6) Aviation. The investor discusses the investment proposal with the Directorate General responsible for the industry in which his investment will operate.

3.51 When agreement in principle has been reached, for example, between the prospective foreign investor and the Directorate General concerned over the advisability of submitting an investment application, the foreign investor must complete a letter of intent, known as Form A, which describes the investor, the nature of the business, the

location, partners, annual production capacity, manpower provisions and the benefits requested under the investment laws (such as exemption from corporate taxes and duty-free imports). The completed Form A is forwarded to the Minister of Industry with a copy to the appropriate Director General who is responsible for the industry and the Foreign Investment Board. If no modification of Form A is required, the Ministry of Industry will give its preliminary approval. The foreign investor has three months from the date of the preliminary approval in which to complete and submit a project proposal (known as Form B) to establish and operate a company under the Foreign Investment Law. The Foreign Investment Application Form B provides a detailed description of the project proposal including partners and participants; production plans, processes, capacity; sales potential, exports, foreign exchange savings; capital structure; projected income; manpower requirements, and foreign/domestic composition.

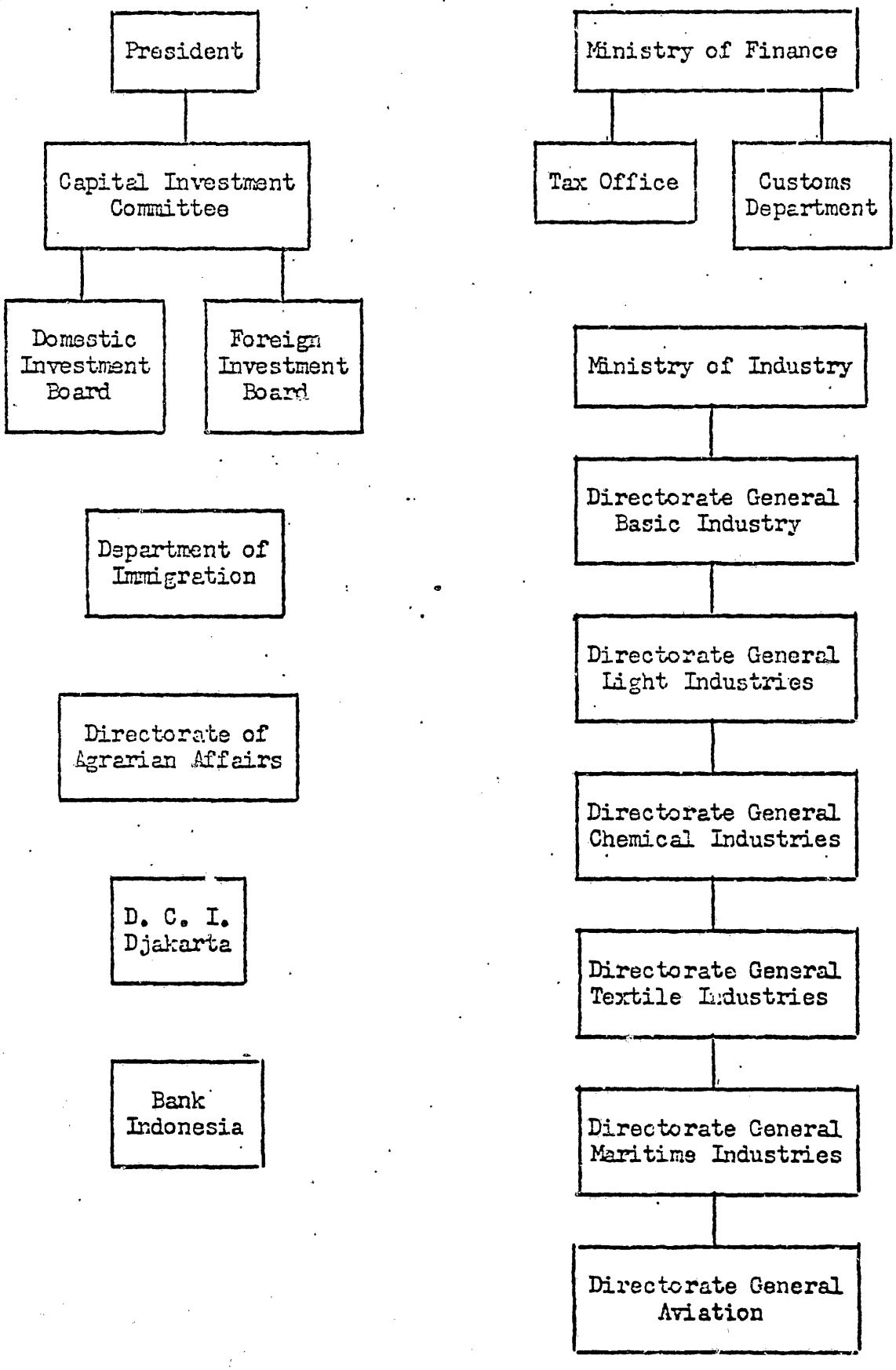
3.52 The foreign investor must negotiate separately with numerous Government ministries and departments for tax holidays (Ministry of Finance), duty-free imports (Customs Department), permission to employ non-Indonesian manpower (Department of Immigration), and investment credit (Bank Indonesia). In addition, after approval of Form B by the President of the Republic, the investor must negotiate the acquisition of land use and construction rights in order to erect and operate a factory. The investor must select the land he requires and insure that the Indonesian authorities agree to its use as industrial property. The land is purchased from the Indonesian owner with the assistance of the Directorate of Agrarian Affairs. Since foreigners cannot own land in Indonesia, the land officially becomes the property of the Indonesian Government, and foreign investors must negotiate for the right to use it.

3.53 These negotiations, as well as others that the prospective investor must undertake, are complicated, time-consuming, and involve substantial economic costs. Table 3.4 presents schematically some of the principal institutions with which the domestic and foreign investor must negotiate, normally more than once, to obtain license and permits, or to reconfirm them once they are granted. It often takes a foreign investor two years from the time he initiates discussions with the Foreign Investment Board to the start up of production. It takes some six months to one year from initial exploration of the possibility of applying for foreign investment approval to the final approval of the investment application (Form B). Another year is required on the average from Form B approval to the start-up of production, although this will obviously vary depending upon the nature and magnitude of the investment. The economic costs, the present administration of the industrial investment incentive system, and the need for institutional and procedural reforms are discussed below.

G. Labor Laws

3.54 The existing labor legislation is designed to protect the living standards of employed workers and guarantee security of employment by providing generous fringe benefits and making it virtually impossible to dismiss a worker for misconduct or other cause. After employment by a firm for 90 days, management is not able to dismiss

Table 3.4 DOMESTIC AND FOREIGN INVESTMENT APPROVAL PROCEDURE



a worker even for serious misconduct or the absence of profitable employment. If a worker is finally dismissed due to a legitimate contraction in business activity, heavy severance pay must be granted to the worker by the firm.

3.55 Large and medium-sized firms are able to evade the law by hiring workers on a "temporary" basis for three months, discharging them, and then rehiring them; however, small-sized plants are often able to evade the law completely since official enforcement is more difficult. In addition, firms face a complex of other labor laws and regulations that provide for payment in kind, bonus payments, and generous holiday and sick leave which, together with restrictions on management's right to dismiss for reasonable cause, have the effect of inhibiting employment creation and encouraging labor-saving methods of production. Thus, the Government's proper concern to protect the conditions and stability of employment has the undesirable side effect of discouraging employment-creation in spite of official preoccupation about growing urban unemployment.

## Performance of Present Incentive System

3.56 The section above described in some detail the investment laws, policies, taxes and tariffs, organizations and procedures that constitute the main elements of the existing system of incentives affecting the manufacturing industry. This section examines the performance, allocation effects, administrative costs and other special problems of the present incentive system in an attempt to clarify the nature, scope, and direction of its impact on domestic and foreign investment in Indonesian manufacturing in recent years.

### A. Foreign Private Investment

#### (a) Composition and Regional Distribution of Approvals

3.57 From 1967 to March, 1971 some 357 foreign investment projects in all economic sectors except petroleum and banking, involving an estimated investment expenditure of nearly $1.5 billion ($1,477.4 thousand), were approved by the Government of Indonesia. As can be observed in Table 3.5 below, there has been a general slowdown in the number of foreign investment approvals in 1971 as compared to 1970, although the average size of investment during the first quarter of 1971 is considerably larger than the previous year, with no foreign investment application approved for the mining, forestry, or agricultural sectors.

Table 3.5

Foreign Investment Approvals, 1967-March, 1971
(millions of US dollars)

| Year | No. of Projects | Planned Investment 1/ |
|---|---|---|
| 1967 | 22 | 170.4 |
| 1968 | 66 | 224.0 |
| 1969 | 84 | 704.5 |
| 1970 | 163 | 240.6 |
| Jan-Mar 1971 | 22 | 137.9 |
| Total | 357 | $1,147.4 |

Source: Foreign Investment Board, April, 1971

3.58 Nearly 90 percent of total planned foreign investment is accounted for by mining ($534.5 million or 36 percent), forestry ($384.9 million or 26 percent), and manufacturing ($368.5 million or 27 percent). There are fewer mining and forestry projects, the project scale being on an average much larger than manufacturing projects, as can be observed in Table 3.6. In the manufacturing sector alone, 193 foreign investment projects have been approved during the period from 1967 through March 31, 1971, with planned investment amounting to $403.5 million. There has been a steady increase in the number and amount of foreign investment projects approved each year since 1967, with a peak year for approvals reached in 1970, when 87 projects were approved with planned investment of $127.3 million. While there has been a decline in the number of foreign investment project approvals in manufacturing during the first quarter of 1971, the estimated value of project approvals for the year will undoubtedly exceed that of 1970.

1/ All economic sectors except petroleum and banking

Table 3.6

Foreign Investment Projects Approved

Planned Investment By Sector

1967 - March, 1971

| Sector | 1967 - March, 1971 No. of Projects | Planned Investment | Percent % |
|---|---|---|---|
| Agriculture and Estates a/ | 43 | 62.7 | 4.2 |
| Forestry | 49 | 384.9 | 26.1 |
| Fishing | 9 | 13.4 | .9 |
| Mining | 9 | 534.5 | 36.2 |
| Manufacturing | 193 | 403.5 | 27.3 |
| Hotels/Tourism | 6 | 42.8 | 2.9 |
| Transport/Communication | 9 | 9.4 | .6 |
| Others b/ | 39 | 26.2 | 1.8 |
| Total | 357 | 1,477.4 | 100.0 |

a/ Includes livestock
b/ Includes infrastructure and services

Table 3.7
Foreign Investment Approvals in Manufacturing Industry

1967 - March, 1971

(millions of US dollars)

| Year | No. of Projects | Planned Investment |
|---|---|---|
| 1967 | 11 | 29.8 |
| 1968 | 37 | 45.4 |
| 1969 | 40 | 76.2 |
| 1970 | 87 | 127.3 |
| Jan-Mar 1971 | 18 | 124.8 |
| | 193 | $403.5 |

Source: Foreign Investment Board, April, 1971.

3.59 Table 3.8 shows that three-fourths of the foreign investment project approvals for all sectors are scattered in four islands: Java (30 percent), West Irian (14 percent), Kalimantan (23 percent), and Sumatra (9 percent). The Djakarta area accounts for 18 percent of total foreign investment projects, which are predominately manufacturing projects, the mining and forestry investments being located mainly in West Irian, Sulawesi, Kalimantan, and Sumatra.

3.60 Table 3.9 indicates the distribution of foreign investment project approvals within the manufacturing sector for the 1967-1970 period. Most foreign investment has gone into food processing, chemicals and rubber, metal products and textiles. A number of these projects are fully operational, and they tend to be medium and large-scale plants, employing 50 and more local laborers and operating near rated capacity.

Table 3.8

Foreign Investment Projects Approved

1967 - March, 1971, By Region

( in millions of U.S. $ )

| Region/Sector | 1967 - 1970 No. of Projects | 1967 - 1970 Planned Investment | Jan - March 1971 No. of Projects | Jan - March 1971 Planned Investment | 1967 - March, 1971 No. of Projects | 1967 - March, 1971 Planned Investment | Percent % |
|---|---|---|---|---|---|---|---|
| Djakarta and Suburbs | 156 | 209.2 | 10 | 56.6 | 166 | 265.8 | 18.0 |
| Java, excl. Djakarta | 67 | 116.6 | 8 | 62.6 | 75 | 179.2 | 12.1 |
| Sumatra | 60 | 114.8 | 3 | 17.7 | 63 | 132.5 | 9.0 |
| Kalimantan (Borneo) | 29 | 341.0 | 1 | 1.0 | 30 | 342.0 | 23.1 |
| Sulawesi (Celebes) | 8 | 87.9 | | | 8 | 87.9 | 6.0 |
| West Irian | 5 | 204.4 | | | 5 | 204.4 | 13.8 |
| Other Islands | 10 | 265.6 | | | 10 | 265.6 | 18.0 |
| Total | 335 | 1,339.5 | 22 | 137.9 | 357 | 1,477.4 | 100.0 |

Source: Foreign Investment Board, April, 1971

Table 3.9

Foreign Investment Project Approvals in Manufacturing
1967 - 1970

(millions of US dollars)

| Sector | No. of Projects | Planned Investment |
|---|---|---|
| Food processing | 29 | 47.3 |
| Textiles and leather | 19 | 58.6 |
| Paper and paper products | 6 | 4.2 |
| Chemicals and rubber | 62 | 66.6 |
| Basic metals | 4 | 4.5 |
| Metal products | 52 | 65.2 |
| Other | 3 | 32.3 |
| | 175 | 278.7 |

Source: Foreign Investment Board and Bank Indonesia, March, 1971. An adjustment was made in the "Other" category to conform with latest total figures available from the Foreign Investment Board.

3.61 The food processing projects (including beverages and tobacco) are small and medium scale, moderately capital-intensive and utilize imported raw materials; they are located mainly in the Djakarta area; and the output is destined for the domestic market, with a few projects that can be considered export-oriented. Most textile projects are spinning and weaving plants based on imported synthetic fibers and filaments, although at a later stage there are plans to manufacture synthetic fibers locally to supply this industry. The chemical projects cover a range of industrial chemicals and chemical products, including pharmaceuticals, plastics, and fertilizers; rubber products include crumb rubber and tires for light and heavy vehicles. They tend to be medium-scale industries by international standards and employ relatively simple capital equipment and semi-skilled labor. Foreign investment in metal products include such items as sewing machines, motor scooters, trucks, light bulbs and electrical transformers, mainly destined for the domestic market, although a few specialized items such as air conditioners, refrigerators and electronic components are exported.1/

1/ See IBRD Report No. EAP-22 (Indonesia: Investment and Growth Perspectives in the 1970's) March 25, 1971, for fuller details.

3.62 The US is the most important source of foreign investment (measured in terms of value of planned investment) with $522.6 million as of March 31, 1971, followed by Japan with $213.4 million and Hongkong with $78 million. During the first quarter of 1971 both Japan and Hongkong were granted more investment licenses with a higher value of planned investment than the US. There appears to be some slackening in the overall rate of US investment in Indonesia. (See Tables 3.10 and 3.23). According to the Foreign Investment Board, the slow-down in foreign investment applications has been noticeable since September, 1970. It is variously attributed to the slow implementation of the tax holiday incentive as government policy has become more selective; uncertainty induced by the July, 1971 elections and their possible impact on Government policies; and the difficulty investors encounter in importing machinery, spare parts, and raw materials, although this last factor is not a new one.

(b) Disbursements

3.63 Date available from Government sources on the number of foreign investment projects in the planning, construction, and production phases, as well as their actual investment expenditures, are incomplete and not current. However, according to the best available data on recorded disbursements (derived from the Customs Department) on projects approved from 1967 through December 31, 1970, investment expenditures have been made by nearly 60 percent (197 out of 341) of the projects approved for all economic sectors. Disbursements are lagging considerably since only 13 percent of planned investment expenditures have actually been completed by the end of 1970.

3.64 With respect to the manufacturing sector, disbursement performance is considerably better, probably reflecting smaller average project size and more quick-yielding projects, since about 25 percent (or $75 million) of planned investment expenditures ($278.6 million) have been realized during the same period.1/ The distribution of disbursement by major industry sector can be observed in Table 3.11.

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1/ There is considerable discrepancy between the high disbursement rates by economic sector derived from the recent University of Indonesia study of foreign investment performance based on a sample of approximately two-thirds of the total foreign investment project approvals, and disbursement rates based on recorded Customs data as described above. According to the University of Indonesia study, the disbursement rate for a sample of manufacturing sector projects was 58 percent (i.e. 58 percent of planned investment was realized by December 31, 1970). The discrepancy may be due to the fact that the 203 firm sample was not representative of the universe of foreign investment project approvals to December 31, 1970, or to incomplete and unreliable Customs data.

Table 3.10

Foreign Investment Projects Approved

Principal Countries, 1967 - March, 1971

( millions of U.S. $ )

| Country of Origin | No. of Projects | Planned Investment |
|---|---|---|
| U. S. | 56 | 522.6 |
| Japan | 60 | 213.4 |
| Hongkong | 46 | 78.0 |
| Canada | 3 | 77.7 |
| Philippines | 13 | 61.5 |
| Singapore | 27 | 52.5 |
| Netherlands | 20 | 34.3 |
| Malaysia | 18 | 29.6 |
| United Kingdom | 27 | 26.2 |
| Other | 87 | 382.0 |
| Total | 357 | $1,477.8 |

Source: Foreign Investment Board. Data refer to investment in all economic sectors except banking and petroleum.

Table 3.11

Foreign Investment Project Disbursements in Manufacturing
1967- 1970

(millions of US dollars)

| Sector | No. of Projects | Disbursements Amount |
|---|---|---|
| Food processing | 29 | 22.3 |
| Textiles and leather | 19 | 12.2 |
| Paper and Paper products | 6 | 1.4 |
| Chemicals and rubber | 62 | 14.6 |
| Basic metals | 4 | .1 |
| Metal products | 52 | 24.4 |
| Other | 3 | - |
| TOTAL | 175 | 75.0 |

Source: Foreign Investment Board and Bank Indoneisa.

Disbursements for food processing and metal products are especially high, in the 30-35 percent range. The other sectors tend to be lower than average in disbursement performance compared to the sector as a whole. By the end of December, 1970, about half of the foreign investment project approvals in manufacturing has recorded some investment expenditures. At the end of March, 1971, disbursements on planned foreign investment in manufacturing of $403.5 million should be approximately $100-110 million.

3.65 There appears to be no single central body in the Government, including the Investment Implementation Unit of the Foreign Investment Board, that collects, records, and disseminates information on disbursements for foreign investment projects. Partial data are available from the Bank Indonesia, the Customs Department, and the Ministry of Industry. Progress reports are submitted irregularly to the Ministry of Industry and to the Foreign Investment Board by firms, but there is no comprehensive information on the overall rate of progress of foreign firms in starting up production, investment expenditures, or utilization of capacity. No regular procedure exists by which the Government bodies concerned with foreign investment (Foreign Investment Board, Ministry of Finance, Ministry of Industry, Bank Indonesia) are able to keep themselves informed and up to date on the progress made by foreign investors, after approval of Form B, in setting up a new plant or in carrying out an expansion program in established enterprises. The Customs Department has information on imported items on the investor's master import list that have cleared customs. The Bank Indonesia also has data on investment credit

disbursements on foreign and domestic investment programs. In addition, the Ministry of Industry requires periodic progress reports on investments which are filed with the relevant Directorate Generals within the Ministry. These sources provide partial and incomplete information on the progress and status of capital projects, but it is not collected or distributed on a regular basis within the Government.

3.66 Infrequent surveys sponsored by the Foreign Investment Board and undertaken by the University of Indonesia's Management Institute provide the only comprehensive review of the performance and problems of foreign firms: the stage of physical construction, capacity utilization, arrival of imported machinery and problems encountered in obtaining concessions and licenses. This kind of ad hoc information is useful but it does not keep the Government of Indonesia adequately informed of the status of investments which have important effects on domestic supply, employment and foreign exchange availability.

3.67 It would be desirable for the Capital Investment Board to establish a regular questionnaire survey of all foreign and domestic investors enjoying benefits under the Foreign and Domestic Investment Laws. A simple questionnaire could be sent quarterly to all foreign and domestic investors to be completed and returned by the enterprises within a two-week period. Some effective penalty for noncompliance with the request for information would probably have to be introduced to insure regular, comprehensive coverage. The Capital Investment Board could then prepare a quarterly report, based on the results of the questionnaire, on the status of these investment projects for the distribution to the President, Cabinet officers, Bappenas, and relevant ministries and departments. The report would provide valuable information for industrial planning and project implementation as well as for Bappenas' annual economic projections.

## B. Domestic Private Investment

### (a) Composition and Regional Distribution of Approvals

3.68 From November, 1968 to December, 1970, a total of 689 domestic investment applications were processed under the Domestic Investment Law (No. 6, November, 1968) and 488 were approved for all economic sectors. Planned investment for the 488 approved projects amounted to 153.2 billion Rupiah or about $410 million, with a foreign exchange component of 113.2 billion Rupiah or 74 percent of total planned investment cost.[1/]

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1/ According to the Domestic Investment Board, in January, 1971, 32 additional domestic investment applications were approved with planned investment totalling 18.4 billion Rupiah. Therefore, at the end of January, 1971, there were 520 approved domestic investment projects with planned investment of 171.7 billion Rupiah or about $460 million.

About 85 percent of planned investment of 153.2 billion Rupiah is concentrated in the manufacturing (63 percent), agriculture estates (15 percent) and forestry (8 percent) sectors.

3.69 The regional distribution of domestic investment projects approved for all economic sectors can be observed in Table 3.12. Djakarta and the rest of Java account for 107.2 billion Rupiah or 70 percent of total planned investment, while the other larger islands with a richer natural resource base, such as Sumatra, Kalimantan (Borneo) and Sulawesi (Celebes) account for only 28 percent. Most of the planned domestic investment in agriculture estates is located in Sumatra; forestry in Kalimantan; manufacturing, transport and tourist investment overwhelmingly in Java.

3.70 With respect to manufacturing, during the November, 1968 - December, 1970 period a total of 308 domestic investment projects were approved with planned investment amounting to 86.5 billion Rupiah or about $230 million. Domestic investment has been attracted mainly into the food and beverages, textiles, and chemicals and plastics sectors. These are mainly small-scale, quick-yielding investments, of the packaging, finishing and assembly type; they have a high import content and mainly supply the domestic market. A few, large-scale projects, such as synthetic textile mills and electronic assembly plants, produce mainly for export. Overwhelmingly, domestic investment has been of the import substitute rather than export-oriented type.

3.71 As in the case of foreign investment, domestic investment projects in the manufacturing sector are heavily concentrated in Djakarta and elsewhere in Java. About 90 percent of planned domestic investment in manufacturing is located in Djakarta (47 percent) and the rest of Java (43 percent); Sumatra accounts for most the remainder. See Table 3.13 for further details. The imbalance in the distribution of manufacturing investment in recent years is by no means new and merely continues a longer-term trend towards industrial and demographic concentration in Java. The attraction of the Djakarta area as an industrial site is the result of powerful historical and economic factors which fiscal incentives alone obviously are incapable of overruling. The Djakarta area is the hub of government policy and decision making, banking and commerce; it contains the largest, most sophisticated urban market in Indonesia; the greatest concentration of entrepreneurs, managers and skilled labor generally; comparatively good transport infrastructure and access to international markets. While public utilities and services (electric power, water, sewerage and telecommunications) are inadequate, they are superior to what is found elsewhere in the country. It is not surprising that Djakarta exerts a strong pull on foreign and domestic investors.

3.72 On the other hand, the thinness of industrial concentration in the other major islands is the result, among other things, of the scarcity of local and foreign capital (foreign capital often is held by Indonesian nationals of Chinese origin) which has been attracted to the Djakarta area. Investors of Chinese origin face considerable risk of political

Table 3.12 Private Domestic Investment Projects Approved

November, 1968 - December 1970

( Amounts in Rps. million)

| Region/Sector | Agriculture & Estates 1/ | Forestry | Fishery | Manufac-turing | Mining | Transport & Tourism | Others 2/ | Total |
|---|---|---|---|---|---|---|---|---|
| Djakarta & Suburbs | 110 (2) | - | 369 (1) | 36,957 (146) | - | 18,553 (35) | 208 (3) | 56,197 (187) |
| Java, elcl. Djakarta | 2,147 (18) | - | 352 (1) | 44,274 (132) | 1,093 (1) | 1,930 (12) | 1,170 (1) | 50,966 (165) |
| Sumatra | 16,210 (43) | 2,041 (7) | 548 (2) | 2,556 (25) | - | 1,591 (3) | - | 22,946 (80) |
| Kalimantan (Borneo) | 3,078 (12) | 13,977 (29) | 29 (1) | 166 (2) | - | 56 (1) | - | 17,306 (45) |
| Sulawesi (Celebes) | - | - | 50 (1) | 2,398 (2) | 302 (1) | - | - | 2,750 (4) |
| Other Islands 3/ | - | 1,712 (5) | - | 126 (1) | - | 1,246 (1) | - | 3,084 (7) |
| Total | 21,545 (75) | 17,730 (41) | 1,348 (6) | 86,477 (308) | 1,395 (2) | 23,376 (52) | 1,378 (4) | 153,249 (488) |

1/ Includes livestock.
2/ Real Estate & Infrastructure
3/ Bali, Nusatenggara, Maluku, West Irian.
Figures in brackets indicate number of projects.

Source: Domestic Investment Board

Table 3.13

Domestic Investment Project Approvals in Manufacturing

By Location and Major Products, 1968 - 1970

| | Djakarta | Java | Sumatra | Kalimantan | Sulawesi | Other | Total | Percentage Composition |
|---|---|---|---|---|---|---|---|---|
| Food & Beverages | 32 | 14 | 7 | 1 | 1 | - | 55 | 17.9 |
| Tobacco | - | 6 | 1 | - | - | - | 7 | 2.2 |
| Textile | 19 | 73 | - | - | - | - | 92 | 29.9 |
| Chemicals and Plastics | 37 | 16 | 8 | - | 1 | 1 | 63 | 20.5 |
| Printing | [illegible] | 5 | 2 | - | - | - | 18 | 5.8 |
| Metal Products | 21 | 5 | 3 | | | | 29 | 9.4 |
| Electronic Assembly | 9 | 2 | - | - | - | - | 11 | 3.5 |
| Other | 17 | 11 | 4 | 1 | - | - | 33 | 10.7 |
| Total | 146 | 132 | 25 | 2 | 2 | 1 | 308 | 100.0 |
| Percentage of Total | 47.4 | 42.9 | 8.0 | 0.6 | 0.6 | 0.3 | 100.0 | |

Source: Domestic Investment Board

repression and discrimination in the outlying islands. In addition, costs to investors stemming from bureaucratic delays, distribution and transport costs are generally higher and real incomes lower.

(b) Disbursements

3.73 The reporting on the implementation and disbursements of approved domestic investment projects is incomplete and not up to date. However, partial data available indicates that about 35 percent (170 out of 488 projects) of approved projects for all economic sectors are in operation (111), under construction (51), or engaged in pre-investment activity (8). It is not possible to say anything about disbursements on approved domestic investment in the manufacturing sector for lack of data. Although most of the approved domestic projects reported to be in production are established enterprises, completely new enterprises are becoming progressively more numerous as time passes.

(c) Summary

3.74 In summary, the incentive system has contributed to the rapid growth of foreign and domestic investment in manufacturing which has been observed in recent years in Indonesia, especially since 1969. At the end of December, 1970, a total of 483 foreign and domestic investment applications had been approved for the manufacturing sector, with planned investment of $508.7 million. The key question is how much of this investment can be attributed to tax, tariff and other specific incentives offered investors since 1967 - 1968 compared to other factors such as the favorable political and economic climate established by the Government in recent years. There is evidence that the elimination of political instability, the anti-business bias, inflation, multiple exchange rates, import licensing, the threat of nationalization, and labor unrest were the major factors in making Indonesia attractive to foreign and domestic investment.1/

3.75 Until these major political and economic obstacles to investment were removed, it is highly doubtful that the specific incentives described earlier would have stimulated investment by themselves. In some countries investors have reported that the favorable political and economic climate was sufficient incentive to induce them to establish operations

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1/ These were the factors most cited by foreign investors causing them to rule out Indonesia from their investment considerations during the Sukarno regime. See Obstacles and Incentives to Foreign Private Investment, 1962 - 1964, National Industrial Conference Board, New York, 1965

without special tax and tariff treatment.[1] In the absence of systematic information on investment motivation in Indonesia, there is no way of knowing with any degree of confidence whether or not the incentive system has made much difference. However, there is fragmentary evidence to support the contention that at least some of the investment since 1967 - 1968, particularly foreign investment in the initial years, would not have been made without special incentives in spite of the sharp improvement in the general investment climate.[2]

3.76 Actual investment expenditures by local and foreign firms as opposed to planned investment of $508.7 million is estimated at $100 - $125 million at the end of 1970, and by June, 1971, actual investment is estimated at $175 - $200 million. These are order of magnitude estimates since precise, reliable figures on disbursements by foreign and domestic investors are not available. The economic impact of this volume of realized investment over essentially the past three years on Indonesia's small manufacturing sector has not been insubstantial. The incentive system has helped to encourage foreign and domestic investment amounting annually to roughly 7 - 8 percent of value-added in manufacturing,[3] a not considerable achievement when compared to the poor investment performance in manufacturing during most of the 1960's.

3.77 There has been a slow down in foreign investment project applications since September, 1970, which has continued into 1971. It is variously attributed to a more stringent government policy in granting incentives, delays in freeing goods from Customs, and political uncertainties in the pre-July, 1971 election period. Data on domestic investment for 1971 is too incomplete to permit any firm conclusions to be drawn, but it does not appear that there has been any similar slow down in domestic investment applications. The US is the main source of foreign investment (planned investment of $522.6 million at the end of March, 1971), followed by Japn and Hongkong. Foreign and domestic industrial investment is heavily concentrated in Djakarta and the rest of Java as a result of the strong political, economic, financial, and infrastructure attractions and the higher costs of production and scarcity of entrepreneurs and skilled labor in the other islands.

3.78 The fiscal inducements offered by the government to locate outside of Java (essentially an additional year of exemption from corporate taxes) are far too weak to offset the considerable additional transport, communications, infrastructure and other costs incurred by the investor. The government has not yet formulated a comprehensive industrial location policy that includes public investment and other incentives (fiscal, financial, infrastructure) needed to encourage industrial location outside Java.

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1/ Ibid

2/ Discussions with foreign investors in Djakarta, April/May, 1971

3/ Value-added in manufacturing is estimated at about $800 million per year in recent years.

C. Implementation Problems

3.79 As noted above, the incentive system has helped to encourage a considerable volume of domestic and foreign investment, especially in 1969 and 1970; while complete and up-to-date information is not available, the existing data indicated that total foreign and domestic investment approvals for all economic sectors since 1967 is close to $2 billion. Investment approvals (foreign and domestic) in the manufacturing sector from 1967 to mid-1971 amounts to about $600 million and actual investment expenditures in the vicinity of $175 - $200 million. These are order of magnitude estimates and are subject to correction as better information becomes available. Nevertheless, the figures indicate that the Government has been to a large extent successful in stimulating foreign and domestic investment in Indonesian industry.

3.80 Despite the overall success of the system, there are various implementation problems which arise after investment project approval, some of them of a long-standing nature, that must be overcome if industrial investment is to be further accelerated in the 1970's. These implementation problems are of an administrative, institutional and legal nature and are not easily solved. In part they are the result of the considerable inflow of new investment which the administrative machinery is not equipped to handle efficiently.

(a) Domestic Private Investment

3.81 As pointed out in IBRD Report on the Indonesian Economy (No. EAP 19a) of November 27, 1970, domestic approvals could be accelerated by reducing the duplication of work involved in the application procedure. "The procedure is a three-stage process whereby the applicant gets approval from a Regional Team, the Domestic Investment Board, and finally the Ministry of Finance. At each stage the same questions must be answered and the identical issues resolved." In order to reduce delays in the domestic investment approval process, the Government should centralize decision-making authority in the Domestic Investment Board and Regional Teams by requiring that representatives of the Government ministries and departments and the local government agencies be members of or immediately available to the Domestic Investment Board and have the power to act for their ministries and departments in the granting of operating, building, and land-title licenses; duty-free import permits; and tax and other incentives.

(b) Foreign Private Investment

3.82 The administrative and procedural problems faced by foreign investors in obtaining investment approval, locating land and purchasing it, erecting a factory and starting up operations are so considerable that they clearly discourage investment. Many of these problems have been described in earlier economic reports; however, it may be useful to

summarize briefly some of the major problems causing delays, frictions and costs to be incurred by foreign investors. These include: confusion and lack of coordination between local and central Government policies and regulations; inadequate economic infrastructure facilities (transport, telecommunications, ports); excessive and arbitrary custom inspections; uncertain application of tax and customs duty exemptions for which approval has been received; lack of coordination between central government departments; excessively complicated procedures for import clearance and tax documentation and extreme difficulties in obtaining land-titles and purchasing land for factory development. Domestic investors are, of course, faced with parallel problems.

3.83 A recent survey of foreign investors whose investment applications have been approved was undertaken by the Management Institute of the University of Indonesia, and foreign investor complaints and suggestions were recorded. A few of them are quoted below to indicate foreign investor thinking.

Land Purchase

"There is a great need for practical assistance from Government in locating and purchasing land for factory development."

"Land purchase is extremely confusing and difficult due to ownership laws, lack of title deeds, and absence of knowledgeable brokers."

Excessive Decentralization of Decision-Making

"If all required approvals and licenses were negotiated with one central interdepartmental authority, much time could be saved."

"Our experience is that we must negotiate with an excessive number of authorities to obtain approvals which is cumbersome and time-consuming.

"We recommend that the Government study the EDB system in Singapore. The Republic of Singapore has succeeded in attracting foreign investment, among other reasons, because the investor has only to deal with the EDB."

Tax and Import Privileges

"Approvals for duty-free imports, tax holidays and concessions, work permits, etc. could be granted automatically following President's approval thus obviating the need for each application to be again submitted for further approval."

"In order to speed up flow of imported goods all procedures regarding import clearances and tax documentation should be very much simplified and not bureaucratic."

3.84 The Government is actively considering the establishment of industrial estates which would solve some of the problems faced by domestic and foreign investors in purchasing land and obtaining land-use rights, access to adequate infrastructure facilities, and various licenses and permits. The much-discussed Investment Promotion Center appears to be no closer to reality than it was a year ago, although some central authority with the task of providing information and assistance to foreign

investors, but more importantly with the delegated powers to negotiate the necessary licenses and permits with the investor, is urgently needed.

D. Economic Cost of Administrative Delays

3.85 In Indonesia the magnitude of the economic loss due to administrative delays and cumbersome regulations has never been studied in detail. The length of time required to obtain government clearances and approvals can discourage foreign and domestic investors from making a direct investment. It appears that administrative delays in Indonesia have seriously retarded the rate of foreign investment and discouraged foreign or domestic firms from establishing new plants. While bureaucratic delays, such as negotiating the master import list or obtaining title to land-use rights, vary from sector to sector and project to project, on the average it takes an estimated two years to start up of production from the date of initial submission of a letter of intent (Form A) to the Ministry of Industry, as was noted earlier. Very large industrial investments involving heavy infrastructure expenditures take much longer to move from initial application to production start-up. Administrative delays in Indonesia appear to be excessively burdensome compared with other developing countries, and every effort should be made to minimize them.

3.86 To the extent that the lengthiness and cumbersomeness of obtaining Government (national and local) clearances required to make an investment discourages foreign or domestic firms from proceeding with a direct investment, the rate of capital formation and growth of the Indonesian economy is retarded. Lengthy administrative procedures are costly and adversely affect the competitiveness of Indonesian industry. They tend to discriminate more against the small and medium-sized firms, which are predominantly Indonesian enterprises, than against the large-sized firms, often foreign-owned, that are able to bear the cost of delays better. Bureaucratic delays and other hidden costs also tend to discourage entrepreneurship in a country where it is extremely scarce and needs stimulation.

E. Legal and Illegal Smuggling

3.87 There have been various estimates of the magnitude of Indonesia's "unrecorded" trade or "smuggling" that range from $100 to $200 million a year.1/ Formidable statistical problems and incomplete data makes any attempt at quantitative estimation extremely hazardous. Nevertheless, there is considerable evidence that "smuggling" is a major economic issue with far-reaching impact on the development of national industry.

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1/ Far East Economic Review Year Book, 1968 Page 201, and IBRD Economic Development of Indonesia, February 1968 Volume I, Page 18.

3.88 While shipments of oil and mineral products more generally are hardly affected by smuggling, there is plenty of opportunity for smuggling of manufactured goods, especially for the smuggling of consumer goods. Indonesia has some 50 larger ports, and many smaller ones scattered over a 3,000 island archipelago that stretches 3,500 miles from western to eastern ends. The extensive Indonesian coastline is naturally difficult to patrol effectively, and the Government's coastal patrol capacity is severely limited. According to the Customs Department, only 16 coastal patrol craft of a fleet of 40 craft operated by the Coast Guard are currently in operation. Coastal patrols for customs purposes probably can never prevent all or even a substantial amount of goods entering the country illegally, but it is clear that 16 coastal patrol boats are entirely inadequate to control even a small part of the shipborne smuggling that occurs across the Strait of Malacca between Sumatra and Malaysia-Singapore.

3.89 There are two kinds of smuggling or illegal import of goods into Indonesia: (1) illegal smuggling, or the clandestine movement, normally by ship, of goods into Indonesia that do not pass through Customs and (2) "legal" smuggling, sometimes termed "technical smuggling", by which goods are imported into Indonesia through the system of ports and customs control points with the active collusion of customs officials.

(a) Illegal Smuggling

3.90 There are essentially two stages in the illegal movement of goods into Indonesia by ship from Singapore, Malaysia, Philippines, and Portuguese Timor. First the goods are transported by ship from the foreign export port or location to one of the many secluded, sparsely populated islands of the Indonesian archipelago in the South China or Java Seas; the second stage consists of transhiping the goods by inter-island air or sea transport, or by land transport, to the densely populated regions and urban centers where the goods are sold. The major centers of "illegal" smuggling (goods entered illegally that evade customs control completely) are the following:

(1) Riau islands at the eastern mouth of the Strait of Malacca
(2) Sabang on Weh island off the western tip of Sumatra
(3) Banka-Belitung islands off the East Sumatra coast
(4) Karimata islands and West Kalimantan
(5) Kuching in Sarawak
(6) Nunukon region of East Kalimantan
(7) Mamudju region between South and Central Sulawesi
(8) Sangir Taland islands off the southern coast of Mindanao in the Philippines
(9) The border between Indonesia and Portuguese Timor.

3.91 During 1970/71, the Coast Guard made 296 patrols, mainly in the Straits of Malacca area, apprehended 294 persons, and captured 49 vessels

including sailing ships. Approximately 450 metric tons of smuggled goods were seized during the twelve-month period, a small part of the many tons of goods entering Indonesia illegally through the shipborne commerce.

(b) "Legal Smuggling"

3.92 Sometimes called "administrative" of "technical" smuggling, this kind of importation of goods requires the cooperation of the Customs Department at sea and airports. Evasion of import duties takes place through under-invoicing the value of import; underassessing the duty owing on imports; and misclassifying goods in order to qualify for a lower duty. In all these instances, the Customs officials cooperate and share in the gains enjoyed by the smuggler. According to the Customs Department, passengers of ships operating between Sabang and Ule Theue and on the Belawan-Singapore-Djakarta line import goods without paying customs duties, although they enjoy no legal exemptions.

3.93 In the 1970/71 fiscal year the Customs Inspectorate collected 230 million rupiah (or about $600 thousand) from customs violations, 70 percent of which were derived from Tandjung Priok, the port of Djakarta, and about 15 percent from Belawan. In 1969/70 fiscal year 260 million rupiah were collected in fines.

3.94 There is considerable direct evidence of smuggling in the Djakarta market. Data was collected for eleven items on the Customs Department's list of most actively smuggled items to compare the local wholesale prices and the estimated prices of the same goods based on c.i.f. import prices plus duties and taxes due at the time of import. As can be observed in the Table 3.14 below, smuggled goods were being sold by dealers in Tandjung Priok at roughly one third to one half of the prices of the same legally imported goods on the local Djakarta market. Although admittedly a very small sample, there was no consistent pattern that indicated the degree of evasion tends to rise with the height of the duty plus tax as the Cooper report found.

Market and Revenue Effects

3.95 There have been numerous complaints of the adverse impact of large-scale smuggling on the local manufacturing enterprise producing the same or similar products. The imported goods on which full taxes and duties are not paid provide severe competition to the local manufacturer who may not be able to compete with more efficient producers abroad. It may make it impossible for the local manufacturer to continue production and may discourage new investment in manufacturing. There is evidence, for example, that smuggling is reducing the domestic market for domestically manufactured textile goods even when local production is relatively efficient. Japanese textiles, such as shirting material, are able to sell in Djakarta below the cost of production of

Table 3.14

Comparison of Prices of Selected Duty-Paid and Smuggled Imports in the Djakarta Market a/

( in Rupiah )

| | | | Djakarta Wholesale Prices | |
|---|---|---|---|---|
| | Unit | Import Taxes and Duty | Duty-Paid Price | Smuggled Price |
| Textiles | per yard | 167 | 390 | 220 |
| Tetoran cloth | 36" wide | 1,788 | 5,000 | 3,000 |
| Powdered Soup | 45.4 Kg. | 50,241 | 68,100 | 25,000 |
| Condensed Milk | per carton | 3,024 | 8,640 | 4,300 |
| Plain Glass Tumblers | per dozen | 4,212 | 7,750 | 5,000 |
| Plain Porcelain Plates | per dozen | 757 | 1,860 | 1,000 |
| Soap (Green Leaf) | per dozen | 2,861 | 8,640 | 5,000 |
| Tires (520 x 12) | per tire | 2,283 | 6,250 | 4,750 |
| Battery (60 x 30) | per dozen | 130 | 600 | 250 |
| Biscuits | per dozen tins | 2,370 | 7,840 | 3,600 |
| Lager Beer | 24 cans | 1,318 | 2,400 | 1,500 |

a/ As of approximately May 1, 1971.

Note: Prices for the legally or duty-paid imported goods were obtained at Pasar Pagi market in Djakarta whereas prices on illegally imported goods were obtained from dealers in Tandjung Priok.

even efficient, large-scale producers. In addition, smuggling is known to have reduced the inducement to invest of certain foreign investors who decided not to establish plants in Indonesia since they could not compete with their own goods produced in Singapore and smuggled into Indonesia.

3.96 Smuggling also involves considerable revenue losses to the Government since import duties and taxes either are not paid at all or paid or underassessed values. Assuming that goods valued at $100-200 million (which may be a conservative estimate) evade full payment of import duties and taxes, and an average rate of duty of 20 percent is applicable on these imports, then the Government's revenue loss is roughly of the order of $20-40 million per year; a reduction in smuggling clearly could have important revenue effects. Unenforceably high tariffs are self-defeating since they make smuggling profitable and may weaken the incentive to invest in local manufacturing.

3.97 In order to reduce, if not eliminate, smuggling and the adverse effects on local manufacturing, the problem must be combated on a wide front. It is desirable that high tariffs, especially on known smuggled goods, be revised downwards to reduce the incentive to evade duties; the investment incentives and policies of the Government should encourage more efficient production and lower prices for local manufactures; the customs administration in harbors and ports should be improved and increased penalties should be attached to smuggling and official collusion; the numbers of coastal patrol craft and the size of the Indonesian coast guard should be increased; and joint cooperation should be established with the Coast Guards of Malaysia and Singapore.

## F. Nominal and Effective Protection

3.98 There are a variety of advantages and disadvantages of employing tariff policy as an instrument of promoting the industrialization of developing countries like Indonesia. On the one hand, protection provides a powerful inducement to foreign and domestic investors to establish manufacturing plants; by raising manufacturing profits it provides a source of savings to sustain further industrial growth; and it provides a ready made market of known dimensions for the output of the newly-established manufacturing enterprises. On the other hand, protection enables industry to make high profits (if efficient) or to become inefficient at the expense of consumers who must pay the difference between the c.i.f. price of imports and the protected price of local production. Protection, therefore, is a way of taxing the economy, but it may be better under some circumstances to rely less on protection and to tax the community more directly and to channel these public savings to industry through development banks. High protection can have adverse effects on foreign trade and the rate of growth; it can lead to monopoly profits and a low incentive to technological and product innovation; and may increase rather than reduce dependence on imports.

3.99 As an instrument of industrial promotion, the Indonesian tariff structure suffers from the following defects: (1) excessive aggregation or "umbrella" categories for goods where more refinement of commodity description is needed; (2) excessive disaggregation or refinement for certain goods, such as textiles, where it is not needed; (3) classification of some products according to end-use, which presents problems for customs enforcement; (4) excessively high tariffs on finished consumer goods resulting in widespread evasion of payment of duties (5) anomalies which take the form of substantially different duties on goods of similar use; different duties on the same goods, depending on its end-use; raw materials dutiable at higher rates than goods at a higher stage of fabrication embodying the raw material, thus, discouraging some processing activities; (6) low duties, normally ten percent, on capital goods which encourages the adoption of capital-intensive techniques of production.

3.100 The general principles guiding the restructuring of the Indonesian tariff schedule (simplification, lowering and harmonizing of duties) for long-term industrial development proposed in the Cooper Report and the specific recommendations currently under study by the Government move in the right direction and deserve full support.1/ However, the encouragement given to an industry, the strength with which protection pulls factors of production into manufacturing, is better measured by effective than nominal protection: the nominal rate of protection (product protection) being equal to the percentage excess of domestic over foreign prices due to the imposition of tariffs and other protective measures; effective protection (protection of value added) measured by the percentage excess of domestic value added resulting from protection over world market value added.2/

3.101 It is desirable that a study be undertaken soon of the structure of effective protection in Indonesia and its resource allocation and growth-effects. Such a study could provide an improved basis for further modification of the tariff structure to make it a more effective instrument of industrial development. While admittedly there are many difficulties in measuring effective protection in Indonesia, including the lack and poor quality of basic statistical data for manufacturing, a start should be made.

## G. Allocation Effects

3.102 Although it is not possible to demonstrate precisely on the basis of few and unreliable statistics, it appears that the system of incentives designed to promote the domestic and foreign investment in

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1/ See the Cooper Report, pp. 31-35, and an earlier section of this chapter dealing with import duties for a fuller discussion of the recommended tariff changes.

2/ Bela Balassa, Industrial Protection in Developing Countries, IBRD Report No. EC-175, June, 1970.

manufacturing, in combination with the other Government policies affecting the general investment climate, is having the following broad allocation effects:

(a) Reallocation of labor to the Djakarta area

3.103 The reallocation of labor from the countryside to Djakarta and other urban centers is a characteristic Indonesia shares with the entire developing world. Since less than 10 percent[1] of the Djakarta region income is generated by manufacturing industry, the overall effect of industrial investment on the reallocation of labor to Djakarta has been small. On the other hand, the incentive system for industry tends to promote the continued concentration of manufacturing investment and employment in Djakarta and elsewhere in Java. In order to reduce, if not reverse, the concentration of manufacturing in the Djakarta area, a comprehensive program must be established by the Government which could include the establishment of industrial estates, strengthening the incentive system to provide considerably greater benefits to those firms that locate outside of Java, and regionalizing government decision making to reduce the need to recur to Djakarta to obtain licenses and approvals from the central government.

(b) Capital-Intensive Methods of Production

3.104 The incentive system appears to have led to some reallocation of domestic capital from nonmanufacturing sectors to manufacturing, especially since 1969, as well as increased the inflow of foreign capital to manufacturing. Like most developing countries, Indonesia tends to import highly capital-intensive and labor-saving manufacturing equipment designed in the advanced countries for different requirements and factor endowments. This is particularly evident in the new medium and large-size industries established under the Foreign and Domestic Investment Laws. The policy of duty-free imports of capital goods (a central part of the incentive system) keeps the price low in relation to other capital goods. While wages tend to overstate the social cost of labor, the price of capital goods tends to understate their social cost of scarcity value. In addition, severe restrictions placed on the employer's right to dismiss workers (in practice virtually impossible) and other labor legislation tends to encourage a policy of substituting capital for labor and discourages new employment.

3.105 In Indonesia the rapid depreciation of a capital (machinery, equipment and tools) permitted under the incentive laws also encourages capital intensive investment. Relatively low interest rates on State Bank loans to industry under special credit programs tends to reinforce the overall bias of the incentive system towards capital intensive, labor saving investments. As industrialization proceeds, Indonesia's

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1/ Census and Statistics Office DCI Djakarta.

current policies will tend to steer manufacturing investment into capital-intensive technology neglecting the possibilities open to creating employment by adapting the form of capital, encouraging labor-intensive industries and increasing the number of shifts worked.

(c) Allocation of Capital to Large and Medium Size Firms

3.106 The imperfections of the Indonesian capital market tends to allow only large firms with cash reserves and collateral access to the relatively cheap credit of the State Banking system while limiting the small-size firms and handicraft production to the unorganized segment the capital market with extremely high interest rates. All industries must have 25 percent of the credit sought ready for deposit in a State Bank as collateral upon approval of the credit. Total collateral must amount to 150 percent of the loan, including the 25 percent cash. This matter is discussed at length in Chapter IV.

3.107 Small-scale industries and handicraft production should receive special credit terms and facilities from the State banking system. At present the industrial finance system discriminates against small firms, handicrafts and new ventures; it tends to favor large firms, and wealthy individuals with cash reserves and property. Large and medium size firms also can withstand the burdensome administrative costs of obtaining government clearances, licenses and credits better than smaller size firms.

(d) Other Effects

3.108 Under the 1970 amendment to the Corporate Income Tax, the Minister of Finance is authorized to establish rules for the revaluation of fixed corporate assets. However, as of this writing (June, 1971), the regulations to implement this decision have not yet been formulated or published. At present, Indonesian firms have seriously understated book values for their fixed assets purchased more than five years ago as a result of past inflation and devaluation. In many cases, the book value is now virtually zero although the market value of the assets is much higher. As a consequence, under present capital gains and corporate tax laws, the sale of such under-valued assets leads to fictitious or paper capital gains which are taxed at the 20 percent rate if the assets have been held over four years.[1/]

3.109 The undervaluation of corporate assets tends to discourage mergers and industrial rationalization since the capital gains tax is relatively high and there may be little real gain from which to pay the tax. It also tends to discourage investment since the asset cannot be

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1/ The 45 percent corporate tax rate applies to capital gains on assets held less than 4 years.

further depreciated under the present system, while it might be possible in many cases to further write off the remaining useful life of the asset if a more realistic valuation system applied. There is a need for a reduction of the tax burden on the revaluation of fixed assets.

H. Promoting Manufactured Exports

3.110 Like other developing countries in Indonesia in the past has encouraged import substitution industries more than manufacturing for export. Indonesia's diversified resource base should permit the substantial development of semimanufactured and manufactured exports over the medium and longer term if adequate export incentives and economic policies are adopted by the Government. Extensive and varied forest resources offer an exceptional opportunity for developing a wood products industry to supply domestic needs and foreign markets. The processing of mineral products and foodstuffs, the manufacture of rubber, leather, chemical, petrochemical and other products for export, should also become possible as the domestic industry base expands.

3.111 The Government policy on the promotion of manufactured exports is at an experimental and preliminary stage and a comprehensive, effective export promotion program is lacking. There has been some experimentation by the Foreign Investment Board in providing tax rebates, negotiated on an ad hoc basis, on manufactured exports. However, bureaucratic delays and costs involved in obtaining the rebates have been considerable and have reduced their value to the exporting manufacturer.

3.112 There is considerable evidence available that export incentives (and disincentives) do work, as the examples of Hong Kong, Taiwan and Korea suggest.1/ However, what is required for a successful export promotion policy goes far beyond adjustments in the tax and tariff system, although they are important. An export promotion "package" must be devised after careful consideration of the special conditions of Indonesia's manufacturing sector and potential export markets. Special institutions, such as a strong Export Promotion Center, will probably be required to provide direct government assistance to exports. The "package" of promotional measures might include government export credit and insurance; dissemination of foreign market information; assistance with foreign market surveys and exhibitions abroad; assistance in design, packaging and quality standards; and reform of those elements of the public administration and export procedures which cause delays and increase the administrative cost of exporting.

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1/ See Ian Little, Tibor Scitovsky, Maurice Scott: Industry and Trade in Some Developing Countries, London, 1970, Chapter VII.

3.113 The Government should be assisted to study the establishment of an adequate framework of inducements to export which could serve to stimulate manufactured exports during the 1970's. Since Indonesia's manufactured exports are starting from a low base, there is exceptional scope for increasing exports in the 1970's. There are no grounds for export pessimism if steps towards establishing the proper institutional and policy framework are taken over the next few years.

I. Value of Incentive System to Investors

3.114 The value of the tax and tariff incentives provided under the foreign and domestic investment laws during the early years of plant operation may be considerable. A rough estimate of the incentive effect or subsidy to manufacturing enterprise under the corporate tax holiday, exemption from import duties and taxes and accelerated depreciation allowance can be gathered from the following (actual) example of a $10 million investment in a textile enterprise in Indonesia. (The figures have been rounded and modified somewhat to avoid disclosure of the firm).

Table 3.15

Textile Plant and Investor Subsidy
($ US)

| | | |
|---|---|---|
| 1. | Total investment expenditures: | $10 million |
| | (a) land and buildings | 8 million |
| | (b) machinery, equipment, vehicles | 2 million |
| 2. | Gross profit: | 1 million per annum |
| 3. | Corporate tax holiday of 5 years | |
| 4. | Corporate tax rate of 45% | |
| 5. | Accelerated depreciation (4 years on $10 million) | |
| 6. | Normal depreciation (10 years straight line) | |
| 7. | Average import duties and taxes of 25% on $8 million (dutiable) imports. | |

3.115 Under the above conditions an investment of $10 million in a textile plant would lead to exemption from over $4.3 million in corporate taxes, import duties and sales taxes during the first five years of plant operation. In practice, additional exemptions are normally requested and granted for exemptions from the capital stamp duty as well as dividend, interest and royalty taxes. The accelerated depreciation allowance would commence in the year after the expiration of the tax holiday. During the four years of accelerated depreciation, investment expenditures would be increased by roughly $6 million, considerably reducing post tax holiday profits. Any losses sustained during the period of exemption from corporate tax can be off-set against profit subject to tax after the end of the period of the tax holiday.

3.116 During the first four years of construction and initial operation of the plant, the rate of return on the $10 million investment with exemptions from corporate tax and import duties would be 10 percent. If, however, payment of import duties is spread over the four year period ($500 thousand per year for four years) and corporate taxes were required to be paid, the rate of return would drop to less than 1 percent during the critical initial years. Thus the incentives clearly are extremely valuable to this project.

3.117 The textile project gives a rough indication of the value of the tax and tariff incentives to a potential investor, and suggests that such incentives can provide a strong inducement to invest in Indonesia. They also suggest that in certain cases the incentive system may be excessively generous to investors at the expense of government revenues and domestic producers; the system might be re-examined from this point of view.

## CRITERIA FOR AN EFFECTIVE INCENTIVE SYSTEM

3.118 In broadest terms, the objective of a system of industrial incentives (embracing financial, fiscal, tariff and other direct inducements) is to encourage industrial investment, employment, and output beyond that which would have occurred under a policy of laissez faire. An effective system of incentives to industrialization in an economy like that of Indonesia's, with both publicly and privately-owned manufacturing enterprises, would limit direct government licensing, restrictions and controls over the daily economic affairs of management, and use the price mechanism to induce public and private industrial managers to make decisions based on calculations of profitability.

3.119 In order for a system of specific incentives to be effective, the general investment climate must be favorable, which implies the existence of a reasonable degree of political and economic stability as a general framework within which the incentives can operate. If there is political instability, an anti-business bias, rapid inflation, labor unrest, import and other controls and a threat of nationalization, as existed under the Sukarno regime, specific tax and tariff disincentives are insufficiently powerful to overrule these general disincentives and cannot be expected to promote industrial development alone. However, even with a favorable climate for domestic and foreign investment, the

effectiveness of specific incentives should not be exaggerated. The Government should re-examine the obstacles to increased domestic and foreign investment in manufacturing, in order to decide which incentives effectively encourage investment and which should be reduced or eliminated.

3.120 The incentive system must influence prices in such a way that the right industries are given sufficient encouragement so that a more broadly based, competitive national industry is established in Indonesia over the next few decades. There is, of course, no single "most effective" incentive system that is valid for all countries and times. Incentives must be established on an empirical basis and adapted to the actual conditions and needs of the manufacturing sector of the particular country in question; duly taking into account any undesirable side effects. There must also be a degree of consistency between the incentive system and the Government's own industrial development strategy and priorities, which implies that the latter are specified in an operationally useful way.

3.121 In general, Indonesia's industrial incentives have helped to encourage foreign and domestic investment in manufacturing in recent years. Direct controls and restrictions have been broadly eliminated, and a smooth transition effected to an open economy. Industrial investment has benefited greatly from the favorable climate for foreign investment and private initiative established by the Government, and reforms are planned or underway to modify the financial, tax and tariff systems, and to provide services that will tend to promote a more efficient industrialization. However, the present incentive system should be re-examined and modified in new directions to offset, at least partially, the inherent biases against manufactured exports, industrial employment, light industry, and to correct other aspects of the system which, by raising costs, discourage foreign investment and local entrepreneurship. Indonesia would benefit from replacement of the present restrictive system of industrial licensing and multiple official approvals required by various levels of government by a simplified, centralized system which would include investor registration, and more automatic approvals, and elimination of non-essential applications and tax reporting.

3.122 The cost to the economy of a liberalized system of entry for foreign and domestic investors would likely be small in the event of overinvestment or other investor mistakes. Simpler, centralized government procedures and more automatic approvals, once specified conditions are met, would reduce bureaucratic delays, arbitrary official decisions, and increase industrial efficiency. On the other hand, in cases where it is clear that the local market cannot support more than one factory to produce a particular commodity, only one plant should be encouraged and monopolistic practices avoided or minimized by permitting import competition. Although imports are not licensed in Indonesia, the administrative regulation of imports under the investment laws produces results similar to that of an import licensing system. Customs Department decisions on permitting imports of tax-exempt goods often involve

delays of many weeks, or even months, in obtaining essential materials, components, parts, and spares. The manufacturer must insure against these delays by either holding an excessive inventory of these inputs with attendant costs or suffering production slow downs, lower capacity utilization, wasteful use of capital, and lower income.

3.123 While requiring more official judgment and running the risk of abuse, the incentive system should be made more flexible and effective by making greater distinctions between industry sectors, production scale and products, foreign and domestic investors, import substitution, and export-oriented industries to be stimulated or discouraged. The aim should be to design the incentives to alter the industrial mix (for example, encouraging machine industries, wood and mineral-based industries); to increase and diversify manufactured exports, to more effectively employ local resources (particularly labor), and to achieve a better income distribution resulting from higher employment.

3.124 In general, experience seems to indicate that incentive systems tend to be crude policy instruments and are more effective in increasing the amount than in determining the precise direction of industrial investment. It is also difficult to anticipate unwanted side effects which accompany any attempt to guide investment through the price mechanism, including government revenue losses from excessive generosity in granting tax and tariff exemptions. Experience in the less developed countries[1/] indicate that there is often limited scope for an investment system, even broadly conceived and well-administered, to achieve certain government industrial development objectives. The direct and indirect employment generated by industrial expansion, induced by special incentives, typically is small or negligible in many developing countries, for example. In Indonesia the exceptionally small share of manufacturing in GNP (8 - 10%) insures that a substantial impact on employment cannot be expected from industrial growth, however effective the incentive system might be in encouraging labor-intensive methods and industry sectors.

3.125 The industrial development objectives and priorities of the Government are set forth in the Foreign and Domestic Investment Laws, Ministry of Industry documents and in the Repelita. They provide general guidance on the broad industry categories (e.g. domestic resource-based industries, basic and textile industries) and types of industries (e.g. earn or save foreign exchange, create substantial employment) to be promoted by the incentive system. However, these broad priorities are too general to be operationally useful to government officials responsible for deciding which specific products or

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1/ See George Lent, Tax Incentives for the Promotion of Industrial Employment in Developing Countries, IMF Fiscal Department document, January 13, 1971.

product lines are appropriate for Indonesia and deserve special fiscal and other incentives. A more specific, less aggregated set of industrial priorities (based on preinvestment studies) is required to provide more discriminating guidance for policy-makers in granting incentives.

RECOMMENDATIONS FOR IMPROVING THE INCENTIVE SYSTEM

3.126 The incentive system introduced since 1967 has undoubtedly helped to encourage the flow of foreign and domestic investment into the backward Indonesian manufacturing sector, especially since 1969. However, the undesirable side effects, biases and burdensome economic costs of the incentive system itself have become increasingly apparent. The major problems and gaps in the incentive system and the way in which it is administered should be re-examined and the necessary changes introduced into the system. An appropriate mix of policies and institutional arrangements must be established in order to insure appropriate and efficient incentives for industrial development in the 1970's. The following important programs and measures appear to be required:

(a) Special assistance is needed to broaden the base of industrial development in light industries and strengthen locally-owned enterprises to withstand competition from imports and foreign investors. The following measures will be required: (i) a program of prefeasibility and market studies to attract investment; (ii) technical assistance to establish an industrial project evaluation and studies unit in the Ministry of Industry as a means of upgrading the analytical and conceptual skills there; (iii) establishment and wide distribution amongst potential investors of a list of priority products and product lines which the Government wants to encourage; (iv) expansion of investment promotion activities, with a re-examination of tax, tariff, and other incentives to differentiate and sharpen the impact of the incentives; (v) special financial, marketing and technical assistance to new and expanding enterprises during the early operational stage; (vi) special financial incentives for smaller scale industries, including favorable loan terms and conditions of eligibility, possible direct equity participation, and investment insurance.

(b) Re-examination of the present licensing system for investment is required since this system often leads to arbitrary decisions and other abuses, discourages some new investment due to the costs of bureaucratic delays; and contains an implicit or explicit understanding of future official protection from competitive pressure. There is a need to re-examine this system and consider replacing it by a system of free access upon registration, which would eliminate the automatic official presumption in favor of granting tax holidays, import duty exemption and other incentives and the implicit commitment of the Government to shield local enterprise from competition.

(c) There is a need to reconsider the administrative, institutional and procedural aspects of the present incentive system. The

present cumbersome system of obtaining investment licenses, tax clearances, duty exemptions, locating land and gaining title, securing permits to erect and operate a factory results in heavy economic costs, discourages capital formation and private initiative, and discriminates against small and medium scale industry. Technical assistance should be provided to undertake an examination of the policies, rules, regulations, licenses, procedures, and other controls and institutional arrangements affecting foreign and domestic investment in order to estimate the economic costs involved and recommend reforms. There is an urgent need for a central authority not only to provide information and assistance to all investors but with the power to negotiate the necessary licenses and permits. Whenever possible automatic approval should be granted to investors that have met specified conditions and multiple approvals for the same thing should be eliminated.

(d) It appears desirable to reconsider the problem of "legal" and "illegal" smuggling with the aim of instituting practical reforms and measures to reduce, if not eliminate, the serious competitive impact on finished consumer goods industries. "Legal" smuggling or evasion of import duties results from underinvoicing, underassessing the duty owed, and misclassifying goods to qualify for lower duties and mainly occurs in ports and harbors with the active collusion of customs officials. "Illegal" smuggling avoids passing goods through the customs at all; they enter Indonesia in a clandestine manner in sparsely settled islands or places and generally are transhipped to populated regions where they are sold. A set of measures will probably be required to combat smuggling on a wide front: (i) downward revision of high tariffs, especially on the principle smuggled goods, to reduce the incentive to evade duties; (ii) strengthen the customs administration in ports and harbors; increase the penalties attached to smuggling and official collusion; and provide generous rewards to informers; (iii) increase investment in coastal patrol craft and deploy them more efficiently (iv) joint cooperation in coastal patrols to control illegal trade with Malaya, Singapore and the Philippines.

(e) The reduction and simplification of import duties and taxes now under discussion in the Ministry of Finance seems to be generally in the right direction; however, an attempt should be made to estimate the rates of "effective protection" in order to provide the basis for a more effective adjustment of the tariff code to avoid over or underprotection of value-added.

(f) Some easing of the tax burden on the revaluation of fixed assets is probably desirable in order to improve debt-equity positions, encourage joint venture arrangements and improve the incentive to invest. Some of the alternatives to be considered include: a deferred tax payment; a percentage-of-gain basis of valuation; and offsets of tax against increased depreciation allowances.

(g) There is a need to promote manufactured exports through a program which includes economic as well as noneconomic incentives and

assistance to exporters. A system of rebates of import duties and sales taxes (domestic and import) should be examined in order to offset duties paid on intermediate goods embodied in exports and sales taxes embodied in the price of such exports. Consideration should also be given to export subsidies. Initially, to simplify administration, it would probably be preferable to establish a flat percent subsidy of export value. However, a broader study of the framework of financial, economic, and noneconomic inducements (including related institutional arrangements) is required to establish the most effective set of measures the Government might adopt. Technical assistance could be provided to undertake such a study, including the feasibility of duty-free export areas and reduction of the bureaucratic costs of exporting.

(h) In view of the growing concentration of industry and population in Djakarta and Java generally, consideration should be given to establishing an industrial location policy aimed at creating new and strengthening incipient resource-based growth poles outside of Java, such as a wood products industry in Kalimantan. The present incentive system, overly centralized in Djakarta from a regional locational point of view, is incapable of counteracting the powerful historical and economic factors attracting industrial investment to the Djakarta region. Inter-island and international shipping costs, especially from the larger islands, should be examined to ascertain their impact on private location decisions.

(i) In spite of Government concern over the serious urban unemployment in Indonesia, the present incentive system appears biased against employment-creation. Duty-free imports of capital goods, high depreciation allowances, severe restrictions on discharging employees after 90 days of service and other labor legislation and financial arrangements encourage labor-saving investment. This aspect of the incentive system requires further analysis.

(j) There is a need to strengthen the weak and inadequate system of industry planning, project evaluation, feasibility studymaking and collection of essential industrial planning data within the Ministry of Industry and outside. A consideration should be given to establishing more specific operational industrial investment priorities (including a positive list of products which are eligible for investment) to guide investors; to identify specific industry investment opportunities through prefeasibility and market studies; and to bring this information to the attention of potential domestic and foreign investors. This could be done in the Ministry of Industry or some related organization.

(k) There is evidence that the value of the incentive system, in terms of tangible benefits in the form of tax and tariff exemptions, tax holidays, loss carry-overs and accelerated depreciation and other allowances, is considerable and exercises a considerable attraction for new investment. It may, however, be excessively generous to some investors and should be re-examined to avoid unnecessarily high benefits to investors and undue Government revenue losses.

## List of Tables

## STATISTICAL APPENDIX

Table 3.16

## SCHEDULE OF NORMAL DEPRECIATION OF CAPITAL EXPENDITURES

A. No depreciation is allowed for expenditures made by whatever body for:

1. Luxurious furniture and fittings.
   (Luxurious furniture and fittings, which with due regard to their function in the enterprise concerned, are considered as luxurious items by the Director General of Taxes)
2. Rest-house buildings.

B. Depreciation is allowed for expenses incurred on fixed assets and for operating expenses covering several years according to the following schedule:

Depreciation items

| | |
|---|---|
| 1. a. Building -- not being residential houses or rest-houses -- for business engaged in agriculture, horticulture, fishery, cattle-breeding, mining, industry, transportation and other productive activities to be specified by the Minister of Revenues: | |
| 1. Permanent building ..... | 15 - 40 |
| 2. Semi - permanent building ..... | 10 - 15 |
| 3. Wooden buildings etc. ..... | 8 - 12 |
| b. Building -- not being residential houses or rest-houses -- for business engaged in the fields of operation other than those mentioned under a : | |
| 1. Permanent buildings ..... | 40 - 50 |
| 2. Semi - permanent buildings ..... | 15 - 40 |
| 3. Wooden buildings etc. ..... | 10 - 15 |
| c. Buildings for residential purposes | |
| 1. Permanent buildings ..... | 50 - 75 |
| 2. Semi - permanent buildings ..... | 20 - 40 |
| 3. Wooden buildings etc. ..... | 10 - 15 |
| 2. Non - luxury furniture and fittings, office machines ..... | 5 - 10 |
| 3. Land transportation equipment -- not being sedan cars nor luxurious station wagons -- including tractors etc. ..... | 5 - 10 |
| 4. Motor vehicles -- such as sedan cars and luxurious station wagons used by bodies: | |

| | |
|---|---|
| a. operating in agriculture, horticulture, fishery, cattle-breeding, mining, industry, transportation and other productive fields to be specified by the Minister of Finance for the performance of work of their staff of the first, second, and third level .... | 5 - 10 |
| b. operating in fields other than those mentioned under a for performance of work of their staff of the first level ..... | 5 - 10 |
| 5. Motor vehicles, like sedans and luxurious stationwagons for taxi - undertakings entirely used for public transportation .... | 5 - 10 |
| 6. Water/transportation, equipment, including docks, etc. ..... | 10 - 12 |
| 7. Air transportation equipment ..... | 7 - 10 |
| a. Exploitation for several years, if the period of use can be determined accurately | during useful period |
| b. Exploitation for several years if the period of use cannot be determined accurately | 5 - 10 |
| C. Expenditures incurred on equipment not mentioned under (B) above for business engaged in the fields of: | |
| 1. Agriculture, horticulture, fishery and cattle-breeding ..... | 16 - 25 |
| 2. Industry, mining and transportation ..... | 8 - 12 |

Source: Ministry of Finance, May, 1970

Table 3.17 Accelerated Depreciation of Capital Expenditures (Four Years)

| Capital Expenditures Eligible for Accelerated Depreciation. | Accelerated Depreciation |
|---|---|
| 1. Infrastructure expenditures (roads and bridges, electrical installations, telephone and telecommunication installations) | 25% |
| 2. Permanent goods (land improvements, buildings, employees' housing) | 10% |
| 3. Directly productive machinery, tools and equipment. | 25% |

Note: Companies enjoying the benefit of a tax holiday under Domestic and Foreign Investment Laws must start their four-year depreciation period in the year after the expiration of the tax holiday. During tax holiday normal depreciation is the rule. Firms not enjoying tax holidays may choose in which of the four years to take the accelerated depreciation.

Source: Decree of Minister of Finance No. KEP 630/MK/II/10/70 October 9, 1970.

Table 3.18 Investment Allowance for Additional Investments by Existing Enterprises

| Allowance | |
|---|---|
| 20% of actual investment spread over four years starting with year of the investment | |
| Year 1 | 5% |
| Year 2 | 5% |
| Year 3 | 5% |
| Year 4 | 5% |
| Total | 20% |

Table 3.19 Interest, Dividend, and Royalty Tax

| Coverage | Tax Rate |
|---|---|
| Tax levied on payment of interest, dividends or royalties (withholding tax paid by person, government entity or company making the taxable payment) | 20% |

Table 3.20 Corporate Tax Rate Schedule and Tax Exemptions

| I. Corporate Profits | (%) Tax Rate |
|---|---|
| Up to and including 5 million Rupiah | 20% |
| Over 5 million Rupiah | 45% |

| II. Tax Exemptions | Length of Time |
|---|---|
| Dividend Exemption | 2 years |
| Tax Holidays<br>Basic exemption for new investments (domestic and foreign) in priority areas. | 2 years |
| Additional Exemptions<br>for projects that: | |
| (a) are substantial foreign exchange earners or savers. | 1 year |
| (b) are established outside of Java. | 1 year |
| (c) require special infrastructure investments or extraordinary risk. | 1 year |
| (d) coincide with other special priority objectives of the Government. | 1 year |
| | 6 years (max.) |

Table 3.21 Import Sales Tax Schedule (PPN)

| Import Duties | PPN | Kind of Goods |
|---|---|---|
| 0% | 0% | Essential Goods |
| 5, 10, 20% | 5% | Semiessential Goods |
| 30, 40% | 10% | Ordinary Goods |
| 50,70, and 100% | 20% | Ordinary Goods |
| | 50% | Luxury Goods 1/ |

1/ Luxury articles
such as console radios,
T.V. sets of 23" tube size and larger,
kitchen ovens, electrical washing machines, and
automobiles with f.o.b. value of U.S. $2,000
and above

Note: The import sales tax must be calculated on the total of the c.i.f. value of the imported goods, import duty, surtax and retribution (profit margin estimate).

Source: Ministry of Finance, Customs Department, May 1, 1971.

Table 3.22

Foreign Investment Projects

Approved Annually By Country

Of Origin and Planned Investment

1967 - 1970

( millions $ ) 1/

| Country of Origin | 1967 | | 1968 | | 1969 | | 1970 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of Projects | Investment Amount | No. of Projects | Investment Amount | No. of Projects | Investment Amount | No. of Projects | Investment Amount | No. of Projects | Investment Amount |
| U. S. A. | 5 | 143.70 | 10 | 14.92 | 14 | 282.66 | 24 | 74.74 | 53 | 516.02 |
| Japan | 2 | 3.00 | 8 | 14.39 | 15 | 102.03 | 28 | 37.20 | 53 | 136.62 |
| Hongkong | 1 | 0.25 | 10 | 12.92 | 9 | 13.58 | 21 | 17.14 | 41 | 43.89 |
| Singapore | - | - | 7 | 10.24 | 8 | 16.68 | 11 | 10.60 | 26 | 37.52 |
| Netherlands | 1 | 0.30 | 8 | 18.83 | 2 | 0.80 | 7 | 12.92 | 18 | 32.85 |
| West Germany | 1 | 0.31 | 4 | 5.33 | 7 | 3.29 | 5 | 10.12 | 17 | 19.85 |
| Philippine | 2 | 4.50 | 1 | 5.00 | 8 | 249.00 | 2 | 3.00 | 13 | 261.50 |
| Malaysia | - | - | 1 | 1.00 | 4 | 14.00 | 13 | 14.64 | 18 | 29.64 |
| France | 3 | 2.50 | 2 | 3.00 | 1 | 5.79 | 1 | 2.10 | 7 | 23.39 |
| United Kingdom | 2 | 2.14 | 3 | 0.55 | 1 | 4.50 | 21 | 21.05 | 27 | 26.24 |
| Swiss | - | - | 2 | 0.99 | 1 | 0.33 | 8 | 14.90 | 11 | 16.22 |
| Belgium | 1 | 0.24 | 2 | 5.36 | 1 | 0.50 | 10 | 3.63 | 14 | 9.73 |
| Australia | 2 | 3.54 | 1 | 0.10 | 3 | 0.91 | 4 | 7.90 | 10 | 12.45 |
| Canada | - | - | 3 | 77.66 | - | - | - | - | 3 | 77.66 |
| Norway | - | - | 3 | 4.23 | - | - | - | - | 3 | 4.23 |
| Denmark | 1 | 1.00 | 1 | 1.50 | 1 | 1.50 | 1 | 1.00 | 4 | 5.00 |
| Thailand | - | - | - | - | 5 | 4.25 | 2 | 2.85 | 7 | 7.10 |
| Panama | 1 | 9.00 | - | - | 1 | 1.50 | 1 | 1.50 | 3 | 12.00 |
| South Korea | - | - | 1 | 48.50 | - | - | 3 | 4.90 | 4 | 53.40 |
| Sweden | - | - | - | - | 1 | 1.20 | - | - | 1 | 1.20 |
| Liberia | - | - | - | - | 1 | 1.00 | - | - | 1 | 1.00 |
| India | - | - | - | - | - | - | 1 | 0.65 | 1 | 0.65 |
| | 22 | 170.38 | 66 | 224.02 | 84 | 704.52 | 163 | 240.93 | 335 | 1,339.85 |

Source: Foreign Investment Board

1/ Converted from foreign currencies at going rate

Table 3.23

Foreign Investment Projects Approved

By Country of Origin and Planned Investment, January - March, 1971

( thousands of U.S.$ )

| Country of Origin | No. of Projects | Amount 1/ |
|---|---|---|
| U.S.A. | 3 | 6,630 |
| Japan | 7 | 76,814 |
| Hongkong | 5 | 34,100 |
| Singapore | 1 | 15,000 |
| Netherlands | 2 | 1,350 |
| West Germany | | |
| Philippine | | |
| Malaysia | | |
| France | 1 | 2,473 |
| United Kingdom | | |
| Switzerland | | |
| Belgium | | |
| Australia | 2 | 1,150 |
| Canada | | |
| Norway | | |
| Denmark | | |
| Thailand | | |
| Panama | | |
| South Korea | | |
| Sweden | | |
| Liberia | | |
| Irdia | | |
| Bahama | 1 | 400 |
| Total | 22 | 137,917 |

Source: Foreign Investment Board
1/ Includes Indonesian share in joint enterprises.

Table 3.24

Foreign Investment Projects Approved

Planned Investment By Sector, 1967 - 1970

( millions U.S.$ ) 1/

| Sector | 1967 | | 1968 | | 1969 | | 1970 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of Projects | Investment Amount | No. of Projects | Investment Amount | No. of Projects | Investment Amount | No. of Projects | Investment Amount | No. of Projects | Investment Amount |
| Agriculture | - | - | 2 | 8.19 | 2 | 2.00 | 39 | 52.50 | 43 | 62.69 |
| Forestry | 4 | 5.50 | 9 | 67.61 | 22 | 279.75 | 14 | 32.00 | 49 | 384.86 |
| Fishery | 3 | 4.50 | 2 | 3.00 | 1 | 0.50 | 3 | 5.36 | 9 | 13.36 |
| Mining | 1 | 122.50 | 2 | 83.50 | 5 | 329.21 | 1 | 0.30 | 9 | 534.51 |
| Industry | 10 | 28.76 | 30 | 38.83 | 38 | 70.68 | 68 | 105.60 | 146 | 243.87 |
| Pharmaceuticals | 1 | 1.00 | 7 | 6.56 | 2 | 5.50 | 19 | 21.67 | 29 | 34.73 |
| Public works | - | - | 3 | 3.10 | - | - | 8 | 4.68 | 11 | 7.78 |
| Housing/Real-Estate | 1 | 2.00 | 3 | 5.60 | 5 | 6.94 | 8 | 14.70 | 17 | 29.24 |
| Communication transportation | 1 | 6.00 | 2 | 0.16 | 3 | 1.42 | 1 | 0.50 | 7 | 8.08 |
| Trade/Crumb-rubber | 1 | 0.20 | 5 | 3.40 | 2 | 0.63 | 2 | 3.62 | 10 | 7.85 |
| Hotel/Tourism | - | - | 1 | 2.60 | 4 | 7.89 | - | - | 5 | 10.49 |
| | 22 | 170.46 | 66 | 223.55 | 84 | 704.52 | 163 | 240.93 | 335 | 1,339.46 |

Source: Foreign Investment Board

1/ Converted from foreign currencies at the going rate

Table 3.25

Foreign Investment Projects Approved

By Sector, January - March, 1971

( thousands of U.S.$ )

| No. of Projects | Sector | January | February | March | Total |
|---|---|---|---|---|---|
| | Agriculture | | | | |
| | Forestry | | | | |
| | Fishing | | | | |
| | Mining and Quarrying | | | | |
| 18 | Manufacturing | 23,449 | 64,238 | 1,100 | 89,387 |
| 2 | Food | 800 | 500 | | 1,300 |
| 6 | Textile and Leather | 17,049 | 57,265 | 300 | 74,614 |
| 3 | Pharmaceuticals | 1,600 | 2,473 | | 4,073 |
| 2 | Printing | 750 | | 550 | 1,300 |
| 1 | Chemical Products | | | 250 | 250 |
| 1 | Nonmetalic minerals | 1,750 | | | 1,750 |
| 1 | Steel | | 4,000 | | 4,000 |
| 1 | Metal Products | 1,500 | | | 1,500 |
| 1 | Other | | 600 | | 600 |
| 1 | Construction | | 15,000 | | 15,000 |
| 1 | Hotels | | | 32,250 | 32,250 |
| 2 | Transportation & Communication Services | | 400 | 880 | 1,280 |
| Total 22 | | 24,374 | 80,238 | 34,230 | 137,917 |

Source: Foreign Investment Board and Bank Indonesia

Table 3.26

Foreign Investment Project

Approvals and Disbursements, 1967 - 1970

| Field of Activity | Approved Projects | | Disbursements | |
|---|---|---|---|---|
| | Number of Projects | Proposed Investment (Mn.$) | Number of Projects | Invested Capital (Mn.$) |
| Mining | 9 | 463.5 | 8 | 11.7 |
| Forestry | 49 | 385.3 | 42 | 43.0 |
| Plantation | 40 | 62.6 | 8 | 2.3 |
| Fishery | 10 | 14.4 | 8 | 7.2 |
| Transportation and communication | 8 | 10.7 | 7 | 6.0 |
| Tourism | 10 | 18.2 | 10 | 8.6 |
| Manufacturing | 197 | 305.8 | 106 | 80.7 |
| Processing of agricultural products | (38) | (55.2) | (18) | (12.0) |
| Electrical equipment and appliances | (13) | (29.1) | ( 6) | (12.1) |
| Pharmaceutical | (31) | (36.7) | (16) | ( 6.9) |
| Light iron and steel products | (22) | (26.0) | (11) | ( 5.4) |
| Chemical | (12) | ( 8.4) | (10) | ( 3.7) |
| Textile | (12) | (53.9) | ( 8) | (11.2) |
| Miscellaneous manufacturing | (69) | (96.5) | (37) | (29.4) |
| Miscellaneous | 18 | 17.8 | 8 | 1.9 |
| Total | 341 | 1,278.3 | 197 | 161.9 |

Note: Excludes investments in the petroleum and banking sectors. Data covers investments approved by the Foreign Investment Board from 1967 to December 31, 1970. Invested capital is the recorded disbursement for the same projects through December 31, 1970, based upon customs data and conversion of foreign claims under the DICS.

Source: Foreign Investment Board and Bank Indonesia

Table 3.27

Foreign Investment Disbursements

As a Percentage of Planned Investment

| Sector | Disbursements as Percentage of Planned Investment |
|---|---|
| Mining | 10 |
| Manufacturing | 58 |
| Forestry | 44 |
| Fishery | 63 |
| Transport/Communication | 72 |
| Trade/Crumb Rubber | 88 |
| Real Estate | 43 |
| Infrastructure a/ | 4 |
| Hotels | 162 |
| Plantation/Agribusiness | 39 |

Source: The Management Institute, University of Indonesia. Data as of December 31, 1970. Survey of 203 enterprises.

a/ Housing, dredging, etc.

Table 3.28

Estimated Future Manpower Needs for Foreign Investment Projects in Operation as of December 31, 1970

| | Estimated Number of Employees Required | | | | | |
|---|---|---|---|---|---|---|
| Skills Required | 1970 | 1971-1972 | 1973-1975 | 1976-1980 | 1981-1985 | Total |
| Skilled | 315 | 1,736 | 1,223 | 306 | 193 | 3,773 |
| Unskilled | 419 | 2,902 | 1,707 | 749 | 250 | 6,027 |
| Supervisory | 29 | 183 | 62 | 31 | 25 | 330 |
| Managerial | 24 | 107 | 37 | 18 | 5 | 191 |
| Technical | 119 | 438 | 312 | 172 | 158 | 1,199 |
| Others | 375 | 327 | 1 | 1 | 1 | 705 |
| | 1,281 | 5,693 | 3,342 | 1,277 | 632 | 12,225 |

Source: Management Institute Survey, University of Indonesia, April, 1971. Survey of 203 Enterprises in various sectors.

Table 3.29

Survey of Planned and Realized Foreign Investment

Including Fixed and Working Capital Expenditures

As of December 31, 1970

( in thousands U.S. $ )

| | | | Realized Investment | | |
|---|---|---|---|---|---|
| Sector | No. of Projects | Planned Investment | Fixed Capital | Working Capital | Total |
| Mining | 8 | 368,500 | 3,820 | 7,721 | 37,541 a/ |
| Manufacturing | 113 | 159,900 | 67,741 | 23,322 | 91,661 a/ |
| Forestry | 39 | 139,400 | 39,174 | 19,782 | 61,419 a/ |
| Fishery | 7 | 9,606 | 4,534 | 1,538 | 6,072 |
| Transportation/ communication | 6 | 11,749 | 15,265 | 961 | 16,226 a/ |
| Trade/Crumb Rubber | 8 | 4,030 | 2,566 | 995 | 3,561 |
| Real Estate | 12 | 21,847 | 7,555 | 1,848 | 9,403 |
| Infrastructure (Housing, Dredging, etc.) | 4 | 8,790 | 260 | 90 | 350 |
| Hotels | 1 | 400 | 650 | - | 650 |
| Plantation/ Agribusiness | 5 | 20,750 | 6,964 | 1,163 | 8,127 |
| Total | 203 | 744,972 | 148,529 | 57,420 | 235,010 |

Source: Questionnaire Survey, Lambarga Management Institute, University of Indonesia, April, 1971

a/ Does not total due to incomplete data on disbursements on fixed and working capital

Table 3.30

Survey of Labor Employed on

Foreign Investment Projects As of December 31, 1970

| Sector | Labor Employed | | |
|---|---|---|---|
| | Construction | Operations | Total |
| Mining | 2,074 | | 2,074 |
| Manufacturing | 2,277 | 18,816 | 21,093 |
| Forestry | 1,094 | 12,025 | 13,119 |
| Fishery | 160 | 824 | 984 |
| Transport/Communication | 11 | 346 | 357 |
| Trade/Crumb Rubber | | 1,775 | 1,775 |
| Real Estate | 830 | 1,366 | 2,196 |
| Infrastructure a/ | | 1,023 | 1,023 |
| Hotels | | 434 | 434 |
| Plantation/Agribusiness | 300 | 24,772 | 25,072 |
| Total | 6,746 | 61,381 | 68,127 |

Source: Management Institute Survey, University of Indonesia, April, 1971. Data as of December 31, 1970 from survey of 203 enterprises.

a/ Housing, dredging, etc.

(capital/labor ratio in manufacturing = $4,344 per employee.)

Table 3.31 Domestic Investments Classified By Payout Period and Capitalization

| Sectors | Gestation Period | | | Sources of Capitalization | | |
|---|---|---|---|---|---|---|
| | Short-term (1 year) | Medium-term (2-5 years) | Long-term (6-15 years) | Natural-born Citizens | Natural-ized Citizens | Mixed Origins |
| Agric./Estates | 57 | 16 | 2 | 35 | 29 | 11 |
| Forestry | 34 | 7 | - | 25 | 11 | 5 |
| Fishery | 6 | - | - | 4 | 1 | 1 |
| Mining/Mfg. | 225 | 55 | - | 89 | 176 | 45 |
| Transport/Tourism | 30 | 21 | 1 | 29 | 13 | 10 |
| Others | 3 | 1 | - | 4 | - | - |
| Total No. of Projects | 385 | 100 | 3 | 186 | 230 | 72 |

Source: Domestic Investment Board

# CHAPTER IV

## FINANCING INDUSTRIAL INVESTMENT

4.1 The availability of credit and finance for fixed investment and working capital has a significant effect on the success of an industrial development program. The cost of credit, the terms on which it can be obtained partly determine the type and extent of investment in industry that will be undertaken. In this sense the conditions surrounding the availability of finance can be considered a part of the policy framework of incentives that is discussed in Chapter III. This chapter covers the conditions and terms of supply of credit, and the factors affecting demand. This involves a brief discussion of the structure of the banking system and how the several parts of the system contribute to the supply of credit. A special program to increase the supply of investment funds to industry and other economic sectors is also evaluated.

4.2 In view of the acceleration of industrial development that is recommended in Chapter II of this report, provisions for credit for investment and working capital purposes should be adequate so that finance will not be a constraint. It is not only a problem of the sufficiency of credit in the aggregate but also whether credit facilities and programs are varied enough to meet the different kinds of demands that are likely to occur in the next few years. From the analysis that follows it appears that credit availability is not at present limiting the growth of industrial development, though there are certain gaps in the programs, but in the future the needs will very likely be not only greater in amount but also require a greater range of credit facilities. Recommendations are made for several types of policy development or change that will help adjust to the changing economic environment.

## THE SUPPLY OF CREDIT

### The Structure and Operations of the Banking System

4.3 The principal banking sources of finance for industry consist of the Bank Indonesia (the Central Bank), the State Commercial Banks, the State Development Bank (Bapindo), the group of national private banks, and branches of foreign banks. All of these banks provide both short-term and investment credit for industry; however, the groups of banks within the system differ from one another in their command over resources, their position and importance in the market, and their ability to provide particular kinds of credit (specifically investment credit). These differences among the groups of banks have certain effects on the supply of credit that are described below:

4.4 At the present time, there are five State commercial banks which have about 600 offices in the country, about half of which are concentrated in the Djakarta area. About half of the total branches

are those of the Bank Negara Indonesia 1946 (BNI). Initially the five State commercial banks were intended to concentrate their activities in certain functional areas; for example, the BNI has been regarded as the prime industrial bank; the Bank Bumi-Daya (BBD) has concentrated on estate agriculture, and the Bank Dagang Negara (BDN) has emphasized mining. Bank Rakjat Indonesia (BRI) has specialized in rural credit and Bank Ekspor Impor in financing export products. Although there is still some degree of specialization in the loan and credit activities of the State banks, there is more and more evidence that these specializations are becoming blurred and that the degree of competition among these banks has been increasing. Customers in one economic sector no longer have as strong ties to a particular bank as they once did. This seems particularly true in loan activities affecting manufacturing industry, including production for export. It seems likely that this process will continue and that each of the banks will more and more reach into economic areas that were formally the main province of another bank. Such a blurring of specialization is probably all to the good, since it means that there will be more than one bank to whom a new customer in industry might apply for credit. One official of a State commercial bank said that competition for deposits and loans was indeed keen and seemed likely to continue so. There is still a close relationship between individual banks and many of their old customers, but as business expands the ties will not be so close as they may have been in the past. This also suggests the possibility that the State banks may undergo change in the future, possible in the direction of merger or consolidation of some of the banks in the group. Such a development might occur if there are advantages in having larger total assets in a single institution.

4.5 The group of national private banks is comprised of about 120 banks with some 250 offices. As the name implies these are private banks in which the State has no ownership interest. Three of the largest of the private banks are permitted to engage in foreign exchange transactions and together with the State banks they comprise a group called the foreign exchange banks. On the whole the private banks are small in terms of their total assets, limited as to the kind of banking business that they normally undertake, and they have had a somewhat checkered career in the banking system in Indonesia. There have been a number of cases of failures with a loss of deposits and assets; embezzlements and other illegal practices have marred the reputation of these banks as a group and their experience and competence as bankers has often times been brought into question. As a result, their relative position in the banking system has declined particularly in comparison to the growth of the State banks and the foreign banks. Yet they have a potentially important role to play in the future in the provision of banking facilities for industry and other sectors.

4.6 Although there have been branches of foreign banks for a number of years, some of the branches have been established in the

last few years. There are eleven such banks and they are confined to the Djakarta area. Several of these branches have been associated with banks in Singapore and Hong Kong and have been particularly important in the repatriation of funds that originally left the country in the early 1960s. The volume of business of these banks has grown very rapidly in the last few years.

4.7 In addition to the banks just mentioned there are others of lesser current importance to industrial finance. The local or regional development banks, about twenty in number, are located in each province. Originally it was intended that they undertake development finance of local industry and agriculture, but they now function primarily as the banking agent handling the receipts and disbursements of local government. Their development banking activities are minimal, as statistics presented later clearly show. But this may be changed in the future. The needs and opportunities for development finance for industry will increase and the local development banks should be encouraged by the central bank and the government to re-enter the field. Encouragement could take the form of technical assistance in creating competence in project evaluation plus making credits available to these banks, as is now done for the state commercial banks, for investment and working capital for local industry. Such a program could be one significant element in stimulating the geographical dispersion of industry.

4.8 There is a private development bank that has been in operation for some years and a new one with foreign participation was organized recently. The former bank has had only indifferent success. During the period of inflation the bank barely survived, since all investment in industry was at a very low level. It is possible that in the future private development banks may grow and become a significant part of the credit system, but they are not significant elements now. A new private finance company is also in process of formulation, though it has taken a rather long time. It will concentrate on supplying credit to small or medium-sized businesses that are now very poorly serviced. In addition to supplying credit, this company will also provide technical assistance; this is a very necessary ingredient to the success of small business. Without it the supply of credit alone is probably insufficient to guarantee survival of the new firms. There are also plans to have the private finance company make direct equity investments and undertake underwriting of security issues, but these activities are probably far in the future. The immediate need is to get the finance company organized and in operation. It has been too long delayed, and some action should be taken to get it moving.

4.9 There are other kinds of banks and financial institutions in Indonesia such as village and paddy banks, insurance companies, state and private savings banks and the like, but none of them are of importance for industrial finance, though they have other roles.

There is one additional element that deserves mention and that is the unorganized money market located mainly in Glodok. These are the street money lenders. Very little is known about this market. It provides short-term high interest rate loans to individuals, which is traditional, but it may also provide funds to firms. In Korea business firms regularly go to the unorganized market for funds, but this apparently is not so true in Indonesia. To some extent the private banks provide funds at interest rates higher than can be obtained from the state banks for loans that are risky or that do not qualify at the state banks. But it is possible that some firms do utilize the unorganized market at certain times. More information is needed to determine the extent and importance of credit transactions outside the banking system.

4.10 Total bank credit has been increasing rapidly in the past few years and this has been accompanied by an increase in the proportion going to the private sector and a change in the relative shares supplied by the State banks. Summary figures on bank credit by banking sources, division between the public and the private sector, and economic sector use are shown in Table 4.1. In the period from the end of 1968 to the end of 1970 total bank credit almost tripled. The central bank still supplies more than half of the total (a great part of it in the form of liquidity credits to the State banks) but this proportion has declined. The largest gain was by the state commercial banks which now account for over 1/3 of the total (excluding the aforementioned liquidity credits). The national private banks and the foreign banks together account for approximately 8 percent. In this period there was also a shift in the supply of credit in favor of the private sector. At the end of 1968 the public sector received about 2/3 of the total, but, by the end of 1970 the private sector was receiving over half of the total credit. There has been very little change in the general sector allocations. Production, which denotes loans made to industry, agriculture, and similar commodity producing sectors had slightly under half of the total and the sector called "other", which covers commerce and trade, had about the same. Slightly less than 8 percent was to export finance.

4.11 Some details on the structure and operation of the supply of credit are given in tables 4.2 and 4.3. In the former table Bank Indonesia credits to the banking system are accounted as part of the State bank total. The private banks are broken down to show separate figures for the private commercial banks, the local development banks and the foreign banks. Based on these figures the State banks supplied almost 2/3 of the total credit outstanding, a large part of which was represented by the credits from the central bank. Only a nominal amount of central bank credit has been provided to the private banks. There are also differences in the sectoral composition of the loan portfolios of the different

Table 4.1

Total Bank Credit by Source, Sector, and Use *

| | 1968 Rp bill. | 1968 % | 1970 Rp bill | 1970 % | Increase % |
|---|---|---|---|---|---|
| I. Source | | | | | |
| Total | 126.8 | 100.0 | 363.1 | 100.0 | 186 |
| Bank Indonesia | 92.0 | 72.6 | 209.6 | 57.7 | 128 |
| State banks | 26.2 | 20.7 | 123.3 | 34.0 | 371 |
| All private banks | 8.5 | 6.7 | 30.2 | 8.3 | 255 |
| II. Sector | | | | | |
| Public | 81.7 | 64.4 | 157.7 | 43.4 | 93 |
| Private | 45.1 | 35.6 | 205.4 | 56.6 | 355 |
| III. Use | | | | | |
| Production | 55.4 | 43.7 | 168.5 | 46.4 | 204 |
| Export Finance | 10.1 | 8.0 | 28.4 | 7.8 | 181 |
| Other | 61.2 | 48.3 | 166.2 | 45.8 | 172 |

* End of year. Bank Indonesia credits to the banking system included in BI total

Source: Bank Indonesia

Table 4.2

Total Bank Credit by Bank Source and Use, 1970*
(Rp billion)

| | Rp billion | Distribution within Banks (%) |
|---|---|---|
| 1. Bank Indonesia | 96.8 | 100 |
| Production | 19.8 | 20.4 |
| Export | .4 | .4 |
| Other | 76.6 | 79.2 |
| 2. State Banks | 233.6 | 100 |
| Production | 137.2 | 58.7 |
| Export | 26.3 | 11.3 |
| Other | 70.1 | 30.0 |
| 3. Private Commercial Banks | 20.9 | 100 |
| Production | 9.0 | 43.1 |
| Export | 1.4 | 6.7 |
| Other | 10.5 | 50.2 |
| 4. Local Development Banks | 3.6 | 100 |
| Production | .9 | 25.0 |
| Export | .1 | 2.8 |
| Other | 2.6 | 72.2 |
| 5. Foreign Banks | 8.2 | 100 |
| Production | 1.7 | 20.7 |
| Export | .1 | 1.2 |
| Other | 6.4 | 78.1 |
| 6. All Banks | 363.1 | 100 |
| Production | 168.5 | 46.4 |
| Export | 28.4 | 7.8 |
| Other | 166.2 | 45.8 |

* Bank Indonesia credits to banking system are counted in the State Bank and Private Bank totals

Source: Bank Indonesia

bank groups. The State banks have a majority of their loans to industry, agriculture, and the commodity sector whereas the private banks have a majority of their loans to trade and commerce. In part this is a reflection of the affect that the medium term credit program, which is discussed in the next section is almost exclusively the province of the State banks.

4.12 Table 4.3 presents a specific comparison of bank credit outstanding purely in the commercial banks, that is, excluding Bank Indonesia. On this basis the State banks provide over 80 percent of the credit, with the foreign banks providing about 6 percent and the national private commercial banks about 12 percent. It was not so long ago that the national private banks supplied about 20 percent of total credit. Over the past few years they have been losing ground to both the State banks and the foreign banks.

4.13 The relative decline of the private banks is traceable to several elements. As mentioned earlier, their performance and stability has not always been satisfactory. Losses have been incurred by depositors, and there are numerous instances where they were in violation of the requirements with respect to the maintenance of reserves. Also deposits at the State banks have been guaranteed by the central bank and the rise in interest rates paid on their deposits has tended to direct the flow of savings towards the State banks. Finally, lending rates at the State banks are typically lower than those in the private banks. Loans to industry by the State banks are at the commercial rate of 2 to 2½ percent per month, whereas rates at the private banks are above that and at present range upwards to 10 percent per month. For all of these reasons, the State banks and the foreign banks have grown more rapidly than private banks. The latter have essentially become, to some extent, lenders in more risky ventures or those that cannot, for some reason, secure a loan from the State banks. This factor, coupled with the fact that the private banks have not had effective legal means to collect on defaulted or overdue loans has placed these banks in a somewhat precarious or marginal position vis-a-vis the other parts of the banking system. The central bank is now undertaking steps to help correct some of these problems. At the direction of the central bank some State banks are undertaking to help one or more private banks with respect to training and the conduct of their banking operations, but there is a great deal that needs to be done, and it will take some time to accomplish. It is a necessary task, however, since it seems likely that in the future there will be increased demands upon the banking system that cannot be met by the State banks alone. Moreover, since foreign banks are limited to the Djakarta area they cannot be expected to meet needs that arise out of that area.

Table 4.3

Bank Credit by Sources and Use*
(Rp billion unless indicated otherwise)

| | State Banks | Foreign Banks | Other Banks | Total |
|---|---|---|---|---|
| 1. 1968 | | | | |
| Production | 13.4 | - | 2.5 | 15.9 |
| Export | 6.1 | - | .8 | 6.9 |
| Other | 6.7 | 1.1 | 4.2 | 12.0 |
| Total | 26.2 | 1.1 | 7.5 | 35.8 |
| 2. 1970 | | | | |
| Production | 60.5 | 1.6 | 7.3 | 69.4 |
| Export | 16.9 | .1 | 1.2 | 18.2 |
| Other | 45.9 | 6.4 | 9.2 | 61.5 |
| Total | 123.3 | 8.2 | 17.7 | 149.2 |
| 3. Increase, 1968 to 1970(%) | | | | |
| Production | 351 | - | 192 | 336 |
| Export | 177 | - | 50 | 164 |
| Other | 585 | 484 | 119 | 412 |
| Total | 371 | 645 | 136 | 317 |

* Omitting Bank Indonesia and Bank Pembanguanan Daerah

Source: Bank Indonesia.

4.14 Prior to 1969 bank credit was almost solely limited to short-term credit primarily for uses in trade and commerce. Until the economy was relatively stabilized and inflationary pressures were curtailed, there was neither a demand for longer term credit for investment purposes nor any willingness on the part of the banks to make such credit available. Beginning in 1969, however, a special program was instituted to make investment credit available in the economy. The growth of that program is indicated by the figures in table 4.4. Although short term credit is still by far the largest part of the total, as of January 1971 investments credits amounted to about 23 percent of the total. The details and performance of the investment credit program are described in the next section.

4.15 In summary, it appears that the banking system has been expanding credit at a rather rapid rate and the structure of the system is clearly dominated by the State commercial banks. In the future they are likely to continue to expand but it will be desirable to strengthen the capabilities and the role of the national private commercial banks. The program is already underway and should be continued and possibly accelerated. At the same time the large number of national private banks probably cannot be maintained. It will be difficult for all of them to continue to grow, and many of them are of such a small size that their effectiveness is quite limited. There are economies of scale in banking as in industry and in the interests of efficiency some merging of the private banks into a lesser number with a larger average size would probably be in the interest both of the banks themselves and of the country. The steps cannot be accomplished by direction but could be encouraged in various ways by the Government. At the present time there is about one banking office per 130,000 people and while this is adequate at present, over the next five to ten years the commercial banking system will undoubtedly need to expand its facilities and services if other development objectives are to be achieved.

## The Medium Term Credit Program

4.16 This program was started in early 1969 to provide investment credits at favorable interest rates and with longer maturity periods than had formerly been available from the banking system. The purpose was to stimulate investment in priority projects in all sectors in accordance with the development plan. The funds are channeled through the State commercial banks to the private firms. This program has expanded rapidly in total size since its inception and in the process has undergone certain changes in the sectoral allocation of the loans. In the next few years decisions must be made as to the growth in this kind of credit that will be required or desirable, the composition of the sources of funds,

Table 4.4

Distribution of Credit

| End of Year | Short-term Credit Rp bill | Short-term Credit Percent | Investment Credit Rp bill | Investment Credit Percent |
|---|---|---|---|---|
| 1967 | 31.2 | 100 | 0 | 0 |
| 1968 | 126.2 | 99.5 | .6 | .5 |
| 1969 | 238.7 | 96.3 | 9.2 | 3.7 |
| 1970 | 321.8 | 88.8 | 40.4 | 11.2 |
| Jan. 1971 | 331.9 | 76.7 | 43.0 | 23.3 |

Source: Bank Indonesia

the terms on which the credit is extended, and the sectoral emphasis in the program. These decisions are particularly important if the suggestions made earlier in this report for an acceleration of industrial development are accepted. The first two years of the program have been a period of experimentation and learning; the next few years should be a period of maturing of the program and a skillful use of it to accomplish the industrial development objectives.

4.17 The original funds for the investment credits were provided by Bank Indonesia, the budget, and the state banks themselves. The figures below show how the percentage shares of the actual credits outstanding have changed during the past two years.

| | Original | January 1970 | January 1971 |
|---|---|---|---|
| Bank Indonesia | 50 | 65 | 59 |
| Budget | 33 | 25 | 17 |
| State banks | 17 | 10 | 24 |

The central bank continues to supply the majority of the funds in the form of credits to the state banks. The contribution from the budget has been declining and probably will continue to do so with a possible stabilization at some as-yet undetermined level. The share of the state banks, using the funds supplied by the growth in their time deposits, has been growing and is now almost a quarter of the total.

4.18 The budget share is at no interest cost to the state banks and the central bank share carries an interest cost of 4 percent. With the rate on one year time deposits at 24 percent, the interest cost of the funds to the state banks under the original sharing arrangement was about 6 percent, since the state banks have been supplying a larger part of the total. The lending rate for the medium term credits is 12 percent. There is a spread between the costs of the funds and the returns which makes the program a profitable one to the State banks, but the spread has been decreasing and may continue to do so. There lies a problem for the next few years. If we assume that the central bank provides half of the total and the budget 10 percent, with the State banks' share rising to 40 percent, the interest cost of the funds with the present rates on time deposits would be almost 12 percent, the same as the lending rate, and the motivation for the State banks to continue the program would be gone. On the other hand if time deposit rates were decreased to 1.5 percent per month, as has sometimes been discussed, the interest

cost of the program would be slightly over 9 percent, thus providing a margin of profit to the State banks. Clearly, if the State banks are to assume a larger share of the program from their own resources, the appeal of the program, and its success, are sensitive to the interest rate structure on deposits.

4.19 Typically the funds are made available for up to five years and 75 percent of the project cost can be financed. The borrower must contribute 25 percent of the total and also provide collateral to total 150 percent of the loan. These have been the standard terms for the loans under the program. It has now been proposed to make these terms applicable to priority projects and to establish separate terms for non-priority projects. The differences proposed are an interest rate of 15 percent rather than 12 percent and a requirement that the borrower contribute 33 percent of the cost of the project. This is a step that should inject some greater flexibility into this credit program; however, it is likely to affect primarily larger-scale projects that conceivably could obtain funds from other sources. If the total investment credit program can grow without limit, allocation of resources to such users through this program is generally helpful to development. But the program probably has some limits on its size and if preferential interest rates and other terms are to be used as incentives for industrial development, some greater range in all terms may be desirable. For example, a range in interest rates from 10 percent to 18 percent, borrower contributions ranging from 10 percent to 40 percent, and maturities ranging up to 8 or 10 years could be considered within the next few years. As is shown a little later in this section, the medium term credit program has primarily been directed toward larger-scale industries, and the greater needs for finance may very well lie with smaller-scale industry. Moreover, a consideration of a wider range of lending rates, downpayments, and maturities could make this program a more effective credit instrument, capable of meeting a wider range of needs.

4.20 There have been problems in the implementation of the investment credit program but they have been those common to a learning process. The processing and disbursement of loans has not always been followed in uniform fashion by all of the banks. Slightly different criteria have sometimes been applied, as for instance, with respect to the character of the borrowers' contribution. Sometimes the bank has interpreted this as requiring 25 percent cash payment on the part of the borrower, whereas at other times actual work in place has been accepted. Although feasibility studies are required on loans above Rp 100 million, such studies have sometimes been required of smaller projects and sometimes omitted. The requirements for central bank approval of loans usually adds a month or two of delay and if the project is regarded unfavorably, a typical action is simply to

delay the processing rather than to give a negative decision. The banks themselves have not had the technical staff capable of making the feasibility studies but have employed local consultant firms for that purpose. It is taking time to build up mutual confidence among banks, consulting firms, and the customers. All of these problems are gradually being ironed out and as there is more experience of the program, loan applications and implementation will undoubtedly become smoother.

4.21 By January 1971 the investment credit program had grown to a total of about Rp 71 billion in approvals and has continued to grow in the months thereafter. Tables 4.5 and 4.6 summarize the program as of early 1971. Total disbursements are about 60 percent of approvals and in general disbursements seem to lag about five or six months behind approvals. This is not an unusual amount of lag, but there are individual differences within the sectors; in particular, loans to manufacturing seem to lag more in their disbursement than do loans to agriculture or other industries. On the other hand, the percentage of funds allocated to manufacturing industries has grown more rapidly than the total program and now accounts for about 38 percent of the total. Within the manufacturing industries there has been some concentration. Food processing and textiles together account for over 60 percent of the total. Only very small amounts have gone to the chemical industries (except for the crumb rubber plants) or to metals or machinery industries, which are the industries identified in as being particularly retarded in the economy. This lack of credit undoubtedly stems from the lack of demand and not because of any lack of willingness to supply funds to such industries. There can be no complaints about rate of growth of the total program or of the share going to manufacturing industries. Investment credit appears to be supplied in a satisfactory manner.

4.22 There has also been a concentration of funds geographically. As of March 1971, 41 percent of the credit approvals for industry were concentrated in Djakarta; an additional 36 percent were to firms allocated in other parts of Java so that together the island commanded three-fourths of the total. This is more than the existing geographical concentration of industry in Indonesia and suggests that the concentration is apt to grow higher as a result of this program. On the whole the loans in the investment credit program have gone to medium and larger scale firms. Three-fourths of the total funds have been in the form of loans of over Rp 100 million as is shown in Table 4.7. Only 2 percent have been in loans under Rp 10 million and only about 12 percent in loans of under Rp 50 million. Based upon a small and probably biased sample, it appears that about 60 percent of the loans have gone to firms that employ over 300 people and very few to firms employing less than 100. It is probably inevitable that this kind of emphasis should have occurred during the

Table 4.5

Investment Credit Ceilings and Actuals
January 1971
(Rp billion)

| Sector | Ceiling | Actual | Percent Used |
|---|---|---|---|
| 1. Total | 70.8 | 43.0 | 60.7 |
| Manufacturing | 31.2 | 16.3 | 52.2 |
| Mining | .3 | .1 | 33.3 |
| Agriculture | 18.9 | 12.5 | 66.1 |
| Others | 20.4 | 14.1 | 70.0 |
| 2. Shares (total) | 70.8 | 43.0 | 60.7 |
| Bank Indonesia | 50.3 | 25.4 | 50.5 |
| State Banks | 10.2 | 10.3 | 101.0 |
| Budget | 10.3 | 7.3 | 70.9 |

Source: Bank Indonesia

Table 4.6

Investment Credit Outstanding
(Rp billion)

| | Total | Manufacturing | Percent of total |
|---|---|---|---|
| June, 1969 | 3.6 | .2 | 5.6 |
| January, 1970 | 11.3 | 3.1 | 27.4 |
| January, 1971 | 43.0 | 16.3 | 37.9 |
| Percent increase (Jan.1970-Jan.1971) | 280 | 426 | |

Source: Bank Indonesia

Table 4.7

Size of Loans in the Medium Term Investment Program

| | Percentage of Funds |
|---|---|
| 1. Under Rp 10 million | 2.1 |
| 2. Rp 10 to Rp 50 million | 9.8 |
| 3. Rp 50 to Rp 100 million | 13.4 |
| 4. Over Rp 100 million | 74.7 |

Source: Bank Indonesia

early phase of the program; the larger firms are generally in a better position to take advantage of the availability of this kind of credit. Moreover, it takes just as much time and energy to appraise and supervise a small loan as a large one; that is true of all kinds of financial institutions and partially accounts for the banks' preferences for the larger loans. It is suggested, however, that in future some greater attention be paid to the lower end of the spectrum. It is further suggested that this attention might be undertaken not only by the State banks but possibly also through the private banks. What is being suggested is the possibility that the investment credits be channeled through the private banks rather than solely through the State banks. This might be done on a highly selective basis to include those banks that have demonstrated by past performance and conditions that they deserve trust and confidence. It would be one way of bringing them into investment finance activities, and they might be able to minister effectively to the smaller scale industries leaving the larger ones to the State banks. In fact it might be initially useful to set some upper limit on the total amount of credit that the private banks could extend in a single loan. At present there is some joint financing between state and private banks but it is nominal. The implementation of a program of channeling investment credits through the private banks would of course require a careful analysis by the monetary authorities in Indonesia before any action could be taken.

4.23 The medium term credit program seems to be fulfilling the expectations that were originally held out for it. It has been both responsive and expansive and shows every sign of continuing to be so. This program is now being supplemented by development loans through the banking system where the loans are supplied by foreign countries with an initial loan of $15 million under consideration. This supplementary program is primarily for the purchase of machinery and apparently contains no specific commitments beforehand to particular projects. It should be a useful supplement in the area of investment finance. If the suggestions made previously in this section are examined and found useful by the Government it seems entirely likely that this investment credit program could become strengthened and more effective in fulfilling the investment needs in the development of industry in Indonesia.

## Bank Liquidity and Loan Policy

4.24 Over the past few years there have been recurrent periods when the banking system appeared to have excess liquidity in the sense that actual reserves substantially exceeded required reserves. Although the former normally will exceed the latter by some small safety margin, when excess or free reserves continue to pile up, it is sometimes concluded that the demand for credit is deficient or that the banking system could expand its loans if it chose to do so.

An implication is that the banks are pursuing too conservative a loan policy. There is some evidence that the banking system in Indonesia has accumulated excess reserves and is in a quite liquid position, and the question is whether this condition is temporary and could be reversed by appropriate central bank action or whether there are basic conditions that explain why banks choose to hold excess liquid assets.

4.25 The statistics that seem to indicate excess liquidity in the banking system are shown in Table 4.8 for the four main groups of banks. Reserves actually at the Bank Indonesia are much higher than required reserves for each group. The private commercial banks maintain over twice as many reserves at the central bank as are required, and the other bank groups are not far below this figure. These figures appear to confirm excess liquidity, but in fact they do not. Reserve requirements are set at 30 percent of current liabilities, of which a minimum of 10 percent must be with the central bank and the remainder may be held in the bank's own vault. The figures just cited simply indicate that the banks choose to maintain a larger portion of required reserves at the central bank, and a small proportion in their own vaults.

4.26 It is more appropriate to look at the other column in Table 4.8 showing the ratio of total liquid assets to 30 percent of current liabilities (which represents required reserve levels).1/ These figures are lower than the former ones and show far less excess liquidity, though still relatively high for the private commercial banks and the local development banks. There are differences among the bank groups that are most clearly shown by their holdings of liquid assets compared to their total assets (or total liabilities). Table 4.9 presents the comparative figures by six-month intervals going back to December 1968.

4.27 The branches of foreign banks are in a strong position, as might be expected, with a low percentage of their assets in liquid (i.e. non-earning) form. The foreign exchange banks (the state banks plus three private banks) may, in a sense, be considered to have excess liquidity, but they have had a big increase in their deposits and also large increases (now exceeding Rp 100 billion) in credits from the central bank. Though such credits do not require reserves, a change in the credit programs or withdrawals of

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1/ There has been a recent change in the definition of current liabilities against which reserves must be held. The base now includes demand deposits, 10 percent of time and savings deposits. It is said that the change in definition does not materially change the size of the base, but the mission was not able to verify this from the published statistics.

Table 4.8

Measures of Excess Liquidity in the Banking System
(January, 1971)

| Banks | Ratios: Reserves at BI / Required reserves | Ratios: Total liquid assets / 30% of current liabilities |
|---|---|---|
| 1. Foreign exchange banks | 1.89 | 1.15 |
| 2. Foreign banks | 1.85 | 1.25 |
| 3. Private commercial banks | 2.34 | 1.37 |
| 4. Local development banks | 2.21 | 1.40 |

Source: Bank Indonesia

Table 4.9

The Ratio of Liquid Assets to Total Assets (or Total Liabilities) in the Banking System

| Date | Foreign Exchange Banks | Percent<br>Foreign Banks | Other Banks |
|---|---|---|---|
| January 1971 | 11.5 | 4.1 | 20.2 |
| December 1970 | 10.1 | 5.7 | 17.9 |
| June 1970 | 11.3 | 4.3 | 12.7 |
| December 1969 | 15.2 | 3.3 | 16.8 |
| June 1969 | 19.7 | 2.0 | 18.9 |
| December 1968 | 11.3 | 1.5 | 27.9 |

Source: Bank Indonesia.

deposits could place these banks in an unfavorable position. The extra liquidity may well be regarded as a cushion or extra safety margin against the risks of the market. Except for 1969 the ratio of liquid assets to total assets has held steady at about 11 percent for the foreign exchange banks. This does not denote very high liquidity during this period of change and stabilization.

4.28 The private commercial banks are in a different position. They do maintain a quite liquid position together with high levels of reserves at the central bank. The reasons for this are well known. These banks fear the consequences of not meeting a clearing of checks. Even missing by a few hours has led to suspension of the bank, a loss of confidence, and large withdrawals of deposits. Consequently they maintain an extra measure of liquidity to guard against these risks. The central bank has attempted to strengthen the banks in this respect by making available an automatic credit liquidity equal to the reserve on deposits at the central bank, and in time this added protection should permit a reduction in the amount of liquid assets held by private banks. For the time being, however, the private banks are overly liquid and with so large a fraction of funds tied up in liquid form, the remaining funds must be very productive to earn a return above that necessary to pay interest on their deposits. This has often meant going after the higher-interest bearing risky loans, and when defaults have occurred the private banks appear to have failed in portfolio management, which is what the central bank has often charged. In fact their need for liquidity and safety drives them into unnecessarily risky positions. That is the irony of their position.

4.29 As a whole, the banking system does not seem to be in a state of permanent excess liquidity. The appearances from the published statistics are explicable in terms of the somewhat unique conditions in the structure and operation of the banking system in Indonesia. In the future one should expect to see some decrease in liquidity. The degree of liquidity in the banking system is not due to a lack of demand for credit.

## CONDITIONS OF DEMAND FOR CREDIT

4.30 There is very little that can be said with precision about the future demand for credit, particularly in the industrial sector. The decisions with respect to the relative emphasis to be given to industrial development in the next five years or so are still to be made. If the suggestions and recommendations contained in this report are accepted and implemented, the demand for credit could rise rapidly, and the kinds of credit instruments and institutions to satisfy the demand effectively would have to become more varied. As has been discussed elsewhere in this report, Indonesia

is starting industrial development from a very low base. The record of the past few years in encouraging new foreign investment inflows is very satisfactory, but somewhat less so in terms of domestic investment. A continuation, or acceleration, of these flows depends very much on the maintenance of economic stability in the country. The re-emergence of general inflationary pressures could dry up the demand for funds for investment in industry and divert attention to trade, commerce, and other activities where the turnover of funds is much more rapid.

4.31 The medium term investment credit program has demonstrated that there is a demand for credit for fixed investment, under appropriate circumstances including the subsidized interest rates. But this new investment will also generate a demand for working capital. A survey conducted by the State banks concluded that on the average the follow-on demand for working capital is about 60 percent of the fixed investment. This figure will of course vary from one type of industry to the next, but this illustrates the need to make provision for both kinds of credit. A lack of working capital is one of the classic reasons for the severe underutilization of capacity that is frequently found in developing countries. The State banks are already considering the volume of working capital demands that will be generated by the investment credit program. This takes on added significance at the present time when something of a credit squeeze is being imposed.

4.32 Finally, very little is known about the elasticity of credit demand relative to changes in the lending rate. This will depend on expected and realized profit rates in industry. There seems little doubt that some of the investments under the medium term credit program would not have made without the preferential interest rate, but that is not universally true. For the immediate future the preferential rates probably must be maintained.

## SUMMARY AND RECOMMENDATIONS

4.33 There have been virtually no financial constraints on investment, at least in the industrial sector, in the last few years. Total bank credit has been expanded rapidly, stimulated in part by large liquidity credits to the State banks by the central bank. The allocation of credit has also shifted in favor of the private sector. An investment credit program has been started, greatly expanded, and can be counted a success so far. The rapid increase in credit, both short-term and investment, has apparently not had any inflationary impact, though the price increases in the first half of 1971 have been somewhat greater than expected. The rate of increase in the supply of credit probably will decline in the next few years, and the existence of ceilings on total new credit may raise some difficult allocation decisions among credit programs. There are several policy problems that deserve attention in the future.

4.34 At the present time the mix of investment credit to short-term credit is about 1 to 3. Whether this or some other ratio will prove to be the appropriate one cannot now be determined. It is said that the investment credit program will be expanded to about Rp 150 billion, or twice the level at the end of the first quarter of 1971. These plans may change of course; the level of the program will depend on the strength of the demand, the extent to which overall credit ceilings may pinch all credit, and the concurrent need for credit for working capital purposes. The management of credit will undoubtedly become somewhat more complex in the next few years.

4.35 An expansion of the investment credit program is justified, but it is suggested that the government consider certain modifications in the program. First, a greater range in interest rates, maturities, and downpayment terms would give greater flexibility to the program and permit great discrimination among types of projects. The proposal for a distinction between priority and non-priority projects is a first step in that direction; other steps can be taken later. Second it is suggested that central bank credits to the banks for this purpose be expanded to include selected private commercial banks, thus strengthening and expanding the institutions serving the investment market. Initially a ceiling might be put on the size of a loan that can be made by the private banks and they should be encouraged, with help from the State banks, to service smaller-sized businesses. Third, all of the banks in the program should be similarly encouraged to seek out investment needs of under Rp 50 million.

4.36 For some time to come the investment credit program must be supported through central bank credits, if a preferential interest rate on such loans is to be maintained. However, the banking system through its own resources is taking a larger share of the total. This has limitations based on the interest rate on deposits, and the upper limit of the State banks' share at present is about 40 percent. In the future, if deposit rates can be reduced, it should be possible to phase down the central bank credits and to place greater reliance on the banking system. At the same time the gap between the preferential interest rates and normal commercial rates can be decreased.

4.37 As mentioned both in the chapter and in an earlier one, a special effort should be made to stimulate medium to small scale industry. A package program including prefeasibility studies, vigorous promotion, technical assistance, and provision of finance is required. It also may be desirable to arrange special risk insurance on loans to small companies. The provision for finance should include a variety of institutions such as a special "window" or section of Bapindo, the state and private commercial banks (possibly through investment subsidiaries), and one or more private finance companies such as the one now being promoted. The financial part of this program will have to be planned with some care. It might parallel the existing investment credit program but with somewhat easier terms and downpayments in

particular. At the same time care must be taken to insure that the funds do not get channeled into trade or commerce but are used for the industrial project that is proposed.

4.38 The private commercial banks are being assisted in several ways by the central bank, and additional suggestions have been mentioned above. The merging of some of these banks to achieve larger financial units is desirable. In the past, mergers were difficult because of the legal requirement that all claims had to be settled prior to merger and only the net balance could be included in the merger. The requirement for such a liquidation process virtually prevented any mergers. The requirement is different from practices followed in other countries. Apparently now it has been agreed that the liquidation is to be simply pro forma and not actual, so that this barrier to merger is removed. If there is any doubt on this agreement, the central bank and the Government should confirm that an actual liquidation is not required. It would further improve the financial position of the banks if the Monetary Board would provide some form of tax relief or dispensation for banks that increase their capital.

# CHAPTER V
# INDUSTRIAL ESTATES

5.1 There has been a great deal of interest in industrial estates in Indonesia in the past two years; discussions of the prospects and uses of estates have been embodied in various reports, and a number of tentative plans have been made. Several of the individual estates have made some considerable progress in the planning process, generally due to the persistence of some company or government office, and there is a sense of optimism about the role of such estates in the future development plans of the country. Yet tangible physical progress has been slow, and as of the Summer, 1971 it does not seem likely that the first estate will be open for business in less than another three years. This conclusion could prove to be wrong, but if that is to happen, certain actions and decisions will have to be taken that so far have been delayed. In at least two instances paper planning is reasonably well advanced and could be followed in short order by physical construction, but there are some obstacles remaining, primarily in the determination of the functions or roles that the government(s) (central and provincial) and private partners are each to perform, and in specific plans to provide services and infrastructure that are needed to support the individual estate plans. After a brief summary of the functioning of industrial estates, including recent experience and the status of individual units, suggestions are presented for ways to remove some of the main obstacles and to accelerate the existing proposals.

## Purpose and Operations of an Industrial Estate

5.2 The purposes that industrial estates are designed to serve and the ways they operate vary depending on the circumstances and the countries in which they occur. They need not be of a uniform kind in Indonesia, but there are some common or minimal characteristics that should serve the development needs of the country. An industrial estate is not just a designated zone in which industry is permitted to locate, nor is it simply a land development scheme, though it includes both of these aspects. It is an area of land that is developed and managed as a unit, and provides utilities, infrastructure, and services specifically for the industrial clients that locate in the estate. This implies that the estate is a separate legal entity, possibly in the form of a limited liability company (i.e. P.T). That is the plan for at least several of the estates.

5.3 The general purpose of the estates is to encourage the installation of new industries through reducing the costs, the delays, and the uncertainties that typically beset an entrepreneur in Indonesia. One of the main stumbling blocks has been the difficulties attendant on finding and making arrangements for the use of land. As is briefly indicated in Chapter III, there are many forms of ownership or rights in land, ranging from outright ownership, which is permitted only to Indonesian citizens, to various rights to use, exploit, and/or build. Many firms have mentioned the difficulties and delays in obtaining a site for a factory. The industrial estate cuts through these difficulties by providing a site for lease. Costs are reduced for the firm

because it does not have to invest its own funds in roads, electric power facilities (typically diesel plants), water or other types of utilities and services. These are provided by facilities for the whole estate and through economies of scale in supply, the unit costs to the consumers normally are lower than they could achieve for themselves. Moreover, the firm does not need to obtain investment funds for these purposes, but simply pays a charge that becomes part of operating cost. Total investment funds for any given size of plant are less. All of these elements also tend to reduce the risks or uncertainties of investment, which on a relative scale are particularly significant to small ventures.

5.4 Because of the numerous approvals that are required between the original submission of an investment project and the commencing of operations, and the many government offices that are involved in the approvals, it has been suggested that the estate company might be a means to streamline this procedure and to substantially cut the delays in the start of actual production. These delays can represent a very real loss to the economy, and as chapter III has shown, they now may amount to several years delay or even be a reason for cancelling an investment. Ideally, the firm should be able to sign one piece of paper to cover all of the approvals needed and obtain these in one step, but that is not possible under present regulations. There are three alternative arrangements that might hasten the process of approvals: (1) the government offices delegate to the individual estates corporation the power of decision in these specific instances; (2) the government offices recognize the estates corporation as their agent without the power of final decision; (3) the government offices establish branch offices at each industrial estate to make the decisions. There is at least one other alternative, not involving the individual estate corporation, that may be superior to any of these. This alternative involves a national estates authority and is discussed later.

5.5 The first and the last of these alternatives can be rather quickly dismissed. The first involves a delegation of government authority to a corporation that probably will have mixed public and private ownership, but where the active management would probably be private. Such a delegation is almost certainly unacceptable in the present circumstances. The third alternative of establishing branch offices would proliferate a bureaucracy and might simply add another layer to the many layers already in existence. The branch office might not make the decisions. The second alternative is somewhat more attractive and palatable. If the individual estate corporation could act as the government's agent, assemble the necessary papers, and establish good working relations with the offices giving approvals, the process could probably be shortened to a measurable degree. However, if each individual estate corporation acts in this way, as the number of estates increases the procedure is likely to become somewhat unwieldy. It might work reasonably well in the first few cases but less well thereafter. It may well be inferior to the alternative of delegating this function to a national estates authority, but that depends on appropriate powers being given to such an authority. If the authority has only advisory functions, the only alternative to individual firm responsibility is to

operate through the estate corporation.

5.6 If an estate is to be run by a mixed public-private corporation, can it be expected that this will be a commercially profitable operation? A corollary question is whether there is any need that it be profitable. The investment costs of an estate cover the following items: initial acquisition of the land; costs of moving people from the land; levelling, draining, and filling; construction of roads; electric power, water, and sewerage systems; buildings for the estate management and maintenance. Other buildings, such as flatted factory buildings to be rented or leased in small units, may be included but are not always in the plans. The operating costs are those incidental to the maintenance and operation of the estate. There are a few rough estimates of investment costs for estates in Indonesia. The investment office of Djakarta Raya estimates that these costs will amount to about Rp 4000 per square meter for Pulo Gadung, or slightly over $10 per square meter at current exchange rates. A somewhat more detailed cost estimate prepared by Westinghouse World Corporation for the same estate arrives at a figure of about $8 per square meter but the detailed costs are missing. Several other estimates of investment costs, apparently used for planning purposes, also are in this same range. These estimates mean that the investment costs for a nominal estate of 100 hectares would be on the order of $8 - 10 million. These costs will vary depending on circumstances. At the proposed Tandes site near Surabaya drainage and filling of the land would be very extensive - and expensive. At Antjol land development is combined with land speculation and prices of land have increased rapidly. But it is significant that these estimated investment costs are high by comparison to the costs incurred at several estates in other countries, such as the Masan zone in Korea or a few estates in Latin America.

5.7 The estate corporation will derive its revenues from leases of land and rental of premises, from charges for providing power and water, centralized services such as maintenance and warehousing, and fees for other services that the estate management might provide the client firms. So far as is known, no one has made any estimates of projected streams of revenue or cash flows based on assumed schedules of charges. A projected income statement does not exist for a single industrial estate; consequently it is impossible to judge the likely profitability of an estate based on specific estimates. However, in the mission's experience, which has been checked in discussions with other persons, there is no industrial estate in a developing country that has been consistently run as a commercially profitable venture. The profitability is that the same experience will hold true in Indonesia. This does not mean that private companies will necessarily lose interest in helping to develop, finance, and operate industrial estates, since there are other reasons than the estate profits that may motivate them, one being that this is a way to help open the market and/or make their own investment in facilities in Indonesia easier and more secure. But it does imply that some greater burden may fall on the national and provincial governments to insure the success of the industrial estates program. In that event the measure of success is not the amount of profits that an estate can generate but rather how much of an incentive it provides to increase the

level of investment, output, and employment. The investment of resources in the estate would have an imputed (though not easily realizable) profit.

Summary of Recent Experience

5.8 At one time or another approximately a dozen different sites have been proposed as locations for industrial estates. Of these about half are in the Djakarta area and one in north Sumatra is the only one which is outside of the island of Java. The status of these proposals ranges from a few on which detailed planning is under way at the present time to others that exist only in the barest conceptual form and on which little or no analysis has been conducted. The two that have the greatest promise for early implementation are at Pulo Gadung on the eastern edge of Djakarta and Tjilatjap on the south coast of Java. The first of these has been under active consideration and planning by the investment offices of the municipality of Djakarta and very recently the most thorough report prepared on any industrial estate has been completed by the Westinghouse World Corporation and its subsidiaries. The idea for the estate at Tjilatjap originated in 1968 with a group of Western Australian businesses which established AIMTO Pty. Ltd. to carry on this particular venture. In other areas, provincial governments, municipalities and at least one private company have expressed interest in the establishment of an estate and in some cases preliminary plans or prospectuses have been drawn up and additional work is being undertaken, in a few cases actively and in more other cases on a somewhat sporadic basis. An estate to be located at Pulo Gadung seems likely to be the first that will actually go into operation, primarily because of the joint interest of the municipality and the private corporation.

5.9 The Westinghouse report selected six possible sites in the Djakarta area for evaluation: an area near the port of Tandjung Priok; Pulo Gadung; Tjawang and Tandjungtoapekong; both located on the Ring Road; Gandaria, located south of Djakarta on the Bogor Road; and Tjibinong which is about 20 km south of the city. The report gave ratings to each of these locations based on 89 specific criteria, covering the size and characteristics of the site, the ease of access, the availability of utilities and transportation, and other special considerations. The ratings were weighted according to the relative importance of the criteria to the ultimate success of the estate. The highest rating was achieved by the site at Tandjung Priok and the second by Pulo Gadung. All of the others rated well below these two. The former site was not ultimately considered because in the master plan it is destined for a combined industrial-residential use and the availability of this land is tied in with the future of the Kemajoran airport. The report concludes that an estate at Pulo Gadung could be established in several stages, with the first stage to develop about 150 Ha. at an estimated cost of slightly over $11 million. In this area, but not included in the proposed stage one development, there are already eight existing plants and seven more are under construction. Each of these plants have provided all of their own facilities, but

they could be incorporated in succeeding phases of the development of the estate. The land is now controlled by the Government and cannot be sold for any purpose without its approval. It is significant to note that the report also concludes that it would take 2½ years after the final approval before the first sites would be ready for occupancy. It is entirely likely that both the estimates of costs and the time to completion could prove to be conservative. In any case negotiations between the Government and the corporation must resolve a number of difficult issues. No specific provision has as yet been made for bringing utilities up to the edge of the proposed site. A final plan showing the participation by the Government and by the corporation has not yet been confirmed and financial planning with respect to the amount of debt and equity is also in a preliminary phase. Solutions to each of these problems must be found before any actual work can commence.

5.10 The proposed estate at Tjilatjap is being promoted vigorously by a consortium of Australian firms incorporated as ADMTO Pty. Ltd. and the consortium itself has been adding new members. None of the firms has had any experience with a venture of this kind, but the location of the estate at the only good harbor on the south coast of Java and on the main shipping routes from western Australia to other ports of Asia has seemed a natural place for this kind of development. The consortium and its consultants have undertaken studies of the port area, the economic potential of the hinterland, and various other special features. No report of the kind completed for Pulo Gadung has as yet been prepared, but essential elements have been identified. The consortium has outlined a mode of operation for the estate and for the capital structure. After discussions with Government officials and others it is suggested ADMTO supply one-third of the capital, central government and/or regional government another one-third, and the final third would be supplied by the private individuals, investment banks, the International Finance Corporation and possibly the Private Investment Corporation for Asia. ADMTO would want a management contract for 10 years and effective control of operations during this period but it expects that the Government will acquire the approximately 200 Ha. of land that will be required. In early summer ADMTO expected to designate to the Government the specific land that would be required. They have estimated the land cost at approximately $5000 per Ha. so that the total land cost would amount to $1 million. They also estimate a need for $1 million for working capital for three years and an additional $1 million for infrastructure. The last item is almost certainly too low. A recent decision to locate a major oil refinery at Tjilatjap has increased the prospects for a successful venture since some of the infrastructure may now be shared in common. There is one significant difference between the plans at Tjilatjap and those being made at Pulo Gadung. The members of ADMTO will constitute the largest single group of companies to locate in the estate. A number of them have expressed an interest in establishing facilities to serve the Indonesia market, and they regard the industrial estate as the most efficient way to obtain entry. There are of course incentives for firms that are not members of ADMTO to locate in the estate as well. ADMTO has been persistent in its promotion of the estate and a key decision point will be reached when they designate a specific land area to be acquired.

5.11 At Surabaja two areas have been suggested for consideration. Tandes is northwest of the city and Rangkut is southeast; however, both of these areas have poor soil conditions and will require extensive drainage and filling. It has been estimated that the swamp-depth at Tandes is over 1 meter and no tests have been conducted as to whether dredge fill is available. Moreover, this site would require a rock-filled dam to lower the water level and provide fresh water and this item could be quite expensive. As an alternative to these two, a third area, the Perak airstrip, is now being more actively considered. It is understood that discussions have been held between the Bechtel Corporation (US) and the local government, but these discussions are at an early stage.

5.12 None of the other proposals for industrial estates are very far advanced. Gandaria is an industrial zone rather than a separate estate. A number of plants are in actual operation in the area but they were established independently, they are not in a contiguous area, and they do not share any facilities in common with the exception of a telephone exchange. Antjol, in the port area of Djakarta is a development scheme that combines bonded warehouses, office buildings, hotels and residences, and a major recreational area. The land is very swampy and a great deal of work lies ahead. Land costs under lease have apparently been rising at a very rapid rate. In north Sumatra the provincial government has undertaken preliminary plans for the industrial estate "Maryland" which lies just off the road from Medan to the harbor at Belawon. About 600 Ha. have been selected and it is estimated that the land cost will be about Rp 700 per square meter. Even with a persistent effort it would take at least five years to complete the estate. No analysis of physical facilities, finance, or operations has as yet been started.

5.13 The outstanding feature of the experience to date in the establishment of estates is the ad hoc and individualistic character of the efforts. There is no shared experience; each effort is attempting to solve the problems as best it can. There are no common solutions to common problems. In fact there seems little or no awareness on the part of one effort regarding what is happening in other efforts, and no attempt to benefit from discussions. The success so far has depended on the vigor of local governments and private corporations, with advisory assistance at the national level from the interdepartmental committee. This way of proceeding is not necessarily a bad one in one important respect. It relies on the interests of those who will benefit most from the development to see that progress is made, but in several respects it is not the most effective form of organization. In particular, it is entirely probable that there will be difficulty in arranging outside finance for the estates so long as such planning is on an individual unit basis. Funding assistance from international agencies cannot easily be given in small amounts to individual estates with the necessity of evaluating the viability of a single unit. Moreover, there is no agency through which such finance can be channeled that can provide the necessary guarantees. If a

national authority for the development of industrial estates is established, many of these arrangements would become far easier; indeed, the IBRD has indicated to the Government that it is prepared to consider financial assistance once such a national authority has been established. The Government of Indonesia has indicated that it intends to establish an industrial estates development corporation. When such an agency is established with appropriate powers and functions, financial and other assistance should become readily available.

## Functions and Powers of a National Industrial Estates Authority

5.14 It is anticipated that some form of national industrial estates authority will be created to succeed the existing interdepartmental committee. The question is how extensive the functions and powers of the authority will be particularly vis-a-vis functions remaining with local government or private firms. It is useful to consider this question in the context of two quite different alternatives. It would be possible, for example, to create an authority which had primarily advisory and coordinating functions but without the responsibility or the powers to engage directly in the operation, finance, and supervision of individual estates. If this course is followed, primary reliance would rest with local governments and the private sector; they would be expected to undertake virtually all of the essential functions for initiating, financing, and managing the estates. The total program that would emerge would be primarily local in character rather than with the imprint of a common national course of action. This way of proceeding might work exceedingly well, particularly in freeing the hands of local people and private interests to find new ways and new arrangements to realize the benefits to local industry. But, as has been mentioned above, such an alternative also has serious disadvantages, primarily in terms of obtaining external financial support for an estate program and in the supervision of individual estates in the best interests of national development objectives.

5.15 The alternative is the creation of a national authority which has powers beyond those of mere coordination and advice, and which includes the ability to make contracts, to arrange loans, to invest funds directly or to commit other resources and to exercise some degree of control and supervision over the conduct of the individual estates. The mission believes that this alternative has distinct advantages for development. The adoption of this alternative would not deny the importance of local initiatives but rather should be aimed at complementing and strengthening such initiatives. Initially, such an authority should be provided funds from the government budget to stimulate the development of new estates or to participate in those that have started with local or private initiatives. Such a provision of funds from the development budget has been the course of action followed in Singapore (Jurong), Taiwan (Kaohsiung) and Korea (Masan).

5.16 There are other powers that would be required by the authority in order to make it both responsive and effective. The following are necessary and probably also sufficient powers to invest in such an authority. First, it must be able, in conjunction with local government, to acquire land and to make this land available on long term lease to an individual estate corporation. It would be particularly appropriate for the authority to take a share in the equity finance of the estate in exchange for making the land available, that is, to capitalize the value of the land and exchange it for stock in the estate corporation. It is suggested that this type of arrangement might become the typical pattern for handling land in estate planning. Second, and very importantly, the national authority should be the channel for loans from international lenders so to increase the resources available for this program. Because of the necessity for Government guarantees on loans it is assumed that other agencies of the Government, such as Bappenas, the Ministries of Finance and Industry, and the Investment Board would together decide on the total size of such programs. These are the two most important functions for the national authority.

5.17 The national authority would also be the appropriate agency to undertake responsibilities for insuring that utilities, roads and other infrastructure were brought to the estate border. For example, in some cases, it would be possible to divert some of the resources in an on-going project in electric power or roads, etc., to provide direct access to the industrial estate. The national authority might also become the intermediary between the industrial firms and the governmental offices in obtaining the licenses and approvals that are now required for investment. This does not mean a usurpation of the approval power by the national authority but simply that it should be possible to work out some shortcuts to current procedures. Finally, because the national authority would, in all probability, provide both equity and debt finance for an individual estate, there would exist a basis for exercising some degree of supervision of the conduct of the affairs of the estate. Such supervision should allow substantial freedom to the estate management but should also, at a minimum, insure the conduct of affairs in accordance with accepted standards of financial accountability.

5.18 The mission believes that the establishment of a national industrial estates authority along the lines that have been briefly outlined above is possibly the single most important step that could now be taken by the Government of Indonesia to advance the industrial estates program.

## Bonded Warehouses

5.19 It has several times been suggested that the establishment of bonded warehouses in the Djakarta area (and possibly other port areas) would provide a valuable service both as a form of economic infrastructure for industry and as a commercially profitable venture

on its own account. In this operation goods are permitted to move directly from the port and are stored under bond in the warehouses. Customs duties and taxes are collected only when the goods are removed from the warehouse by the business firm or user. There are several obvious benefits in such an operation. It permits better scheduling of the inventory flows so that, for example, a manufacturer need not wait a long time, possibly until he runs out of spare parts or other materials before he receives a shipment. This means that he can generally make better production plans and does not have idle machinery while he is waiting delivery. Moreover, he can use the warehouse receipts for these goods as collateral in financing of them. In addition, through better scheduling it is usually possible to maintain lower levels of inventory and hence have fewer funds tied up in inventory investment. Obviously these benefits could be obtained by a manufacturer who has purchased goods for his own operations; by a supplier (importer) who is marketing products to local manufacturers and business; or it is possible that a bonded warehouse operation could be run by commercial banks as an additional service for their clients. It would also be possible for Government offices to undertake such a venture. In fact there are several bonded warehouses now operating in the Djakarta area, but it is not known how successful or profitable their operation is.

5.20 Bonded warehouses are frequently located in industrial estates or in free trade zones which permit import of materials, processing and re-export of a finished or a semi-finished product without payment of the usual duties and taxes. Such kinds of arrangements are found in Singapore, Taiwan, Korea, and in most other cases involving free trade zones. Bonded warehouses also can be conducted as an independent commercial operation serving a single customer or many customers. A prime requirement in successful operation is the absolute security of the goods. The lack of theft or pilferage and the absence of other kinds of fraudulent behavior is essential. At times it is difficult to insure that the operation of the warehouse measures up to these requirements. This sometimes accounts for the lack of interest or success of this type of operation.

5.21 At present Singapore has become the prime supply depot for Indonesia. Importers maintain warehousing facilities in Singapore and tranship to Djakarta when orders are received. It will be difficult to compete with this sort of arrangement by the establishment of local bonded warehouses, although the plans for the Antjol area apparently have allocated 80 Ha. for bonded warehouses alone. This is undoubtedly many times more than the demand will be over a number of years. Although operations based on Singapore are now dominant in the market, it has been estimated that on typical shipments of spare parts and machinery an operation based directly in Djakarta could provide the goods to a local manufacturer at about 10 percent less than an operation based on Singapore because of finance and handling charges. This margin normally would be sufficient to stimulate some local development of bonded warehouses, but under the peculiar circumstances of port and customs operations now existing, this margin might not be sufficient.

5.22 In normal circumstances the operation of bonded warehouses is at least a reasonably profitable operation. There is a single case study which attempts to project the costs and revenues from operating one in the Djakarta area.

5.23 The basis for the calculations is an area of 25,000 square meters consisting of a storage yard of 10,000 square meters and a covered warehouse also of 10,000 square meters. Security is provided by perimeter fencing. It is assumed that 40 percent of the area represents non-usable space (i.e. aisles, etc.) and that usable space would be occupied only 3/4 of the time. On the assumption that goods would turn over five times a year, the warehouse and storage yard would have an annual capacity of 90,000 revenue tons. The study estimates gross annual revenue of $459,000 and gross costs (fixed and operating costs before taxes but including interest on loans) at $216,000 leaving a net profit before tax of $243,000 annually. The cash flow is based on a 4:1 debt: equity ratio with an equity of only $250,000. Consequently the net profit each year is almost equal to the equity investment.1/

5.24 These calculations are overly optimistic and are cited here only to indicate the possibility of undertaking a systematic analysis of the operation of a bonded warehouse. If information of this type were available to investors or businesses, some of them might be interested enough to undertake an investment, but it should be noted that in its discussions the mission did not find any very great interest in pursuing this kind of operation. As and when industrial estates, such as Pulo Gadung or Tjilatjap, become operational, it is a virtual certainty that they will incorporate a bonded warehouse as an integral part of the estate.2/

## Summary and Recommendations

5.25 Industrial estates should continue to be an integral and important element in the industrial development plans for Indonesia. They can be the vehicle for providing facilities in the form of factory sites and associated services with an ease that is now nonexistent in the country. When properly administered they should also make it possible for tenant firms to undertake ventures at lower investment costs and probably at lower operating costs than those firms could achieve if they had to proceed on an individual

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1/ American Technical Assistance Corporation, Warehousing and Financing Arrangements to Facilitate US - Indonesian Trade, (mimeographed) October 1968.

2/ Ibid pp 44-57.

basis. The risks of new ventures are similarly reduced. But in order to get many of them started, financial and other assistance probably will be required. For these reasons it is suggested that national industrial estates authority be established to accelerate and sustain the creation of such estates. Such an authority might have various kinds of powers but among these, two are deemed to be critical to success; first the authority should be the channel through which funds from the Government and from international lending agencies can be made available to individual estates; second, the national authority should have the power to acquire land and to make it available for use by the estates. It is suggested that the land might typically be made available in exchange for an equity position in the estates. The national authority also should have some responsibilities for supervision over estate operation, particularly with respect to financial accountability. Although in the discussion we have designated the national body as an "authority", this is not meant to suggest that one specific institutional form of organization is required. The term is used in a generic way to suggest that such an authority should have the key powers and responsibilities that have been indicated.

5.26 There is one major deficiency in the planning of all of the industrial estates and that is provision for the construction of factory buildings in which small amounts of space can be made available to small scale industries. At the present time the planning seems to be primarily directed toward medium and larger scale firms that would lease a whole site and construct their own buildings. As has been indicated in chapters II and III, there is a need to stimulate the development of smaller scale industries and the provision of factory space within a building should be regarded as part of the package program in this area.

5.27 At the present time there seems to be rather little interest in the separate establishment of bonded warehouses as commercial ventures; however, some additional explorations of this topic are probably warranted particularly with respect to making information on their advantages and costs more readily available to prospective investors. It is anticipated that with the establishment of industrial estates, bonded warehouses will probably be included within the estate itself to serve the resident tenant firms. No special promotional effort appears to be necessary other than those suggested.

# CHAPTER VI

## THE NEGOTIATION & OPERATION OF CONCESSIONARY AGREEMENTS

6.1 Over the past few years Indonesia has concluded a of concessionary agreements [1] with private foreign firms or j ventures for the development of mineral and timber resources, marily on islands other than Java. The physical areas covered the agreements are often extensive, one of them ranging into th hundreds of thousands of square kilometers. The initial result has been a greatly increased level of activity in exploration and development of minerals and timber, though not always in ways or at a pace that is most beneficial to the country. In this chapter the experience under these agreements is briefly surveyed in separate sections for minerals and timber. Preceding these surveys there is a section dealing with some of the general issues that arise in the course of negotiating concessionary agreements and a few suggestions are made concerning aspects of bargaining that may help minimize points of friction between the parties and assist in arriving at a mutually beneficial agreement.

6.2 Many of the current agreements were negotiated hastily, often with only partial comprehension of the facts and the economic attraction of the particular resource by the government, and with additional pressures to start the economy moving. In the result the bargains struck were admittedly generous to the concessionaires. This situation, and the problems that must be faced in future negotiations have been summarized succinctly by a government official.

> "When we started out attracting foreign investments in 1967 everything and everybody was welcome. We did not dare to refuse; we did not even dare to ask for bonafidity (sic) credentials. We needed a list of names and dollar figures of intended investments to give credence to our drive. The first mining company virtually wrote its own ticket. Since we had no conception about a mining contract we accepted the draft written by the company as basis for negotiations and only common sense and the desire to bag the first contract were our guidelines. We still do not regret doing so."

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1/ Although technically many or most of the agreements are "contracts of work," the term concessionary agreement is accurate. There are slight legal differences in items such as the time of passage of the property right in the resource.

With the years, we got experience and international advise. We are learning how better to protect our national interest. And a greater protection of national interest will in the long run also mean a better protection of the interest of foreign investments. If the national society and the foreign investor are both reasonably happy then the relationship will last a very long time. An unfair contract reflecting inexperience of the host country can boomerang later in the form of political repercussions."[1/]

## Elements in Bargaining and Negotiation

6.3 It is not too difficult to state the general objectives of a concessionary agreement; probably both parties to the agreement would accept the statement that the agreement should lead to the development of the resource so as to support the overall development needs of the country; that it should be "equitable" in its distribution of benefits, and that it should seek to avoid conditions or requirements that are likely to lead to a confrontation between the parties and to the imposition of sanctions. This general statement is not, however, very helpful in defining the detailed provisions of an agreement that meet the objectives. The meaning of equity is often in the eye of the beholder; and there are other sources of difference. Yet the general statement is useful in making explicit the desire to avoid a confrontation that would lead to disruption of activities or production. That eventuality is unlikely to result in benefit to either party. A going operation provides a stream of revenues and benefits that need not be interrupted if the negotiation is carried out with forethought and consideration of the alternatives. At the least it is reasonable to aim at an agreement that will minimize the risks of disruptions, since those risks can never be completely eliminated.[2/]

6.4 An unfortunate mistake in approach that can lead to disagreements and, more importantly, to acceptance of provisions that tend to depress the total benefit stream available, is to regard the negotiation as inherently one in which the gains made by one party are necessarily matched by equal losses to the other party. In the language of mathematical game theory this is called

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1/ M. Sadli, "Indonesian Investment Climate 1971," 9 Jan. 1971, Paper prepared for SRI Bangkok meeting.

2/ There are very few systematic discussions of concessionary agreements and negotiations. One exception, that is recommended reading, is R. F. Mikesell, Foreign Investment in the Petroleum & Mineral Industries, Johns Hopkins Press, 1971, especially Chapters 2 & 17.

a zero-sum game; what is won by one side is matched by a loss to the other. One result may be that the outcome of the negotiation tends to minimize the maximum gain or benefit that they could attain jointly. In an actual situation the result may be that the revenues accruing both to the government and to the concessionaire are smaller than they could attain under some different arrangement. It is difficult to demonstrate by example an exact situation where this kind of outcome has occurred, because in all cases there is a mixture of circumstances at work and it is not possible to establish the motivations of the parties, but one reasonably comparable case has occurred in connection with providing wood processing facilities at each timber concession. Most of these agreements have language to the effect that the parties intend that a processing facility will be established within a certain period such as five years. The interest of the government is clearly to increase the processing of the products and hence the domestic value added. On the other hand the concessionaire usually has reasons to prefer the export of logs. In an economic sense it frequently is not desirable to match one processing facility to one timber concession. This is not the best use of resources. The existing concession agreements are thus sub-optimal from the point of view of both parties. But, as is demonstrated in Chapter XI, a larger and integrated wood products complex is economically feasible and represents a better basis for action in terms of total revenues and rewards than the existing arrangements. Both parties can gain from such an agreement. At the present time the concessionaires can prevent the establishment of any processing facility since the agreements do not specify that there is an obligation to do so; they simply state that it is a policy objective or an intent, but in terms of the contract there is no enforceable obligation.[1]

6.5 In the negotiation of a concession the major elements to be covered, and the ones likely to give the most difficulty, are: (a) the provisions for the division of the revenues or benefits; (b) the rules on which party is responsible for incurring costs; (c) the rate which development is to proceed; and (d) the tests of performance on the part of the concessionaire. In some of the agreements, notably those concerning timber concessions, these elements are not always covered explicitly, so that there may not be any clear agreement as to the performance expected or required of the concessionaire.

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1/ For further comments on this and other points see T. A. Manring, "Comments on Agreements in the Fields of Mining and Timber," undated manuscript.

6.6 The negotiation of rules or criteria for the division of revenues also includes a consideration of the kinds of financial incentives that are provided, since these incentives are normally intended to increase the potential profitability of a venture or to reduce the risks. Typically the financial incentives include the following: tax holidays up to five years (though normally not given to mineral processors); reduced levels of income tax; accelerated depreciation, including privilege of changing the method of calculation each year; exemption from import duties on equipment brought in; exemption from export taxes and excises; investment tax credits; extensive loss carry-forward privileges; and sometimes the concessionaire is permitted to make payments that are due on a deferred basis. The multiplicity of the incentives and the generosity of the provisions will contribute greatly to the profitability of the ventures to the concessionaires, and also often represent tax or other revenue foregone by the government. A model contract for mineral concessions has been prepared for the government by the Harvard Development Advisory Service. That contract suggests restrictions in the use of many of the incentives; for example, it suggests that once a method of calculating depreciation is chosen, it should be maintained and not changed annually at the discretion of the concessionaire. The mission believes that this model contract could be the initial basis for negotiating future mineral concessions, even though modifications in it would undoubtedly be required in individual cases.

6.7 Since most of the agreements in both minerals and timber have been in existence for at most a few years, it is somewhat premature to judge what share of the net revenues generated by the concessions Indonesia will obtain. The income tax provisions usually are favorable, and quite typically provide for a rate of 35% in the early years, rising to 40% after about ten years, whereas the rate on other businesses is 45%. But, because of the incentives and some ability to inflate costs above those representing actual costs of resources (e.g. interest paid to affiliates), the income tax rates do not necessarily reflect the true share of net income that should be going to the government. In the future, as the concessions mature, it would be prudent to have a continuing analysis made of the net revenues generated by the concessions and the government's share of them. These could usefully be compared to the experience in other countries with similar agreements.

6.8 As to the incurring of costs, the government has elected to have the concessionaires incur virtually all costs of infrastructure such as roads, housing, schools, and hospitals. All direct project costs are also to be wholly borne by the investor; there is no public participation in the ventures. The avowed purpose is to conserve public funds for high priority development needs that private investors will not undertake. The arrangement on infrastructure costs is similar

to that followed by most countries; however, in Western Australia the government has considered undertaking some of these costs in the Northwest iron ore country, in order to prevent their deterioration in the future as and when individual mining operations decline or otherwise change. It may be useful to find out about this experience and to determine if any of it is applicable to circumstances likely to arise in Indonesia.

6.9 The government is naturally interested in rapid exploitation of the resources and early production; yet in many of the agreements there is little or no provision for requiring early performance by the concessionaire. In mineral agreements it is common to define periods of time for general surveys, exploration, feasibility studies and construction prior to actual operations. Many of these time periods can be extended if certain minimal actions are undertaken by the concessionaire. As is shown later in this chapter, it is entirely possible that actual production might not occur for ten years or more under certain circumstances. In timber concessions the situation is, if anything, worse. There are often no provisions requiring performance, and when one views the number of concessions on which no work is in progress, there is an implication that some of them are being held for speculative purposes and were obtained to preempt the land for future use. These delays in performance are one of the most pervasive, and least defensible, characteristics of the concession agreements. This is one aspect that the government might correct in future negotiations. Penalties, including forfeiture of the concession, could be imposed if some schedule of work is not met.

6.10 The specification of performance levels that a concessionaire is to meet in actual operations is desirable and follows naturally from the argument of the paragraph above. The government is not only interested in early exploitation, but also in a high sustained level of development. The concessionaire may not have the same interest in a high rate of production since that usually implies a high level of investment; he may simply be interested in a minimal scale of operation lasting over a long period of time. Put in another way, the government appears to have a high time rate of discount and the concessionaire a lower one. In these circumstances it would be desirable to try to specify performance standards for production so that the issues can be clearly faced. This is preferable to having no standards and later becoming dissatisfied with the level of performance. The specifications need not, and probably should not, be in the form of fixed production levels to be met, since there are many reasons why a particular level may not be achieved, but a flexible formula tied to market conditions and allowing for contingencies can be sufficiently well stated as to constitute a requirement that must be met.

6.11 In general many of the agreements contain language that is so vague as to be unenforceable. With regard to the installation of processing facilities words such as that the agreement "contemplates" or "intends" that a facility be erected is too vague and does

not create an obligation on the part of the concessionaire. This should be corrected in future agreements. 1/

6.12 The points that have been made on the elements in negotiating an agreement are only major selected ones; they do not exhaust the subject. These and other points are illustrated by the summaries of the timber and mineral concessions, as well as being covered in the material cited in the footnotes of this section.

## Timber Concession Agreements

6.13 Between 1957 and 1967, permits for the exploitation of areas of less than 10,000 Ha were granted by the provincial governments, and for larger areas, product sharing agreements were signed between Perhutani (the Government enterprise in charge of forestry exploitation, created in 1960) and private enterprises. Since the enactment in 1967 of Law No. 1, dealing with foreign investment and Law No. 5, on basic forestry principles, investments, whether made directly by private foreign or national firms or as joint ventures, have been encouraged. With the exception of a small area of privately owned forest land (estimated at 20,000 Ha) and of pre-existing rights based on traditional customs or on specific written grants issued by provincial governors, all forest land in Indonesia can be exploited only after specific agreements are approved by the Central Government through the Directorate General of Forestry in the Ministry of Agriculture, or by the governor (in the case of areas of less than 100 Ha).

6.14 There is no aggregate information on the small regionally awarded concessions. The Directorate General of Forestry has made available a listing of 96 agreements in operation or approved by the GOI through March 31, 1971, while 26 more are drafted and ready for approval, and 72 applications are pending in different stages of processing (surveying teams being prepared, survey underway, agreement drafts in preparation or under discussion by the parts, etc.). The total area involved is more than 20 million Ha of which nearly 12 million have already been approved. Therefore, of the total forest land available for exploitation, almost one-half has already been disposed of, and about 84% has been either awarded or spoken for. (See Graph 11.1 in Chapter XI).

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1/ Cf. Manring, Op. cit., for specific examples.

| | Areas in 000's of Ha. 1/ | | |
|---|---|---|---|
| | Approved Agreements | Draft Agreements ready | Applications pending |
| Foreign investments | 3,178 | 50 | 540 |
| National enterprises | 3,572 | 858 | 832 |
| Joint ventures | 4,329 | 1,135 | 711 |
| Other or undecided | 897 | 335 | 3,669 |
| | 11,976 | 2,378 | 5,752 |

6.15 This listing published by the Forestry Directorate General, however, may not be complete. Many concessions shown in a map, also prepared by the same Directorate, are not included in the listing. This is especially noticeable in the case of applications pending in West Kalimantan, the Moluccas and West Irian. Joint ventures have originated predominantly through Japanese and Malaysian companies, while in the case of straight foreign investments, the largest concession awarded by the GOI (to A. Soriano & Cia.) makes the Philippines the most important country of investment origin, with the United States second (Table 11.2 in Chapter XI). The listing published by the Directorate General of Forestry shows that the largest areas given in concession in absolute as well as in relative terms (in relation to territorial geographical extension) are located in Kalimantan.

| | Concession areas (000's Ha.) | | As a % of Territorial Areas | |
|---|---|---|---|---|
| | Agreements Granted or Drafted | Applications Pending | Agreements Granted or Drafted | Applications Pending |
| Sumatera (Sumatra) | 2,719 | 1,458 | 5.74 | 3.08 |
| Kalimantan (Borneo) | 10,728 | 3,617 | 19.89 | 6.70 |
| Djawa (Java) | - | - | - | - |
| Sulawesi (Celebes) | 400 | 385 | 2.10 | 2.04 |
| Other or undefined | 507 | 262 | 0.89 | 0.46 |
| | 14,354 | 5,752 | 7.54 | 3.02 |

1/ See Table 11.1 in Chapter XI

Expected volume of logging and processing operations

6.16 Targets for the volume of timber logged by each one of the concessionaires in the period 1969-73 have been set by the Directorate of Industries:

| | 1973 Production Targets | |
|---|---|---|
| | 000's of $m^3(r)$ | Average expected yield in $m^3(r)$/Ha. |
| Kalimantan | 13,617 | 1.25 |
| Sumatra | 4,150 | 1.53 |
| Other islands | 994 | 1.57 |
| Total or average | 18,761 | 1.31 |

Average expected yield - 1.31 $m^3(r)$ per Ha. (equivalent to 0.37 forest tons per acre) - is not unrealistic. With a total recycling period of about 40 years, the required volume of net usable timber of some 52 $m^3(r)$ per Ha. (or 15 FT per acre) compares well with projected or actual yields in the projects being developed in similar forested areas in other regions[1/]. But, an analysis of targets for individual concessionaires (Appendix 2 in Chap. XI) shows a wide and, at least in some cases, difficult to justify variation in the expected yields, the largest being 65 times the smallest. Even if the extreme cases are eliminated, expected yields fluctuate between 0.5 and 2.5 $m^3(r)$ per Ha. For seven important concessions (Appendix 3 in Chap. XI) exploitable stands are expected to yield between 22 and 120 $m^3(r)$ of timber, after 5 years of exploitation, and on the basis of a 35-year cutting cycle. Based on the experience so far acquired by active concessionaires it would seem safe to project future volume of log output in sizes and qualities adequate for lumber and plywood at about 30/40 $m^3$/Ha.

6.17 All concession agreements contain provisos for the establishment of processing facilities. If all these facilities are established, investment of $571 million would be required (Appendix 2 in Chapter XI) but lack of enforcement conditions makes it very difficult to forecast what will be the actual extent of processing reached within the present decade. Nearly one-half of the estimates investment are considered in only two agreements: those with A. Soriano & Cia. and Korea Development Co.

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1/ For instance, 11.5 FT/acre expected in the Jengka project in Malaysia for the larger project area. Logs for saw and peeler use available in the Bislig Bay area for the Paper Industries Corporation of the Philippines (PICOP) have been estimated at 150 $m^3(r)$/Ha.

| | Estimated Investment | | |
|---|---|---|---|
| | Total ($ mil.) | Unitary ($/000 Ha.) | Unitary 1/ (Per $m^3$ logged) |
| Kalimantan | 486.5 | 45 | 36 |
| Sumatra | 71.2 | 26 | 17 |
| Other islands | 13.5 | 15 | 14 |
| Total or average | 571.2 | 40 | 30 |
| Soriano & Korea Dev. Co. | 283.0 | 193 | 354 |
| Total or Avge. ex Soriano & Korea Dev. Co. | 288.2 | 22 | 16 |

Sawmilling capacity, in some of the typical important concessions should be able to process between 13% and 41% of expected log extraction. Total processing has been specified at 55% to 60% of logs extracted in another case. Plywood manufacture capacity has been included in the concession terms in one agreement. In this case (A. Soriano & Cia.), projected log input for the sawmills and plywood plants would use all of the minimum log output target.

Obligations of the concessionaires

6.18 Besides the obligation to install processing facilities and to make investments for this purpose--an obligation which is, however, considerably weakened by the fact that the determination of the feasibility is not in the hands of the Government--concessionaires have the following obligations:

(i) To pay license fees (per ha. and per annum for the period of the concession).
(ii) To pay royalties on volume of timber felled.
(iii) To use Indonesian labor and staff personnel.
(iv) To submit work schedules.
(v) To allow use of roads and generally the passing through their concession of workers, materials and products from or for other concessionaires.

6.19 In all the contracts that have been made available to the Mission, payment of license fees is stipulated at U.S. $0.05 per Ha.

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1/ Based on 1974 log production targets

and per annum for the period of the concession. Royalties on production were established (as also were license fees) by Government Regulation N° 22 of December 30, 1967, and rates were set by Decree of the Minister of Agriculture N° KEP. 2/1/1968 of January 20, 1968 (Appendix 6 in Chapter XI). The royalties for the more commonly used species range between $1.00 and $2.00 per $m^3$(r). The obligation to use Indonesian labor is just a declaration of desirability and all contracts contain wording to the effect that concessionaires are allowed to use foreign technical and administrative personnel in the proportion which they find necessary to carry out their operations. Many contracts have clauses referring to community development. In one case examined (Soriano & Cia.), the concessionaire has explicitly offered to budget U.S. $5 million for this purpose over a 10-year period, including the supply of electricity (200 KW). At the other extreme in vagueness, a concession granted to the Korea Development Co. disposes of this question with the following "obligation":

> "In the frame-work of regional development the COMPANY is willing to cooperate with the local Government."

6.20 According to Circular 461/A-1/DD70 of the Director General of Forestry, dated February 2, 1970, concessionaires must present annual, 5-year and overall exploitation plans. Potentially, this obligation is a powerful tool which the GOI has in order to attain its long-term objectives. However, this obligation has generally not been fulfilled by the concessionaires. Annual plans should be agreed upon two months prior to the start of a tree-cutting campaign and should contain a production target based on 80% of the inventoried timber 50 cm in diameter or larger found in the area chosen for exploitation. Cutting cycle for this calculation is assumed to be 35 years. The five-year logging plans should contain the same information as the one-year plans and more specifically contain determination of the forest sections to be cut, construction of infrastructure planned, labor to be employed, and heavy logging equipment to be used. The timber management plan must cover the whole term of the concession and must include the over-all logging plan, forest development and protection methods, the silvicultural system to be used, maps of the whole area and all information required for sustained management of the forest resources.

6.21 Concessions may be terminated due to:

(i) Expiration of the period for which the concession was granted.
(ii) Withdrawal by the concessionaire before end of concession period (prior fulfillment of financial or other outstanding obligations).
(iii) Revocation decreed by the Ministry of Agriculture as a sanction applied to the concessionaire.

Causes for revocation are the following:[1]

(i) Non-payment of license fees at stipulated times.
(ii) Non-payment of royalties.
(iii) Operations not begun within 180 days of date concession is granted.
(iv) Non-delivery of annual working plans, 5-year working plan or overall forest exploitation plan.
(v) Abandonment of concession area and operations by the concessionaire.
(vi) Non-establishment of processing facilities (according to section 5 of the same law, in which, however, what is called for is a sincere effort to establish said facilities).
(vii) Lack of compliance with warnings issued by the authorities (presumably both Forestry Directorate and Provincial government officials) for three times.

6.22 The GOI has a limited role in the making of decisions or the utilization of her timber resources. The only measure explicitly considered in some agreements is a reduction in the concession area if the concessionaire does not install processing facilities. This measure, in the best of cases, could be taken only at the end of the period indicated in the contract for the start of manufacturing activities, but since this period is five years or longer, a considerable volume of timber may have been extracted before such a reduction in area takes place. All the concessionaires are supposed to present annual, five-year and long-term operational plans. Strict enforcement of guidelines for the preparation of operation plans [2] can be an important tool in the control of timber resources but enforcement is very lax at present. Systems for effective control of the application of those guidelines and volume of timber cut should be established. However, the number of professional and intermediate-level technical personnel in the country is inadequate to carry out all the supervision work required for forestry, logging, and export control. In spite of these difficulties, the Mission believes that if integrated plants are installed in Indonesia, the Government would have enough administrative tools to insure the processing of a high proportion of timber, without undue or unfair unilateral rewording of any outstanding concession agreements. This point is further explored in Chapter XI.

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1/ Government Regulation of the Government of the Republic of Indonesia No. 21 (Year 1970) of May 23, 1970, Chapter V, section 14.

2/ See Circular N°461/A-1/DD/70, Feb. 2, 1970, of the DGF; Regulation N°21, May 23, 1970, Section 3, and Guidelines for Preparation of Forest Management Plans, Appendix to DGF's decision of Oct. 20, 1970, No. 3516/A-2/DD/1970.

## Mineral Concession Agreements

6.23 State enterprises, national private business undertakings, cooperatives, or individuals may conduct mining on the basis of "mining authorizations" issued by the Minister of Mines on behalf of the Government. Also, the law stipulates that when necessary the Minister of Mines may appoint other parties, including private foreign businesses as contractors to carry our mining activities which have not yet been or cannot be carried out by a government agency or state enterprise which is the holder of a mining authorization. The Mining Law also contains basic regulations concerning so-called "people's mining", that is, traditional and primitive mining carried out by the local population on a small scale and individual basis.

6.24 The law divides the minerals into three categories:

a. Strategic minerals (oil, tin, nickel, radioactive minerals, etc.)
b. Vital Minterals (gold, silver, lead, zinc, etc.)
c. Other nonvital minerals (minerals not included in above categories)

The implementation of the State's authority to develop strategic and vital minerals is exercised by the Minister of Mines, whereas that of the other (nonvital) minerals is exercised by the Provincial Government of the territory to develop certain deposits of strategic and vital minerals. Any requests for mining concessions are submitted to to the Minister of Mines. Applicants must prove their ability and their capability both technically and financially, to undertake the development of the deposit.

6.25 Foreign companies may obtain exclusive rights to conduct mineral exploration development on the basis of a "contract of work" agreement with the Government. Foreign companies may also act as mining operators or contractors for State enterprises under contract. The foreign party as the operating company has to be incorporated in Indonesia, but it has full control and management of all its activities under the agreement, full responsibility, and it must assume all risks.

6.26 The general agreement consists of a prospecting period of 12 months, an exploration period of 36 months, and evaluation period of 12 months, a construction period of 36 months; the period for exploitation can run up to 30 years. Within one year after the termination of the exploration period, the company has to file a summary of its geological mining, ore dressing, and metallurgical investigations with the Ministry of Mines together will all other gathered data. Although the various periods of time for prospecting, exploration, etc. appear to be specified exactly, in fact they frequently can be extended, so that the lag between initial exploration and the beginning of actual

production may be exceedingly long. An example shows that this lag may be between 8.5 and 11.5 years.1/

| | Without Extension (months) | With Extension (months) |
|---|---|---|
| a. Date of agreement to beginning of general survey | 6 | 6 |
| b. General Survey | 12 | 24 |
| c. Exploration | 36 | 60 |
| d. Feasibility study | 12 | 12 |
| e. Construction | 36 | 36 |
| Total | 102 | 138 |

Since there are no provisions compelling approval of these time periods, it is even possible for the pre-production period to last longer than the figures indicated above.

6.27 The company is subject to payment of land rent for the contracted area, royalties in mineral production corporation tax, and general sales tax. No tax holidays for corporation income taxes are granted to mining enterprises, but there is a reduction of tax rates for the first ten years. Additional tax concessions may even be granted to the investor in the form of an investment tax credit in special cases of large investments. A summary of the provisions is shown in Table 6.1.

6.28 The Foreign Capital Investment Law No. 1 (1967) exempts the investor from import and other custom duties on machinery, equipment, tools, and ancillary supplies needed for operation of the project. Any item imported by the foreign company for operation of the project and that is no longer needed may be re-exported free from all regular export and other custom duties, or may be sold in Indonesia after compliance with customs and import laws and regulations. The law permits repatriation of profits, provided taxes and all other official obligations have been met. Provision is also made for accelerated depreciation of fixed capital assets. Not only is accelerated depreciation allowed but the firm also has the option of changing the method used

1/ T. A. Manring, op. cit., p. 6.

from one year to the next. Moreover, it is sometimes stated that the method used may be different for tax purposes than it is for financial purposes.

6.29 As of December 1970 nine foreign companies have signed agreements with the Indonesian government for the development and exploitation of mineral deposits in the country. Eight are still operating as of the writing of this report, and eleven are currently negotiating contracts with the government. The following foreign companies have agreements for mineral development:

1. Freeport Indonesia Inc. (Subsidiary of Freeport Sulphur Co., U.S.A.)

2. N. V. Billiton Maatschappij (The Netherlands)

3. P. T. International Nickel Indonesia (Subsidiary of INCO, Canada)

4. P. T. Pacific Indonesia (Consortium of U. S. Steel Corp., U.S.A., Koninklijke Nederlandsche Hoogovens en Staalfabrieken, N. V., William H. Muller & Co., N. V., the Netherlands; Newmont Mining Corp., U.S.A.; Sherritt Gordon Mines, Ltd., Canada.)

5. Aluminum Company of America (Alcoa, U.S.A.)

6. Indonesian Nickel Development Co., Ltd. Consortium of Fuji Iron Steel Co., Ltd.; Mitsubishi Shoji Kaisha Ltd.; Mitsui & Co. Ltd.; Nippon Mining Co. Ltd.; Nippon Yakin Kogyo Co. Ltd.; Pacific Nickel Co. Ltd; Sumitomo Metal Mining Co. Ltd.; Sumitomo Shoji Kaisha, Ltd.; and Yawata Iron & Steel Co. Ltd.

7. Overseas Mineral Resources Development Co. Ltd. (Japan)

8. P. T. Kennecott Indonesia (Subsidiary of Kennecott Copper Corp., U.S.A.)

9. P. T. Riotinto Bethlehem Indonesia (Consortium of Rio Tinto Zinc Corp., England, and Bethlehem Steel Corp., U.S.A.)

All companies except Overseas Mineral Resources Development Co. Ltd. are still active in Indonesia. Of these eight, three are for nickel, one for aluminum, one for copper, one for tin, and two for exploration of any mineral deposits.

6.30 An extensive commentary on the provisions in present mineral concession agreements and a model contract for such agreements have been prepared and are available to the government.[1] The Mission endorses the general conclusions of the commentary particularly those to the effect that: (a) the provision of incentives has probably been excessively generous. This applies importantly to the granting of investment tax credits, provisions for changing depreciation methods, and the lax treatment of interest payments paid to affiliates being included in costs. (b) The time periods permitted prior to production and the specification of tests of performance may well lead to excessive delays and to performance in production that is lower than the preferences of the government.

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1/ T. A. Manring, op. cit., and Model Contract prepared by the Harvard Development Advisory Service.

Table 6.1

Summary of Contractual Mineral Agreements

| Name of Company | Date of Agreement Termination | Size of Concession | Obligatory Exploratory Expenditure | Royalty Rent Payments | Obligatory Development Expenditure | Tax Requirements | Present Status |
|---|---|---|---|---|---|---|---|
| N. V. Belliton Maatschappij (tin) | 1968<br>1998 | two areas mostly over-ocean each about 12 square kilometers each | $1,000,000 | 8 2/3% of value of tin metal contained in concentrates produced--4% for associated metals<br>$0.00125 per annum per hectare during survey period--$0.025 during exploration--$0.20 during operating period | $6,000,000 | 40% of net income for first ten years of operating period--48% for remainder of contract | exploration of one area completed within a year--cost was about $2 million--all drill samples analyzed in Holland--indications are that sufficient reserves are available for development--possible development will start in about 1 1/2 years--maximum mining depth 50 meters--explorations indicates ore below this depth |
| International Nickel (nickel) | 1968<br>1998 | 6,600,000 hectares | $1,500,000<br>$500,000 30 days after contract approval | ore with less than 2.5% nickel-cobalt royalty of $0.015 per kilogram of contained metal--ores with more than 2.5% royalty $0.03<br>$0.005 per hectare per annum during survey--$0.10 during exploration--$1.00 during operation period | $75,000,000 | 37 1/2% of net income for first ten years of operating period--45% for remainder of contract | to date, Inco spent $15 million--plans to invest $200 million on plant to produce 50 million pounds of nickel by 1975. Process will include both Inco laterite smelting to produce a 75% matte and Inco reduction/acid leach process to produce a 55% nickel sulfide--exact ultimate process technology not yet decided. Inco claims to have discovered a large low-grade sulfide ore body on their concession |

Summary of Contractual Mineral Agreements

| Name of Company | Date of Agreement Termination | Size of Concession | Obligatory Exploratory Expenditure | Royalty Rent Payments | Obligatory Development Expenditure | Tax Requirements | Present Status |
|---|---|---|---|---|---|---|---|
| P. T. Pacific Nickel Indonesia (nickel) | 1969<br>1999 | 283,000 hectares | $1,500,000 | same as International Nickel | $75,000,000 | same as International Nickel | at present, making general survey |
| Aluminum Company of America (bauxite) | 1969<br>1999 | 400,000 square kilometers | $1,200,000 | $0.20 per ton dry basis of bauxite processed in Indonesia. $0.40 per ton dry basis of bauxite exported.<br><br>first 12 months of general survey, $50,000, next 12 months of general survey $0.005 hectares per year--during exploration--$0.10 per hectare during development $1.00 per hectare per year. | $100,000,000 | same as International Nickel | ALCOA has indications of a large bauxite deposit on Kalimantan. Plans are to construct a reduction plant with an initial capacity of 200,000 metric tons of metal per year--eventual capacity of 360,000 metric tons of metal per year--total project cost will be $300,000,000--plan to be on stream 1976-1977 |
| Indonesian Nickel Development Company (nickel) | 1969<br>1999 | 3,880,000 hectares | $750,000<br><br>$150,000 30 days after contract approval | same as International Nickel | $75,000,000 | same as International Nickel | at present, doing exploration. |

Summary of Contractual Mineral Agreements

| Name of Company | Date of Agreement Termination | Size of Concession | Obligatory Exploratory Expenditure | Royalty Rent Payments | Obligatory Development Expenditure | Tax Requirements | Present Status |
|---|---|---|---|---|---|---|---|
| Overseas Mineral Resource Development Ltd. | 1969<br>1999 | 1,000,000 hectares | | | | | company has relinquished all of its holdings |
| Freeport Indonesia Inc. (copper) | 1967<br>1997 | 10 square kilometers | $1,500,000 | None | None | exempt for first 36 months of operation--35% of next 84 months but not less than 5% of net sales--41.75% of remaining period but not less than 10% of net sales | company will start mining 1/1973--total expenditure $130 million--33 million ton ore body--2.5% copper with small amount of gold and silver--iron ore (40%) present but not economically minable --13-18 year life of present mine |
| Kennecott of Indonesia (all minerals) | 1969<br>1999 | 30,761 square kilometers | during general survey $10 per square kilometer | royalty schedule set up for 43 minerals | None | based on type of mineral deposit developed--see contract for details | |

Summary of Contractual Mineral Agreements

| Name of Company | Date of Agreement Termination | Size of Concession | Obligatory Exploratory Expenditure | Royalty Rent Payments | Obligatory Development Expenditure | Tax Requirements | Present Status |
|---|---|---|---|---|---|---|---|
| Kennecott of Indonesia (all minerals) continued | | | during exploration program $100 per square kilometer with advance payment of $300,000 30 days after contract approval | see contract for details--land rent $0.005 per hectare per annum during general survey--$0.10 during exploration--$2.00 per hectare during operation | None | | exploratory drilling on West Irian for low-grade copper deposit |
| Riotinto Bethlehem Indonesia (all minerals) | 1970<br>2000 | 35,000 square kilometers | during general survey period $10 per square kilometer--exploration period $100 per square kilometer | royalty schedule set up for 43 minerals--see contract for details | None | based on type of mineral deposit developed--see contract for details | at present, making general survey |

# CHAPTER VII

## RESEARCH, DEVELOPMENT, AND TRAINING FOR INDUSTRIAL DEVELOPMENT

7.1 As in most developing countries there is an active interest in the potential benefits to development from research and development activities, on problems such as the transfer or incorporation of technology, the pursuance of information on topics or areas that are unique to the country (e.g. marine biology and pisciculture in tropical waters), and there is a recognition that research and development is generally retarded, in a somewhat confused state, and perhaps not receiving the attention and the resources that are deserved. There is a similar feeling with respect to training needs, though it is not so much a feeling of possible neglect of this topic as it is a recognition of the complexity of defining the needs in specific terms and formulating programs that will be effective.

7.2 The interest and concern with the use of research, development, and training in the national interest is evidenced by recent reports and the papers of a scientific conference. A thoughtful report by Lembaga Ilmu Pengetahuan Indonesia (LIPI; the Indonesian Institute of Sciences) covers broadly the problems and the opportunities for applying science and technology to the development needs of Indonesia and devotes attention to each of the major sectors of agriculture, industry, health, education, natural resources, infrastructure, and the social sciences.[1/] The report is a compendium of information on these topics that could well serve as a basis for discussion and the formulation of appropriate policies. In addition there are the papers of a conference sponsored jointly by LIPI and the National Academy of Sciences, USA.[2/] These papers cover a wide range of topics in the funding, support, and program formulation of research and development, and the experience with these problems in various industries or sectors in Indonesia. What emerges as the central thesis of the report and the conference papers is the need for guidance and a program of support for research and development to realize the latent benefits that are available to the country.

7.3 Unfortunately "research and development" has become a debased term in recent years. It was, correctly, meant to identify activities that contribute to knowledge and that lead to new or better solutions to real problems. In its debased form it is loosely used to cover activities that range from "sales engineering" to largely paper studies of problems whose reality has been removed by appropriate choice of the assumptions. This is not said in criticism of any particular set of activities now going on,

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1/ LIPI, The Application of Science and Technology to Development in Indonesia. Vol. I-II, Djakarta, April, 1971.

2/ Workshop on Industrial and Technological Research, Djakarta January 25-31, 1971. There are some 75 individual and working group reports among the conference papers, the majority of which are by Indonesian officials and scholars.

but rather to make the point that support for activities designated as "research and development" is often blindly regarded as desirable, without investigating the content of the activities, whereas in assessing support for an industrial development program, these activities should be held to rather strict account. The tests are the relevancy of the research and development to specific problems and their productivity in improving the quantity and quality of industrial performance. One knowledgeable observer of the problem in Indonesia has summarized in the following words" " . . . lately many institutions are besotted by 'research fever.' This is partly due to pressures from real needs to carry out research. For the other part, it is due to pressures originating from the urge to follow the fashion to 'do research' on everything. To guard against wastage in research, it is necessary to have a research plan which includes research priorities oriented to strategic sectors of development."1/

## Objectives and Purposes of R&D

7.4 Much of the writing and discussion at the present time is directed toward the need for a "sciences policy" in Indonesia or the proper focus for research and development as a general matter. There is undoubtedly merit in raising such issues, but that is too broad a framework for this discussion. We are confined to R&D as it can, or should, apply within the industrial sector, and specifically as R&D may be directed to solving industrial problems within the context of a development plan. This may be regarded as too narrow a focus, but it has the vesture of directing attention to the most immediate and pressing needs. It is also relatively short-run in its outlook; we are primarily concerned with what might be accomplished in about the next five years. If a good start can be made in this time frame and modest success achieved, the future for R&D, while not assured, will at least be much easier to maintain at a healthy level. This limited definition of the horizon for planning industrial R&D will obviously affect decisions on the programs to be selected, the institutions to be supported, and the budgetary support for them. Programs and personnel that can have a pay-off in the short-run will be preferred over those with along gestation period.

7.5 The implications of this kind of orientation can be contrasted to a somewhat different characterization that has been outlined.2/ This alternative suggests several characteristic features of R&D in Indonesia. The topic area is first characterized as having a "national scope." If this means that there is a national interest or concern in the results, there can be no quarrel, but the programs suggested here is more parochial. Its scope extends only to industrial problems. There is no necessary conflict between the two approaches. Second, the solutions to

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1/ E. Salim, "Research and Economic Development" paper presented at the Workshop on the Technique of Choices and Evaluation of Research Projects, Djakarta, October, 1970.

2/ Ibid. pp 9-10.

the problems are described as those that will bring about "a structural change" in the economic and social system. This is an appropriate characterization for a total development program, but in industry the objective is the much more modest one of solving the technical problems in production that are impeding the successful performance of individual plants. Third, the problems are said to require a "fundamental solution" that is "long term in nature", whereas we emphasize the proximate or pragmatic nature of the required work and stress the need for short-run results. The viewpoint of the former position, which is that of the total developmental effort is, as before, not incompatible with the proposals for industry. Finally, the alternative characterization says that the problems are development-directed and have a "less basic research character", and with that both points of view are in agreement. The contrast that is drawn here is more apparent than real; it has been made in order to emphasize again, and in another way, the imperative need to organize and support an industrial R&D effort that is active not somnolent, and that is problem and performance oriented.

7.6 A statement of objectives or purposes for industrial R&D runs the risk of either being too general, and thus ambiguous and trite, or else too specific, and thus missing the big opportunities, but it is suggested that the following elements constitute a workable set of objectives.

(1) Finding solutions to specific production and technical problems now existing in industry to raise the rate of utilization of capacity, lower operating costs, and for regularized production runs in a plant. Such problems are apt to be most severe in the medium and smaller scale industries, those of domestic origin, and those in the mechanical and light industries. Initial concentration should be in those areas.

(2) Adapting production processes to local conditions. These should be viewed more as micro-problems in adaptation rather than macro-problems. The correct illustration is determining how best to adapt a machinery operation to a metal product, rather than preparing a grand design for a proposed steel industry (though, as is indicated below, certain aspects of this latter kind of work may be required).

(3) Provision of limited but intensive training for selected cadres from industry in the types of problems mentioned in (1) and (2) above.

(4) Preparation of feasibility (and pre-feasibility) studies of projects, or processes within major projects, that are deemed desirable or feasible within the development plan frame. Thus, for example, some of the effort of research institutes could be assigned to the preparation of parts of feasibility studies on the major projects that are recommended in Chapter II and described in detail in Chapters VIII-XII of this report. Such assignments should be made by Bappenas in consultation with other government agencies as appropriate.

7.7 The four points of the suggested program do not exhaust the important opportunities that are available for applying R&D to the tasks of development, but they probably do exhaust the immediately available resources

of qualified personnel and facilities that Indonesia has to devote to these problems. How can these resources be best devoted to the tasks at hand?

## The Commitment of Resources

7.8 Indonesia, together with many other developing countries, has taken seriously the mandate that 1% of the GNP should be set aside for research and development expenditures, and this in spite of the fact that the criteria for establishing that standard are ambigous, generalized rather than related to country unique circumstances, and intended as a guideline rather than a target. But there is little evidence that the standard has been taken literally. Although it is difficult to disentangle the statistics on allocation of funds to specific programs that are supported by different ministries and government agencies, it appears that in 1970-71 the government is allocating about Rp 8 billion (i.e. slightly over $20 million at current exchange rates) to research and experimental development.1/ These are funds directly allocated through the public budget and exclude funds that arise in private industry, foundations, foreign and other sources. All sectors of activity are included. Of this amount approximately 23 percent originate in the routine Government budget and 77 percent in the development budget. The total amount cited is swollen by allocations that clearly have little to do with research and development as defined under even generous standards. For example, almost 30 percent of the amount in the development budget is attributed to expenditures of Government offices whose responsibilities are public information. The nominal amount attributable to activities in industry is on the order of 10 percent of the total. In the aggregate, and accepting the total of Rp 8 billion as representative of all expenditures on research and development, approximately two-tenths of one percent of the GNP is currently allocated to these activities. Given the low level of income per capita and the many claims made against revenues in a forced-draft development program, this allocation cannot be arbitrarily dismissed as insufficient. What can be questioned is the distribution and uses made of the total. Even $20 million will buy a lot of expert assistance if it is concentrated and spent on high priority items.

7.9 There are apparently personnel and special research institutes devoting attention to particular problem areas or topics. The LIPI report identifies 74 non-educational and 96 educational institutes concerned with technological research in one form or another. About 90 percent of the research institutes (excluding academic institutions) are in the Ministries of Agriculture and Industry. There are 17 industrial research institutes in the Ministry of Industry alone, reporting to five different directors general. These institutes get part of their funds from the Government and part from direct contracts. But on the average the size of professional staff of the research institutes is small. The LIPI report notes that "the average non-educational research institute has 12 full-time scientists and 3 part-time people. If

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1/ Muljons "Current Research and Development Funding by Government Agencies", LIPI-NAS Workshop Papers.

we assume that this applies to the technological activities then these institutes are much too small."1/ The same report estimates that there is an upper limit of 800 to 900 equivalent full-time personnel doing technological research, and the implication is that in all probability the actual number falls far short of that limit. In several places, the report also notes the low salaries paid to the research staffs, with the result that many of them hold more than one job. This phenomenon is not unique to research, however; it is typical throughout Government.

7.10 A survey of the actual research work undertaken by research institutes in terms of its applicability and relevance to development needs in industry is somewhat discouraging. The LIPI report contains a brief summary of the extent of work now going on in industrial research; this summary is included as an annex to this chapter. In particular it is noted that the machinery and metals industries are not well covered by research. The work on chemicals has some good points but it is not uniform and thare are gaps. Plastic products are considered only with respect to packaging or their mechanical properties. There is apparently a lack of information and understanding on the part of the research institutes of the needs for industrial research work in support of the development plans being formulated by the Government, and an equal lack of communication between private industry and the institutes. Guidance, discussion, and mutual agreement on the priority issues are generally weak. The "market" is not functioning as it could. As a result, it is not surprising that the research programs tend to be somewhat vague and sporadic in coverage.

7.11 Yet there is evidence that within the research community there is a desire to be productive and to assist in development if guidance can be given and certain other problems can be solved or at least ameliorated. A paper prepared for the LIPI-NAS conference in January, 1971 concerning research at the Bandung Institute of Technology (ITB) sums up this attitude rather well.2/

> "Most of the faculty staff with advanced degrees are in an age bracket which is considered to be within the peak at their creativity and they need an outlet. Opportunities should be created for them; otherwise frustration will arise which will be detrimental and the result will be anything but useful to all."
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> . . . .
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> " . . . a valid question might be raised on the soundness of the budget allocation for research. Clearly the conclusion can readily be obtained that the research

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1/ LIPI, op. cit., Vol. II, p.32

2/ S. Sapiie, "Current Situation of Industrial and Technological Research System Within ITB," LIPI-NAS working paper.

projects being carried out do not reflect any clear cut objectives supporting the basic aims of the present development plan. This is a very valid point indeed which needs clarification. . . ."

. . . .

" . . . . the money appropriated for research in the budget year 1969-70 came very late, towards the end of the year. Bound by various Government regulations on spending which must be done within the budget year, the whole planning was thrown off balance. Control and evaluation of the projects in that budget year was just not possible. Valuable data which could have been reported and would shed more light becomes non-existent."

. . . .

"It is to be hoped that less bureaucratic procedures could be applied . . . ."

This is a plea for guidance and direction so that the professional personnel can feel a sense of commitment to and participation in development, and a request for reasonable budgetary support so that the tasks can be adequately carried out.

7.12 One might summarize briefly the current situation in research and development in the following points: (a) there is a proliferation of research institutes, agencies, etc. beyond what is found in many countries; (b) on the average the size of the professional staff in a unit is small - in a sense to be defined later the average size is "too small", (c) there is a lack of guidance and communication among the planning offices, the institutes, and private industry and the result shows in less than fully productive and unsystematic research programs; (d) professional personnel must often hold several jobs which impairs their productivity, but this is a condition shared with many other persons. Yet there is basis for productive work on important problems. What might be done to improve the situation?

7.13 There are several possible actions that could be initiated; they are offered for consideration and discussion, since detailed programs could not be prepared. First, some consolidation of research institutes serving industry might be undertaken. The Cowley report suggested consolidation of the institutes into seven major groups.1/ textiles and batik; ceramics and cement; materials testing and metallurgy (which is now to be covered by the new Metal Industries Development Center); chemicals; food chemistry and processing; cellulose research, including paper and packaging; and an institute to concentrate on training in operations. These suggestions might be the starting point for a detailed analysis of the problem and the formulation

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1/ W.E. Cowley, UNIDO report, 1969. Cited in LIPI, op. cit., Vol. II, pp. 1, 8ff.

of an action program. It is evident that if consolidation occurs, the average size of the professional staff in an institute could be increased. There are certain economies of scale in research as in production, notably in the better coverage of inter-related problems and more effective specialization. The mission hazards the guess that the minimum critical size of staff is on the order of twice the average size now found, that is, a staff of 25-30, though this varies depending on many factors. This should not (and undoubtedly will not) be taken as a confirmed judgment on which to act, but it is probably in the right direction.

7.14 Second, since it is unrealistic to expect that actions can be undertaken to strengthen guidance and research program formulation in all areas simultaneously, it is suggested that a start be made in the area of machinery and metals. This is in accord with the recommendations made in the latter part of Chapter II where the engineering industries are shown to be both essential to development and currently retarded. This further suggests an initial concentration on strengthening the work programs, staff, and budgetary support for MIDC and ITB. This is a program in which Bappenas should take an interest, in close cooperation with the Ministry of Industry and the institutes themselves.

7.15 Third, in this regard Indonesia can profit from the experience in other countries. One of the more successful programs in coordinating development planning, project feasibility studies, and technical help to industry exists in Korea. There is close coordination among the Economic Planning Board (corresponding to Bappenas), the Ministry of Commerce and Industry (corresponding to the Ministry of Industry), and the Korea Institute of Science and Technology (corresponding to MIDC and ITB). It is recommended that a group representing the four units examine the Korean experience to determine what techniques and arrangements might reasonably be transplanted to Indonesia.

7.16 Fourth, if the proper attention is to be given to helping industry with its immediate production and technical problems, the institutes must establish a close relationship with private industry so that there is a mutual understanding of the problems and the capabilities, and so that a habit is formed of looking to the institutes for help when it is needed. This is particularly important for the medium and smaller scale firms in industry.

7.17 Finally, if this first step in machinery and metals is successful, a pattern will be established that can be emulated in other institutes and industrial areas. The "demonstration effect" should be a relatively powerful one, far more likely to be effective than attempts to undertake improvements across the board at a single time.

## Manpower Training

7.18 The mission has little to suggest in the manpower training field, beyond reiterating points made by others who have worked intensively in

this field and are more knowledgeable.[1] The interrelationships among manpower needs, training, and educational planning are varied, complex, and their significance transcends the interests of a single economic sector such as industry. Unless one is prepared to consider these interrelationships quite fully, in order not to omit salient points, it is prudent to limit the remarks to a few fairly obvious points. There is, first of all, fairly general agreement that a lack of entrepreneurship (in the classic sense of that term) combined with managerial skills constitutes a potential constraint on the expansion of industry in the future, though there is less agreement on the types of programs that will be helpful. Most analysts believe that the problem is one that can be overcome by teaching standard business method courses (though there is a need, for example, for more people trained in standard skills such as accounting). As has been suggested earlier in this report, new entrepreneurs in industry probably must be drawn from those who have made money in trade and commerce and, as the experience of many countries indicates, this transition takes time and careful cultivation. There is general agreement on the need for some kind of management development program in conjunction with improvements in the incentive and support systems for new businesses. The programs of Pendidikan dan Pembinaan Management (PPM) and the Management Institute of the Faculty of Economics of the University of Indonesia are cited as examples of some success in the field; their experience may be worth expanding and/or transferring to other selected agencies. In any event the topic of management development and training is one that deserves continued attention.

7.19 Second, an earlier IBRD report[2] notes that vocational training in the present system is rather specialized and rigid, and of poor quality partly because of insufficient and poorly trained teachers, and partly because of lack of equipment. An alternative is to focus on more flexible and general training in basic knowledge, leaving specialized skills to be learned on the job. If the industrial sector growth is accelerated, the requirements for vocational training of a labor force will similarly be expanded so that this too is an area of special interest to those concerned with industrial development.

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1/ For example, The Ford Foundation has a number of programs and an active interest in training and education and has sponsored reports on a number of topics. Cf. S.B. Jaedono, "Report on a Survey of Opinion on Management Problems," April, 1970. E. Rubin, "Management Problems of the Private Sector and Public Enterprises in Indonesia and Means of Solution."

2/ Cf. IBRD, "Appraisal of an Education Project Indonesia," PE-19a.

7.20 Because of the inadequacy and unreliability of the statistics, many basic studies of the demand for and supply of labor, productivity, etc. cannot sensibly be undertaken, or at least are of very dubious quality when they are undertaken. This impairs seriously the ability to analyze and make decisions relating to the whole range of labor problems. This problem matches the statistical problems, mentioned earlier, with respect to basic industrial statistics on output, value added and the like. A high priority needs to be given to improving the statistical base, not only for industry, but for all sectors.

# PLANNING FOR INDUSTRIAL DEVELOPMENT IN INDONESIA

## Chapters VIII - IX

## Steel and the Engineering Industries

# BASIC DATA

(Original with Chapter I)

# CHAPTER VIII

## IRON AND STEEL

### CURRENT STATUS OF THE IRON AND STEEL INDUSTRY

8.1 Plans to provide Indonesia with its own steel industry go back to 1955 when the Government commissioned a study which recommended the establishment of various small plants. In 1959, under an agreement with the USSR, further studies were undertaken which lead to 3 projects, a blast furnace plant at Lampung, North Sumatra, to make 35,000 tons of pig iron annually, the Tjilegon Steel Plant with a capacity of 100,000 tons of ingot steel annually and the Kalimantan Survey Project, aimed at the establishment of an integrated plant of 250,000 tons of ingot annually. The pig iron from Lampung was to be used, in addition to scrap, in the Tjilegon steel melting shop, which for the purpose was to be equipped with two open hearth furnaces. The Lampung project was abandoned when the iron ore reserves turned out to be insufficient and the Kalimantan Survey Project did not get beyond the survey stage.

#### The Tjilegon Project

8.2 For the Tjilegon project, a contract was concluded with the USSR which covered, at a price of $36 million equivalent, the engineering, design, supply of all equipment, construction supervision and training of staff. The plant was started at Tjilegon, about 80 km. west of Djakarta, the main market and 10 km. east of Merak, the nearest place at which a deep water port could be built and was in fact planned. The rolling mill consisted of a bar and light section mill and a wire rod mill with a capacity, depending on product mix, of 200-250 thousand tons of product annually. The planned output, however, due to the constraint of steel melting shop and billet reheating capacity was 84,000 tons annually. In 1965 project implementation was discontinued for lack of Rupiah funds. By that time, about 80% of the civil engineering work had been completed and about the same percentage of equipment had been delivered, though little had been installed. In 1968, Granite City Steel International made a proposal to complete the project. The proposal provided for the replacement of 100,000 tons open hearth capacity and ingot stripping by electric arc furnaces and continuous casting with a capacity of 208,000 tons annually, so as to provide a more economical steel making process and a better utilization of rolling mill capacity -- 200,000 tons annually instead of 86,000 tons as originally planned. No agreement was reached on the terms of Granite City Steel. The Government expects in the very near future from the Government of the USSR proposals for the completion of the project.

#### Other Projects

8.3 Meanwhile, a local company, P.T. Air Trading built a steel plant in Djakarta with an initial capacity of 10,000 tons annually of reinforcing rods and bars. The plant is understood to have a scrap-fed

electric arc furnace and a cross country mill,[1] built by the company from various new and second-hand components. Licenses have been issued to local firms for fourteen other projects, ranging in capacity from 1,000 tons to 60,000 tons annually, of non-flat products, mainly reinforcing bars and rods, and some of them are in various stages of implementation. Estimated investment costs vary between $29,96 and $297.94 per ton of capacity, and total capacity, if all projects materialize, would be 245,000 tons annually. This, however, seems most unlikely.

8.4 In addition, 8 proposals have been received from foreign investors ranging in capacity from 15,000 tons to 120,000 tons. In May 1971, one of these proposals had been rejected. On four, no progress was achieved, one was under negotiation, and a 30,000 ton project was under construction. Total capacity of the active proposals would come to 246,000 tons. Total capacity of all licensed local and foreign projects would be 492,000 tons annually.

8.5 Licenses have also been issued for 3 plants to make pipe from imported skelp, the largest with a capacity of 21,000 tons. To meet demand for corrugated galvanized sheet, 8 licenses have been issued and 4 plants have meanwhile been built, with a total capacity of 25,000 tons per year.

Present Planning

8.6 The picture of a steel industry emerging here is very similar to that of the Republic of China and the Republic of Korea 15-20 years ago. The Government, preoccupied with urgent development tasks in all fields, and primarily in agriculture and light industries, decides to leave the development of a steel industry to private initiative, perhaps reasoning that the investor who puts his money at risk should best be able to decide whether the time had come to produce steel in the country, and what type of plant meets best the local requirements. In keeping with that approach the Department of Basic Industries has compiled a number of demand forecasts and licensed about double the capacity that would be required on the strength of these demand forecasts - assuming that the Tjilegon project would not come into operation. Given the high mortality rate among such projects, and the early stage in project development at which the license is issued, there would appear to be no danger of over licensing. Project proposals are reviewed, and, to the extent that they call for special preferences or privileges, recommendations are made which in the case of one foreign proposal led to its rejection.

Evaluation

8.7 However, this approach to steel planning has a number of

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1/ A bar mill with the stands arranged side by side, with manual transfer from stand to stand.

drawbacks, as the experience of Korea and China has demonstrated. Basic iron and steel making is a highly capital intensive enterprise, and, as in most capital intensive enterprises, calls for large volume output to achieve economies of scale. In some fields of industrial enterprise production technology itself sets a lower limit - modern ammonia synthesis processes are just not feasible below an output of 500 tons of ammonia per day - but steel, unfortunately, can be made by nearly any process in any desired volume - at a price. Plant capacity becomes then a matter of the investors' ability to raise finance, rather than a matter of relating output to demand in order to determine, whether the marketable output volume permits sufficient economies of scale in production for the product to be competitive with imports. As a result, too many small plants are built, many of which cannot expect to have a positive and acceptable economic rate of return. These small plants pre-empt the market, create planning problems and increase the cost to the economy of eventually establishing an efficient steel industry.

8.8 In planning their small plants the investors do not seem to be taking into account important factors affecting their future production cost. The difference in planned investment cost in the proposals presently licensed quoted above - a ratio of 10:1 (see Paragraph 8.3 above), indicates that quite a few proposals must have been based on unrealistic cost estimates, even allowing for differences in the cost basis and for different rates of exchange used in converting estimated local cost. The very low price for local scrap - $15-25 per ton reflects lack of demand. With increasing demand prices are bound to rise until they reach import parity, at present $60 per ton landed cost net of duty. At present consumers do not appear to be very quality conscious so that savings in investment costs can be made by the use of second hand or rebuilt equipment. But with growing demand and product standardization, quality might well become an important consideration. Imports are presently handled in a way that increases the CIF price by about 15-20% on account of landing cost and so adds considerably to the natural protection afforded indigenous production through the transport cost differential. With the streamlining of port operations, document processing and customs procedures landing costs are bound to come down.

8.9 Protection would then be needed and the Government would be faced with a difficult choice: either burden the developing metal using and construction industries with a high steel price brought about by high duties, or be accused of sacrificing, the "national steel industry". In the latter case, considerable investment resources would be wasted, and any Government would find it very difficult to make such decision. In the former case, the commercial risk for what was a private investment decision is being transferred to the Government, and passed on by the Government to other branches of the economy which had no influence on those investment decisions.

8.10 In the event, the Government might try to compromise, under which the marginal "backyard" producer would be left to his own devices,

and steel capacity would be laid out in such a way as to enable the better equipped small plants to produce finished products from intermediate products supplied by an economically sized integrated plant. In this way at least in steel making, if not in rolling, economies of scale would be achieved.

8.11 Fortunately, the point has not been reached where this difficult policy decision will unavoidably be forced upon the Government simply because most of the licensed projects have not yet reached the implementation stage. This should make it easier for the Government to begin planning development of a steel industry with due regard to considerations of efficiency and economy, taking into account the country's resource endowment. The following is intended to provide an outline for steel planning in Indonesia.

## A PROPOSED OUTLINE FOR STEEL PLANNING

8.12 As with other productive investment, any meaningful planning for steel has to proceed from the market size and the resource endowment to establish whether a satisfactory economic rate of return can be expected from the investment. With modern large scale low cost bulk transport, gaps in the natural resource endowment can be overcome. The necessary skill transfer can be arranged through collaboration or management and technical assistance agreements, and capital can be found if the rate of return is right, but there is no substitute for the domestic market. The viability of a steel industry thus becomes a function of the size of the market. It determines whether the establishment of a steel industry can be considered, and what degree of manufacturing: rerolling, scrap melting or fully integrated processing from ore to finished product, best meets the country's demand. The resource endowment and the cost at which missing resources can be obtained then determine, through the expected economic rate of return, the order of priority in the queue of competing claims for limited investment resources.

### Past Consumption and Market Prospects

8.13 The figures on consumption shown in Table 8.1 are those published by the Biro Pusat Statistik, the Government's Central Bureau of Statistics. These figures represent imports as evidenced by customs documents, and since the rate of duty on steel products is very low, they can be taken to represent actual imports. Steel is imported in small consignments mostly to fill actual orders, and there is no indication that substantial stocks are being held anywhere. Indigenous production - by one small scrap based rolling mill - is only a few thousand tons per year. Imports thus can be taken to represent demand.

8.14 Indonesia consumed in 1970, 426,000 tons of finished rolled steel products corresponding to 505,000 tons of crude steel, if we assume continuous casting, or 570,000 tons of crude steel if ingot casting and stripping is assumed. Of the total demand for rolled products 44.2 per cent

were for nonflat, and 55.8 per cent for flat products. In an economy in Indonesia's stage of development one would expect to find a slightly higher demand for non flat products than for flat products. The difference is easily explained. Structurals, shown in the table under flat products for planning purposes, have most likely been rolled, not welded, structurals. With a large oil and gas industry and extensive ship building and repair, Indonesia is bound to consume more plate and pipe, which, if welded from strip, belongs under flat products, than a country in a similar stage of development, but without the need for interisland sea transport and without an oil industry.

8.15 Demand has nearly tripled during the last three years from the lowest point in 1967. It reflects the extent to which the economy was starved for steel, the speed and dispatch with which aid was organized and put to use, a return of confidence, and the inherent vigor of the economy. But these growth rates are not a suitable basis for demand forecasts, since they indicate deferred maintenance and rehabilitation needs rather than new investment. Any projection method requiring a time series is not applicable in Indonesia to forecast steel demand. Also, as pointed out elsewhere in this report, Indonesia's industrial structure is atypical, so that cross references to other countries might be misleading. Earlier forecasts made by others are definitely too low. The report of the ECAFE Iron and Steel Survey Mission predicted that from 1966 onwards steel consumption would increase by 4 per cent per annum in accordance with a stabilized, but growing economy. The Japanese-AIDC Iron and Steel Survey in their January 1969 report proposed a growth rate of 4.6 per cent through 1985. A forecast computed more recently by the Directorate General of Basic Industries, Department of Industry, quotes various forecasts made by different agencies and consultants of 5-10 per cent for bar mill products.

8.16 The Bank's macro economic model 1/ assumes an average growth of investment between 1971 and 1975 of nearly 14 per cent annually, and 10.4 per cent thereafter. For steel consumption this investment growth rate would imply a doubling by 1975 of the rolled steel consumption of 426,000 tons in 1970. However, there are two factors that would justify projecting an even faster growth over the next five years. We have no way of knowing whether the rehabilitation phase is over. The rapid demand growth, observed over the last three years may very well continue, perhaps at a somewhat reduced rate over the next two to three years before it flattens into a growth rate consistent with that of investment growth. If that should happen, "normal" growth would take off from a level appreciably higher than present consumption. With increasing import substitution in the metal working industries discussed elsewhere in this report, and the preponderance of construction activities in overall investment, the growth rate of steel consumption is bound to exceed the investment growth rate. Both factors are not synchronous; while the rehabilitation-induced consumption growth is bound to abate, consumption caused by new investment and import substitution is bound to accelerate over time.

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1/ Indonesia: Investment and Growth Perspectives in the 1970's - A First Report, EAP-22 - March 25, 1971

8.17 Outside the macro economic model the Bank Economic Mission calculated a public and private investment growth rate of 16-17 per cent, derived from projected development budgets and from an aggregate of projects in the pipeline, planned or identified. This growth rate has been adopted for steel demand up to 1976.

8.18 A 16 per cent growth rate may well turn out to be on the low side. Even with about one million tons of steel products, corresponding to 1.2 million tons of crude steel Indonesia would only have a per capita steel consumption of about 9 kg in 1976. Ten years earlier Thailand had 21 kg, Malaysia 43, the Philippines 24 and Taiwan 51 kg. 1/ Furthermore, an error of 2 per cent in growth rate on either side, would advance or defer the time by which the projected demand is reached, by about six months. Even with a growth rate of only 12 per cent for 1971-73, and 10 per cent thereafter, total consumption of rolled steel in 1976 would still be 807,000 tons.

8.19 These forecasts, also shown in Table 8.1, require various caveats. As actual imports demonstrate, the growth of demand is unlikely to proceed as steadily as the use of a constant growth rate makes it appear. The growth rate itself is unlikely to be constant. It could well be higher in earlier years, in catching up with a demand back log, then recede, while new investments are prepared and finance organized, and pick up again when projects get underway, and when the multitude of investments, presently in the pipeline and planned, materialise and have secondary investment effects. Nor is it likely that demand for the various steel products grows pari passu, as the forecast assumes. The demand for pipe of 6" diameter and above is largely determined by the growth of oil and gas output. In the early years of sustained economic development demand for reinforcing bars typically grows faster than that for other bar mill products. As engineering and durable consumer goods industries develop the share of steel sheet in total steel demand increases. However, in the medium term to which the forecast addresses itself, these developments are not so significant as to justify the assumption of equally arbitrary different growth rates.

8.20 The statistical information, on which the forecasts have been based, shows some gaps which should be filled in in the course of a more thorough study of the market. It is inconceivable that no heavy structurals (joists and beams) have been imported into Indonesia before 1970, when a figure for imports is shown for the first time; earlier imports were presumably listed under some other category. Rails are not shown at all and a separate statistical position for them is required. Sheet and plate are shown in one position, but are produced on very different equipment. While plate can be economically produced on a Lauth plate mill with a capacity of 150,000 tons per year, obviously within the reach of the Indonesian economy in the foreseeable future, sheet can nowadays only be economically produced from coils

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1/ Report of the ECAFE Iron and Steel Survey Mission, December 8, 1967

rolled on wide strip mills, 1/ with capacities of about one million tons and more. Statistical information should be so organised as to distinguish between black sheet up to 14 gauge) cold rolled sheet, light plate (3 mm - 5 mm), medium plate (5 mm - 12 mm) and heavy plate. Steel pipe is an important item in the Indonesian import bill, but the statistics do not distinguish between seamless pipe -- made from ingots or blooms - and welded pipe which requires strip. Since the product range of specific continuous pipe welding equipment is limited, it would be useful to know what the diameter ranges of the imported pipe are. A breakdown in sizes from 1/2" to 3", and from 3" to 6" and from 6" to 16" would facilitate capacity planning.

8.21 A full review of existing statistical classifications for raw materials, intermediate and finished products of the steel industry so as to segregate inputs according to users, and products according to rolling and finishing facilities needed to make them, would be advisable to put planning for steel on a sound basis. The Directorate General of Basic Industries in the Department of Industry should be able to provide an appropriate breakdown.

Alternatives in meeting steel demand

8.22 With market prospects in this order of magnitude, the Government would be well advised to consider the various alternatives open to it for the supply of the country's steel requirements.

8.23 One obvious alternative would be to continue the present policies, described earlier in this chapter, with the effects described there - clearly not a desirable policy.

8.24 Another logical, but perhaps not practical, alternative steel policy would be to concentrate investment, through suitable policies, on the metal working and using industries, and to provide them with access to the cheapest steel available in world markets. This should lead to a fast growth in steel consumption, and should, at some future date, provide the basis for a really competitive steel industry. Whoever wanted to invest in steel making or processing in Indonesia, would be free to do so, on the understanding that under no circumstances would protective duties be introduced. In practise this approach has a number of drawbacks. Steel prices in the world markets are fluctuating more than in national markets, because of marginal export pricing during slack business periods. During boom conditions in major exporting countries supplies to overseas markets become uncertain and expensive. Moreover, steel, even if imported duty free, is subject to a

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1/ Operational experience with reversing single stand strip mills, in the Mission's view, rules out their use for Indonesia.

markup of at least 25 per cent, on account of transport and landing cost, over the f.o.b. price. Reliance on steel imports implies that local production would even then not be competitive with imports. Because this is not necessarily so, the Government has a third alternative: to investigate the feasibility of establishing a competitive steel industry. The following observations are intended to demonstrate a possible approach to the problem.

8.25 As pointed out earlier, steel planning starts with the demand forecast, then eliminates from expected demand all items that cannot be fitted into an economic rolling program, converts the balance into intermediate products, and intermediate products into steel. As a next step the most economic way to make steel is investigated, given the country's resource endowment, and the cost at which these resources can be obtained. Output cost at every stage is then compared, in economic terms, with the cost of imports and the result would show, whether, and at what stages of production the country has a sufficient comparative cost advantage vis-a-vis imports to contemplate indigenous production, and whether the establishment of a steel industry has a high enough economic rate of return expectation, relative to alternative investment opportunities, to justify the commitment of scarce resources.

The rolling program

8.26 With the product mix, as forecast in Table 8.2, the configuration of a rolling program begins to emerge. Sheet, hidden in the plate and sheet position, and in the form of galvanized sheet, tinplate and hoop,[1] even with a much higher growth rate will not reach the million ton volume required by a modern wide strip mill. The demand volume would certainly be sufficient to support a 200,000 ton cold rolling mill to roll various types of sheet from imported coil, but the economics of such an operation may present problems. In any event, such a mill need not be part of an integrated steel plant. Its proper place would be in, or close to, its main marketing area, near a deep water port and with ample power supply. In the planning of steel making capacity sheet demand should be disregarded for the time being.

8.27 The inadequacies of statistical information for planning purposes referred to above require estimates of the actual product consumption of the plate and sheet portion and the pipe portion. It has been assumed that plate and sheet (including tinplate and hopp iron) share equally in the plate and sheet position. This is about the ratio prevailing in Korea in 1960, while ten years later sheet showed about double the volume of plate. A similar development for Indonesia appears feasible.

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1/ Heavier gauges of hoop would normally be rolled on a bar mill. Allocation of narrow hoop to flat products is somewhat arbitrary, but, on account of its small volume, does not affect the concept proposed here.

8.28 For pipe it has been assumed that 20 per cent of the volume would, for technical reasons, be seamless pipe. The statistics show a separate position for drilling pipe, which is seamless, and therefore not considered in Tables 8.1 and 8.2. With modern automatic welding techniques welded pipe is making further inroads in the fields formerly reserved for seamless pipe, so that an estimate of 80 per cent welded pipe is in fact conservative. However, the problem is the size of pipes. Strip for pipe welding is now largely obtained from the slitting of wide strip, but up to a pipe diameter of 6", equivalent to 20" width of strip, a skelp mill might still be an economic proposition. No information was obtainable on the breakdown of sizes. The Department of Industry has licensed or under consideration three pipe welding projects with a combined capacity of 34,000 tons for pipe sizes of up to 4". The balance of demand would come from the oil industry's need for pipe of up to 6" but there was no way of ascertaining what that demand presently is. The problem of size would, of course, disappear, if skelp were produced by slitting wide strip, but the total need for sheet, with skelp added, would still be below the output of a wide strip mill. For purposes of planning it has been assumed that pipe will largely be of 6" and below diameter. A skelp mill, to produce 150,000 tons annually from slab, would then be justified. 1/

8.29 Finally an admittedly arbitrary assumption has been made that about 45 per cent of medium and heavy structurals would not be made from welded plate. Except for piling, most structurals can be made from plate, and what is used in a country, rolled or welded structurals, depends on what is easily available.

8.30 The situation is somewhat clearer in regard to bar mill products. All reinforcing bars and rods and most of the wire-rod can be made in the country. For sections, flats and profiles the volume has to be reduced to take account of special steel products, such as high tensile strength sections for transmission towers, and of odd shapes. The existence of the latter leads to a general observation.

8.31 In countries without a steel industry a multitude of sizes, shapes and quality specifications is in use that removes a considerable share of the market from the scope of a reasonable rolling program. Many of the specific sizes and shapes are used in quantities too small to be rolled locally except at heavy cost. By adopting and enforcing suitable standards a great deal - except specialty products - can be brought into the scope of a reasonable rolling program by eliminating shapes and sizes that serve no other purpose than that of being different. Standardization should, of course, not stop at rolled products but should include pipe, bolts, nuts, screws, nails and extend from there into the whole range of mass produced metal working and engineering products. Instead of developing specific Indonesian standards one of the existing national metric standards should be adapted to the country's needs. Technical assistance in setting the

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1/ Given the arbitrary character of these assumptions, an alternative, and equally likely, interpretation appeared to be called for. It is presented in paras. 8.48 and 8.49.

standardisation process into motion appears to be required and is herewith recommended.

8.32 Table 8.2 shows what rolling program would emerge from all these modified demand forecasts, and, through conversion of final products into intermediate, and intermediate products into crude steel, what steel making capacity is required. Conversion is based on the use of continuous casting, since ingot casting and stripping is in every respect more expensive. Since virgin metal is going to be used, no problems would be expected with continuous casting, which can occur on account of metallic impurities growing from scrap.

8.33 Total crude steel capacity needed would then be 865,000 tons, provided that the estimates of plate volume and of pipe sizes turn out to be about right. If flat products were excluded for the time-being, 480,000 tons of crude steel would be required to make non-flat products.

## ALTERNATIVES IN STEEL MAKING

8.34 The first question, of course, is whether steel making is an economic proposition, whether steel furnace input can be produced and sold at cost below that of scrap. At present local scrap prices in Indonesia $15 - $25 per ton the answer is negative. However, present prices reflect the lack of local demand. Once major scrap consumers appear on the scene, scrap prices are bound to rise until they reach import parity. Imported scrap of Heavy Melting No. II quality is presently offered at $60 per ton landed cost. Conversion cost from scrap to billet, at a level of 250,000 tons annual output and a power price of 10 mills, would be at least $38 per ton, including a 12 per cent return on resources invested. Even if scrap, through bulk imports, should come down in price, to say, $55 per ton, the billet price would still be around $93. Given the transport cost advantage, such price would be competitive with imports, and the concept of a steel industry, based on imported scrap for processing in electric arc furnaces would merit further investigation, which should include a review of the long term scrap supply prospects. This concept appears to underly the Government's plans for an indigenous steel industry, as evidenced by the Tjilegon steel project. However, it should not preclude an investigation of the costs and benefits of indigenous steel making from ore.

8.35 There are various ways to provide steel making capacity. One way would be the conventional route. Conventional steel plants can be built at any size, but the economies of scale in capital as well as in operating cost are significant. Investment cost up to the crude steel stage are about $135.00 per ton of steel capacity for a 400,000 ton plant, but only $86 per ton for a 2 million ton plant. At the present state of technology, the minimum economic size for conventional steel making facilities -- coke oven, blast furnance, basic oxygen furnaces -- is generally considered to be about 1.7 million ingot tons per year, or double the crude steel capacity forecast for 1976. With a growth rate of 15 per cent

it would take about five years, to 1981, until demand would be sufficient to justify a plant of that size, assuming, that no significant changes in the economies of scale occur. However, there are three reasons why Indonesia should not consider, in the foreseeable future, investment in conventional steel making facilities. One reason is the heavy claims on investment resources such a plant would make. Depending on its rolling facilities a plant in the 1.7 million ingot ton steel per year range may cost anything between $500-$700 million, equivalent to $295-$410 per ton of annual capacity. Even with an easier resource position in the next decade and given a satisfactory economic rate of return, such a chunk of investment would crowd out other equally desirable investments. On account of its high investment costs this type of plant would have a very high break even point (between 80 and 85 per cent in Japan) so that any fall off in sales could become very expensive. The problem of indivisibilities is difficult to overcome for a country just building up its steel industry.

8.36 The second reason is that there are now alternative processes, which can be competitive with conventional plants, which permit a capacity build up in much smaller steps and have much lower investment cost, between $180 and $250 per crude steel ton of installed capacity, depending on the extent of rolling facilities provided.

8.37 The third reason is that Indonesia's natural resource endowment points in the direction of these new plants. Indonesia has neither a type of ore suitable for efficient blast furnace operation 1/ nor has it good coking coal (the Ombilin Coal has some strata of weak coking quality but would require the import of strong coking coal for blending). But Indonesia has ample resources of natural gas. Some of the new direct reduction processes do not require coal but use steam reformed natural gas.

8.38 Ways and means of by-passing coke ovens and blast furnaces through direct reduction, have been intensively studied over the last 30 years. 2/ The Krupp-Renn process introduced shortly before World War II was the first technically satisfactory solution, but would not be competitive today. There are various processes presently under trial or in use, with either solid or gaseous fuels as reduction agents. The product is either sponge iron or metallised pellets, with metal contents between 80 and 95 per cent, sufficient for conversion to steel in an electric arc furnace with scrap addition. None of the solid fuel based processes has so far been sufficiently proven to warrant its use in Indonesia. There

1/ Haematite deposits as Lampong, Pleihari and Tanalang are either too small or too low grade to warrant commercial exploitation. Titaniferous ore at Djampang and Tjilatjap has too much $TiO_2$ to permit its exclusive use in a blast furnace. Laterites found in Kalimantan and Sulawesi are unsuitable for reduction given the present iron-technology.

2/ It was first proposed, and subsequently tried out, by Siemens in the 1870's.

are at present two gas based processes in successful operation. The HyL process, used in various plants in Mexico and with one plant under construction in Brazil and the Midland-Ross process, on which two plants are presently working successfully in the United States and one plant each is under construction in Germany and Japan. The latter process uses fine ores which are pelletized in the conventional way and then reduced in a vertical shaft furnace. Metallization of the pellets reaches 95 per cent. These metallized pellets are then continuously charged into electric furnaces for finishing into steel. This process has been chosen to demonstrate here what such a plant might look like, what it would cost and what its economic rate of return could be. It would appear that subject to further investigation, both processes are proven and safe enough to be considered for use in Indonesia. At first sight, the Midland Ross process appears to be simpler and to require less investment than the HyL process. However, this question needs further review.

8.39 It should again be emphasized that the following project outline is merely intended to test whether such investment in Indonesia is feasible enough to warrant the effort and expense of a full range feasibility study. This study, described in more detail later would have to refine demand forecasts based on demand, segregated according to rolling programs. It would have to analyse various processes, investigate site alternatives and to propose an optimal size, composition and location for rolling capacity. In arriving at such solution, market volume, structure and transport costs would have to be carefully weighed.

8.40 If the gas based Midland Ross reduction process is chosen the location of the steel making facilities would have to meet, in descending order of priority, the following requirements:

i) The plant should be located near enough to sheltered deepwater, that large ore carriers can offload fine ore directly onto the plant's ore yard or slurry pond and product can be shipped out. If the location is in or near a marketing area, rail and road communications are also required.

ii) Natural gas supply should be abundant and close at hand. An 800,000 ton crude steel plant needs about $17.4 \times 10^{12}$ BTU steam reformed gas per year for pellet hardening, metallization and power generation.

iii) Ample power supply at prices not to exceed 5 mill per KWH. A plant of 800,000 tons crude steel capacity might consume up to 560,000,000 KWH per year and would have a peak demand of 130 MW.

8.41 The first task of a thorough feasibility study would be to determine the plant location. Assuming natural gas of a heating value of 950 BTU per standard cubic foot (scf) an 800,000 ton per year steel plant,

including power generation, would require 366.4 x $10^9$ scf over the twenty years of economic life of the plant, or a dedication of 550 x $10^9$ scf if a 50% reserve is included. This is not an excessive amount measured against proven reserves and recent discovery experience, but it has to be found near enough to deep water to keep transmission cost at a reasonable level. Deep water in this context refers to the draft - about 45' - needed by 60,000 ton ore carriers. The plant's ore requirements - 1.4 million tons per year - would keep two carriers of that size employed year round, with some time reserve for annual docking and maintenance, and for unforseen events.

8.42 A major cost-saving, both on port operations and gas supply, could be obtained, if the steel plant described here, and the petrochemical plant, described in Chapter X of this report, would draw their gas from the same field, and share at least some of the same port facilities. Their claims on gas are complementary rather than competing. The higher fractions of hydrocarbons which the petrochemical plant requires, would have to be removed from the raw gas, before the remaining methan is steam reformed to convert it into a reduction agent. While each plant might require distinct bulk handling facilities, port services such things as tugs, water boats and administration or navigational aids and channels could be used by all ships serving either plant. Considerable cost savings could be achieved, if exploration and production cost of gas could be allocated to, and if the cost of port installation and dredging were recovered from, two, rather than one, revenue generating enterprise.

Steel Melting Shop

8.43 To produce 800,000 tons per year and with a 90 per cent pellet charge electric furnace capacity of 240 tons would normally be required. It is suggested, however, subject to the findings of the proposed feasibility study, that for a first plant in Indonesia the steel melting shop should have 4 electric arc furnaces of 80 tons capacity each. To reduce tap to tap time and increase output, the furnaces should be laid out for ultra high power operation and provide for continuous charging of metallized pellets. The pelletizing and metallization plant would be composed of two units of 400,000 tons capacity each. The balance of the electric furnace burden would be made up of mill return scrap and scale. The fine ores are assumed to come from Australia, 1/ with an Fe content of 63 per cent. Under the conditions postulated here the furnaces would have a rated capacity of 500,000 tons.

Continuous Casting

8.44 To provide 400,000 tons of billets which the market forecast assumes, at the most two four-strand continuous billet casting machines would be required. With some of the latest continuous casting techniques

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1/ The import of fine ore has been assumed here rather than the import of pellets, to enable the operator of the reduction plant to provide the oxide pellets with such specific physical and chemical properties as the metallization process might require. In the absence of such requirements the import of pellets instead of ore might be more economical and should be explored.

this capacity could probably be reduced, but has been retained here to provide spare capacity against higher furnace output through the addition of mill return scrap.

8.45 The layout for slab casting depends on the configuration of rolling mills for flat products, discussed below in Para 8.39 to 8.50. If the product mix assumed in Table 8.2 is borne out by a subsequent demand survey, and a strip mill and a Lauth plate mill is accepted as meeting best the demand, then a continuous slab caster with 400,000 tons capacity would be needed. If product mix and demand forecasts should justify a semi-continuous wide strip mill the slab caster would have to be laid out for 800,000 tons of annual capacity, using modern continuous concasting techniques.1/ Addition of a plate caster might be considered, if demand for heavy plate justifies the investment, and if present trial operations prove the reliability of the equipment and the quality of the product.

The Rolling Mills

8.46 The processing of nearly 400,000 tons of billets would justify the use of a large continuous mill. However, there are various arguments against such proposal. Even after the product standardization suggested elsewhere in this chapter, has become effective, Indonesia may have too small volumes of the individual shapes and sizes to exploit fully the economies of scale of a continuous merchant mill. Frequent roll changes to accommodate a diversified rolling program might increase downtime to a point, where the advantages of a large continuous mill would become negative. A bar, section and rod mill, generally on the configuration of the Tjilegon Steel Project, but updated to reflect recent improvements in rolling technology, would probably better meet market needs. Such a mill would have an annual output of 200-250,000 tons, depending on the rolling program. For 400,000 tons of products two such mills would be needed. Whether a large mill or two Tjilegon type mills represent the better solution requires a careful analysis of the projected demand for the shapes, sizes and volumes of the various barmill products.

8.47 In making this analysis the location of the steel plant has to be taken into account. If the prerequisits for the establishment of the reduction and steel melting plant discussed in para 8.40 were found in the main marketing area, i.e. on Java, rolling of bar mill products would certainly take place at the plant. The composition of the rolling program, as forecast, would then determine whether the flexibility offered by two mills offsets their higher investment cost. However, if the steel plant, to meet the requirements outlined in Para 8.40, would have to be established, say, in Sumatra, or Kalimantan, then the establishment of the bar mills in the main marketing areas might offer advantages. The diversity of bar mill products

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1/ Which permits several heats to be cast continuously.

argues for nearness to the market, whose specific demands should be closely followed, and preferably anticipated in composing rolling programs. Market orientation would also be an additional argument in favor of two Tjilegon type mills rather than one continuous mill. Finally, this layout of rolling facilities would leave room for the investment made at Tjilegon, discussed in para 8.74 below.

8.48 There is no technical reason why the processing of billets into final bar mill products should take place at the steel plant. There might be a very slight advantage if billets fresh from casting were immediately rehated for rolling, to make use of whatever residual heat is left in the billet after casting. But reheating of a cold billet to rolling temperatures should not require more than $2.4 \times 10^6$ BTU per ton. Assuming that the mill receives its gas at 10 cents per MM BTU, and that a rolling mill elsewhere had to pay 40 cents per MM BTU in the form of heavy fuel oil, the difference would only come to 72 cents per ton of billets. There are also certain offsite and staffing economies of scale in having steel making and rolling in one place, but the considerable economies available in conventional plants from the use of blast furnace and coke oven gas in the rolling mills do not apply to a direct reduction plant. On balance and subject to the findings of the feasibility study there appear to be advantages in locating the rolling mill close to the markets, and, given the demand dispersion, in having two separate mills of 200-250,000 tons, one in the Djakarta and one in the Surabaya area.

8.49 The demand forecasts for flat products shown in Table 8.2 suffer from the inadequacy of statistical information, discussed in para 8.20 and 8.28. If half or more of the sheet and plate demand were in fact for plate and if most of the welded pipe were not to exceed 6" in diameter, a three-high plate mill and a skelp mill would provide the right equipment, though their economies might be somewhat marginal. Sheet would then be produced from imported coil. However, plate demand might very well be predominantly for light and medium plate, as used in the ship building and engineering industries and/or demand for sheet might be much larger than half of the plate and sheet demand. Pipe demand might have a sizable share of sizes between 6" and 16" needed for oil and gas transmission. Then a combination of a plate mill and a skelp mill would be seriously underutilised, but practically all of the 550,000 tons of flat products forecast for 1976, including sheet, could be made more economically from wide strip. Minimum economic output of a 56" semi-continuous wide strip mill would be in the region of 750,000 tons per year. A plant to weld 6"-16" pipe from strip would have to have an output of around 150,000 tons per year. Again this output would not be too far above the 122,000 tons forecast for 1976. Depending on the growth of demand for flat products a semi-continuous wide strip mill (with a reversing roughing train to be expanded, when required, into a continuous train) would be justified two or three years later, in 1978 or 1979.

8.50 This configuration has considerable advantages over the plate mill-skelp mill combination based on a somewhat arbitrary interpretation of demand forecast for 1976 but it would call for a phasing of the investment in reduction and steel making facilities, because investment costs are too high to risk underutilisation.

The Phasing of Investment

8.51 Most steel plants are built up in stages, particularly so in developing countries, to assure high capacity utilization. In this instance, a phasing of investment suggests itself, because it would provide time to obtain a clearer picture of the demand development for flat products, and because no economies of scale would be lost in the reduction plant. Some savings might be obtained if the melting shop capacity was distributed to three or even two instead of four furnaces, as proposed here. However, very much larger furnaces might create problems with the power supply since it is unlikely that the plant could be connected to a sufficiently large grid with a base load high enough to absorb with ease the peak loads generated by large electrical arc furnaces. Distribution of the melting capacity over four rather than two or three furnaces would also be advantageous if continuous con-casting were to be used.

8.52 Another advantage would be a phasing of investment cost over a longer period of time. More time would also be helpful in building up and training the required skilled staff. The phasing of the investment would be dealt with in the proposed feasibility study. For the purposes of this report it is assumed that the first phase would consist of a 400,000 ton Midland-Ross pelletizing and metallization plant, two 80 ton electric arc furnaces and two four-strand continuous billet casting machines. The second phase would follow, depending on demand development, perhaps 2-3 years after construction for the first phase got underway. It would either duplicate the reduction and the steel making facilities, but have a slab casting machine instead of a billet casting machine and presumably a plate mill and skelp mill. Or, if demand growth for sheet, welded pipe and light and medium plate (up to 12 mm thick) would justify it, capacity and steel making facilities could be tripled to allow for the installation of a semi continuous wide strip mill, to produce hot coils for cold rolling into sheet and tin plate, strip for pipe welding, and light and medium plate for the dockyards and engineering industries.

8.53 Since with the suggested process there are only marginal economies of scale in building up capacity in one place, the second phase might even be built as a separate plant in a different location, if subsequent gas discoveries lead to a combination of factors substantially more advantageous than those, on which the location of the first place was based.

## COST AND PRICE ESTIMATES

8.54 Given the same capacity utilisation, larger steel plants have generally lower capital and operating cost per ton of output than smaller plants. Consequently, the cost at all three output levels, 400,000 tons, 800,000 tons and 1,200,000 tons of crude steel representing Stage 1 and alternatives for Stage 2 should have been estimated. However, as stated before, the purpose of this chapter is not to recommend the establishment of a steel industry along the lines proposed; it is merely to ascertain the justification of a full in-depth feasibility study. This purpose is best served by costing the smallest of the plants proposed here, under the least

favorable circumstances, making very conservative estimates of capital and production cost. To that end, it is assumed that only the 400,000 tons Midland Ross plant reduction plant with a steel melting shop consisting of 2 electric arc furnaces and two four strand billet casting machines is built 1,200 miles away from the main marketing areas, and that two merchant mills, roughly identical, each with about 200,000 tons capacity are established in two different locations.

8.55 Both the steel melting shop and the billet caster have been over designed. Two 80 ton electric arc furnaces with ultrahigh power operation, continuous charging and 80-90 per cent metallised pellet input should reach an annual output of 500,000 tons of crude steel. With 5" x 5" billets one machine should be sufficient to handle that output. But such a production requires sophisticated operating practices, which during an extended learning period cannot be expected. It has been assumed that the capability to run the plant at full output would be acquired after five years, and that actual output and sales will not exceed, on the average, 90 per cent of capacity.

8.56 The capital costs are based on U.S. prices - not necessarily the cheapest source of supply - with an addition of 30 per cent to allow for the cost of transport of equipment to Indonesia and for construction and erection far away from home base.

8.57 As regards operating cost estimates, the present Indonesian wage level in private industry has been tripled. A gas price of 20 US cents has been assumed, though it might well be lower, if the plant draws its requirements from non-associated high pressure reserves close to the plant, that does not require too much scrubbing and cleaning. Such gas does exist in Indonesia, (e.g. on the PERTAMINA fields southwest of Palembang) and the discovery experience is encouraging, but the requirement that the plant be located near deep water, and the sheer volume needed, greatly narrows the choice of sites. The landed cost of iron ore reflect prices obtained in recent long term cif contracts, with 2 cents per Fe unit added to cover landing costs.

8.58 Finally, it has been assumed that no duties would be introduced, except those necessary to defend the industry against marginally priced imports. The validity of this concept is discussed in Para 8.66 below. Capital and operating cost estimates up to and including the billet stage are presented in Tables 8.3 and 8.4. The estimates show capital cost, including interest during construction and permanent working capital at $70 million, and production cost of $47.43 without and $59.83 with depreciation calculated at 8 per cent on depreciable assets of $62 million. These estimates provide the basis to test the financial viability and the economic rate of return of steel making in Indonesia. To this end assumptions had to be made on the explant price for billets, and the landed cost of imports net of duty.

Competitive Position

8.59 In determining the ex-plant price of billets the split up between steel making and rolling assumed here has to be taken into account. The lower limit is set by the reasonable profit expectations of the steel plant's shareholders. The upper limit is given by the billet input price, at which the two rolling mills can compete with imports and still have a reasonable return on their investment. This in turn calls for a review of the landed cost of finished products.

8.60 Present cif import prices for selected bar mill products quoted in Djakarta in May 1971 are shown below.

| | Countries of Origin | | |
|---|---|---|---|
| | Japan | Taiwan | Europe |
| 1. Plain reinforcing round bars Thomas quality, 12 m, 1 x folded | | | |
| 5,5mm | 135 | 133 | 142 |
| 7,5mm | 127 | 128 | 135 |
| 9 - 24mm | 107-113 | 112-114 | 139-122 |
| 2. Nailwire | 134-135 | 130 | 142-146 |
| G.I. Wire | 150 | 148 | 168-172 |
| 3. Steel Bars | | | |
| ' Flat Round, squares | 108 | 110 | 124-129 |
| ' Angles, 60/60/8 | 113 | 114 | 135 |
| Larger | 122-130 | 120-125 | 140 |

The prices quoted for reinforcing bars and for angles correspond roughly to those quoted in Granite City Steel's Report on the Tjilegon Steel Plant for October 1968 for imports from Japan. Prices for flat bars from Japan were 16 per cent higher in 1968. The mission was told in Djakarta, that the prices shown above were depressed and inconsistent. The price comparison between 1968 and 1971, and the billet price of $110 F.O.B. in Japan would support a judgment that the present product prices do not reflect real prices, but indicate marginal pricing by various producers trying to stay in the market.

8.61 The small amounts of the various product categories contracted individually, make marginal pricing viable. To illustrate the point: if the present F.O.B. billet price of $110 per ton ex Japan is taken to cover full cost and profit and if only $12 is added to that as the minimum cost of converting a ton of billets to flat bars (in a modern efficient bar and structural mill net of depreciation and with no return on capital) then the resultant F.O.B. price for flat bars would be $122 per ton or, with a minimum shipping rate of $12 per ton, about $134 per ton C and F, $26 per ton or 24 per cent above the cif price, at which that product has been traded in Djakarta in May 1971.

8.62 It will obviously be a highly speculative venture to establish what the real prices should be, and would be, for the various products if the suppliers on changing market conditions or with increasing volumes of supply would raise their prices closer to those of their home market. The Japanese billet quotation, obtained six weeks later than the product prices quoted in Djakarta, would seem to indicate that this process has already begun. Whatever results a thorough study would show, we consider it safe, for the purpose of this report, to add an average of $12 to the Djakarta prices quoted above, to obtain longer term prices. We have also assumed that with a streamlining of commercial, customs and port procedures landing cost for shipments larger than at present, would drop to $8 per ton, or half the average present cost. The average landed cost of imports, weighted in accordance with the product mix forecast in table 8.2 and net of duty would then come to $139.80 per ton.

8.63 With a billet input price of $95 per ton the rolling mills, if they were to match landed costs, would have nearly $45 per ton to cover full conversion cost and to obtain a return on the investment. Conversion cost, net of depreciation, in a modern rod and bar mill at the 200,000 output level are about $12 per ton including a scrap and scale credit of $2 per ton for the cost above billet input. Despite the low Indonesian wage level, even after adjustment, we have assumed $14 per ton for conversion cost. A modern mill, as described, might require $20 million investment cost. We have assumed $25 million, including working capital, and a debt equity ratio of 1:1, depreciation on $20 million depreciable assets at 8 per cent and a capacity use of 90 per cent. A proforma income statement is shown in Annex 8.5. The return to shareholders grows from 6.2 per cent in the first year of operation to 20.2 per cent in the twelfth year with an average of 21.2 per cent.[1] Considering that the return is based on a price competitive with imports admittedly adjusted to eliminate marginal pricing but without the benefit of a protective duty the return is very satisfactory.

8.64 To test the financial viability of the steel plant three questions have to be answered. Would a delivered billet price of $95 be competitive with imports? Would it be competitive with scrap based electric furnaces? What would be the financial position of the steel plant if it had to deliver ingots at $95 per ton landed cost to the rolling mill?

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1/ On account of higher after tax earnings during the tax holiday.

The answer to these questions poses several problems. No billets have so far been imported into Indonesia because there is no use for them, so that freight and landing costs have to be projected from comparable imports. The cost of shipping from steel plant to rolling mill has to be assessed. Present door to door transport costs do not offer a reasonable basis. Finally, marginal pricing poses a problem per se. The following attempts to answer these questions.

8.65 F.O.B. prices for Japanese carbon steel billets stand presently at $110 per ton, 1/ up from slightly under $100 per ton by the middle of 1970. Even if it is assumed that regular bulk shipments would halve the present shipping and landing cost of $30 per ton, and that a bulk rebate would bring the F.O.B. price down to, say, $105 per ton, landed cost in Djakarta would still be $120 per ton net of duty. European prices F.O.B. Antwerp were recently quoted at $84 per ton of Thomas quality and $88 per ton of open hearth quality billets. With shipping and landing cost the landed price should be about $110.

8.66 Information on Australian prices is more difficult to evaluate, since the major producer tends to adjust export prices to market requirements. A notional F.O.B. quotation, converted from Australian to U.S. dollars and from long tons to metric tons, obtained in June 1971, was $82.68 per ton F.O.B. southwest Australian port, or with freight and landing cost about $97 per ton. The price of $82.68 may very well contain an element of marginal pricing, since the Australian steel industry is unlikely to be a more efficient producer than the Japanese industry, and the iron ore transport cost differential cannot amount to more than, say, $7.00 per ton of billet. Whether and to what extent marginal export prices are accepted as a basis for economic return calculations is a complex problem. One might argue that marginal prices ought to be accepted, as long as they apply to the volume anticipated for local production and are offered for reasonably long term contracts, it being of no concern to the importing country, that the exporter's home market in fact subsidises the consumer in the importing country. An equally valid argument would be that marginal pricing is by nature short lived and uncertain, and therefore no suitable basis for long-term investment decisions; that with growing interdependence of the national economies imports obtained at marginal prices are not in the long-term interest of the importing country, because higher prices paid by the consumer in the exporting country reduce, among other things, his purchasing power to buy goods, which the importing country wants to export; and that consequently a case for indigenous production exists, if the full cost does not exceed the full landed cost of imports net of duty. Without taking sides in the argument we will assume that the Australian producer has a $10 per ton cost advantage in billets over the Japanese producer on account of lower iron ore and coal cost and lower transport cost to Indonesia,

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1/ American prices in June 1971 were about $114 per short ton explant, equivalent to $125.69 per metric ton used in this report.

and take a landed billet cost of $110 as the lowest full cost price, at which billets can be imported. At that price, Indonesian billets would not only be fully competitive but would show a considerable gain to the economy. At the same time, it is recommended, that the Government explore, before investment decisions are made, at what prices and terms billets are offered from various sources, and specifically from Australia.

8.67 The competitiveness of billets from indigenous steel making facilities with those made in electric furnaces from scrap is more difficult to establish for two reasons. We do not know, how much scrap is available in the country, how much would have to be imported, and what the prices for both categories would be. It has been assumed earlier in the report that with increasing demand scrap prices would increase until they reach import parity. If that should happen scrap based steel and pellet based steel might have about the same cost, as estimated in para 8.34 above. The second problem is cost allocation. The scrap based electric furnaces, with which pellet based billets would have to compete, form an integral part of integrated plants, and overhead cost and profits can therefore to some extent be shifted between steel melting shop and rolling mill.

8.68 The proposed feasibility study would have to investigate whether steel making, in economic terms is superior to, or just competitive with, electric scrap melting. The study would have to arrive at a difficult judgment on the availability and price prospects for scrap. Presently the U.S. is the only reliable and steady supplier of scrap of a quality that would justify the considerable transport cost. If steel making in Indonesia should be found to be competitive with scrap imports then the mission feels that it should have preference for two reasons: it has a considerably higher value added, and iron ore, or pellets can be procured under long term contract, guaranteeing a degree of input price stability, while scrap moves in a fickle, fairly short term market.

8.69 To arrive at an explant price for billets transportation and landing cost over a distance of 1,200 miles had to be estimated. It is assumed that at both ends the plants would have direct access to deep water so as to permit the use of self unloading specialised carriers, perhaps in the 5,000 DWT class. At a level of 400,000 tons per year and taking into account some return freight in the form of scrap costs have been estimated at $8 per ton. With a delivered billet price of $95 per ton that would leave $87 as explant price.

8.70 An income forecast has been prepared, based on the capital and operating cost estimates shown in Tables 8.3 and 8.4 and is presented as Table 8.6. Again, a 1:1 debt equity ratio has been assumed; depreciation is taken at 8 per cent straightline and an output growth to 90 per cent of rated capacity of the steel melting shop and the continuous casting plant is assumed to achieved after six years of operation, to take account of the learning period required to operate a sophisticated plant efficiently. After tax return to shareholders would then increase from 8.9 per cent in the second

year of full operation to 20.2 per cent in the twelfth year, when all debt is repaid with an average of 17.6 per cent over 12 years of operation. Interest is assumed at 12 per cent and debt repayment at 10 equal annual rates of principal, beginning at the end of the second year of full operation. A comparison between the return to shareholders for both plants would indicate, that a slightly higher billet price would distribute returns more evenly. However, since it is assumed that the rolling mill would buy the billets under longer contract terms than they can obtain from their clients, thus carrying a greater marketing risk, the profit distribution assumed here between steel plant and rolling mills appears equitable.

8.71 The conclusion then is, that steel production in Indonesia should be financially viable even in the first stage investigated here.

Economic Justification

8.72 The economic rate of return, obtained by discounting the cost and benefit streams over 20 years, the economic life of the plant, is 24.75 per cent for the steel plant. It is presented as Table 8.7. The cost of imports has been assumed at $110 per ton and account has been taken of the cost to the economy of transporting billets from the steel plant to the rolling mills. Output and sales have been kept at a level of 90 per cent, to present as realistic a picture as possible. This rate of return would be satisfactory. Another test of the economic justification for a project intended to replace imports would be to calculate the cost of local resources needed to replace $1 worth of import as an indicator of the efficiency of import substitution. To this end the foreign exchange element in capital and operating cost is calculated for the local product and deducted from both the price of the local product and the cost of the import. The ratio between the balances left then represents the cost of replacing $1 worth of replaceable imports. In the case of the steel plant $0.76 of local resources are needed to replace $1 of imports. The calaculation is shown in Table 8.9.

8.73 To obtain an overall economic rate of return for both the steel plant and the olling mills, it has been assumed that the second mill would go into operation two years later than the first mill. Also, total cost of the second mill has been increased to take into account an increase in equipment prices. The economic rate of return, shown in Table 8.8 would then be 18 per cent. This lower, though still satisfactory, rate is due to the split up between steel plant and rolling mills and the ensuing transport cost.

THE ROLE OF THE TJILEGON PROJECT IN THE PROPOSED OUTLINE

8.74 Planning for steel in Indonesia is at present clouded by the uncertainty surrounding the fate of the Tjilegon steel project. In view of the forthcoming discussions between the Government of Indonesia and the Government of the Soviet Union the mission has not reviewed the status of

the project nor would it have been in a position to make recommendations whether or not the project should be proceeded with. However, if the Government of Indonesia should decide to complete the project it would obviously have two choices as regards the future development of the steel industry in Indonesia: The project could be equipped with steel melting capacity, presumably with electric arc furnaces as proposed in the Granite City Steel Report since open hearth furnaces with a 100 per cent scrap charge would not be competitive with electric arc furnaces. This decision would defer the establishment of a fully integrated steel industry, as proposed here for further investigation, by at least two years. The balance of the market demand would then be presumably filled by the establishment of several small projects, as presently licensed, which in turn would defer the establishment of an integrated industry even further. This would lead to a development similar to that in Korea and Taiwan. It would burden the economy with a multitude of small, inefficient, high cost producers and with a loss of investments made, once it is decided to establish an economic integrated plant.

8.75 The alternative would be to use Tjilegon as one of the two economic scale rolling mills envisaged in this report if steel making were found to be a viable operation, to serve the West Java market at a capacity between 200 and 250 thousand tons. The Granite City Steel Report indicates that no additional investment for the rolling mills, except for necessary rehabilitation would be needed. The electric furnaces, which the project would require have not been contracted for. Open hearth foundations have been built, and equipment supplied, but the use of open hearth furnaces was predicated on the supply of pig iron from the Lampung Project, which has been abandoned. It would have to be written off anyway, if electric furnaces were installed.

8.76 The second rolling mill of similar size would then be built presumably in Central or East Java, depending on the outcome of the proposed feasibility study. These two mills would receive their billets from an integrated plant established where the conditions outlined earlier in this report prevail.

8.77 From what is said in this report it would appear that the second alternative, the use of Tjilegon as a rolling mill only, offers considerable cost advantages, if it should be decided to complete the project. However, an investigation in depth on the strength of the information not available to the mission would be needed.

## SUMMARY AND RECOMMENDATIONS

### Summary

8.78 The planning exercise presented here, based on a rough and ready estimate of capital cost and somewhat more detailed estimates of production cost, would appear to indicate that Indonesia might in the foreseeable future offer sufficient comparative cost advantage to justify the establishment of a fully integrated steel plant. The timing would depend on the results of a market survey conducted in depth and demand forecasts built on more solid foundation than those, which the mission had to use.

8.79 The concept chosen here, that of a Midland Ross direct reduction plant with electric arc furnaces, and continuous casting, with two rolling mills located in the marketing centres appears to the mission, at this point in time, and based on the information available to it, a sensible solution for Indonesia's steel need. However, we emphasize again, the conclusion is not that Indonesia should proceed with the establishment of a steel plant along these lines. The conclusion is merely that there is sufficient prima facie evidence, that planning for steel on a concept different from the one presently followed would have considerable benefits, and that the efforts in terms of time and money would be justified that a feasibility study to provide a firmer basis for planning would require.

8.80 Indonesia can still avoid a development that has complicated and increased the economic cost of establishing a steel industry in Korea, as well as in the Republic of China, if a decision is made to proceed with the proposed study soon, before more small plants are built.

Recommendations

8.81

1) The present policy, to "license" projects, as proposed elsewhere in the report, should be discontinued and replaced by a project registration.

2) Interested parties should be informed that the Government intends to embark on a comprehensive steel planning exercise that might lead to the establishment of an integrated economic scale industry. The investor would have to decide for himself, whether he would be able to compete under those conditions, or whether he sees a place in such plan for his project.

3) Assistance should be sought in carrying out the feasibility study of the steel industry
Terms of Reference for this study should include, but not necessarily be limited, to:

1) Market:

a) update present consumption figures, with products segregated according to equipment needed to make them;

b) identify the main consumption areas for the various products;

c) investigate and describe the present distribution and marketing system;

d) estimate, using appropriate fore-casting methods, demand development for the main categories of rolled products over the next 10 years;

e) translate the demand into an economically feasible rolling program;

2) Production Planning

a) optimise the design for a minimum number of market oriented rolling mills and make proposals for their layout and location;

b) estimate conversion cost from billets for the various bar mill products;

c) investigate the feasibility and estimate the cost of producing billets by scrap melting in electric arc furnaces and continuous casting, having due regard to present and future availability and price of local scrap, and of imported scrap required to meet the demand, assuming that electric melting and billet casting would be integrated with the rolling mills;

d) investigate various steel making processes and define the lowest cost solution for Indonesia, having regard to process reliability, Indonesia's resource endowment and to the cost of obtaining inputs not available in the country, and establish the location of a steel making plant;

e) compare, in economic terms, the cost of billets under c) and d) above with that of imported billets from the cheapest source of supply, provided that firm contracts are offered over a sufficiently long time;

f) if c) above should offer substantial cost advantages, estimate the full cost of finished products, compare these costs with the landed cost of imports, net of duty and calculate, what protective duty, if any, would be required, to enable indigenous production to compete with imports. Specific attention should be paid to protection against marginally priced imports.

g) if d) above should be competitive with e) above refine the concept for steel making capacity, by optimising input and capacity ratios - e.g. should fine ores or pellets or metallised pellets be imported? What should furnace capacity be in relation to continuous casting capacity? Should the rolling mills be located at the main markets or a large mill be attached to the steel making facilities? Determine the phasing of capacity build up and the addition of rolling facilities for flat products. Estimate and compare the cost of the finished product with the landed cost of imports net of duties, and estimate what rate of duty, if any, would be required to enable indigenous production to compete with imports;

h) if the import of billets should offer substantial advantages, recommend to the GOI terms and conditions for long term contracts between the sponsors of suitable rolling mill projects and overseas suppliers as a pre-requisite for the grant of applicable investment incentives. Estimate and compare the cost of the finished product, rolled in the proposed mills from imported billets, with the cost of imports and estimate the rate of duty needed to enable the indigenous industry to compete with imports.

3) Policy Recommendations

a) recommend to the Government, in light of findings under 2) above the most economic way to meet the country's demand for rolled steel products;

b) if requested to do so, advise the Government on the best use of the investments made in the Tjilegon Steel Pojrect.

4) Regardless of whatever course of action in steel planning is chosen, foreign assistance should be sought in developing and introducing a system of standards for steel products, starting with the properties, shapes and sizes of rolled steel products, and proceeding to all mass produced metal products.

Table 8.1

## DEMAND FOR ROLLED STEEL PRODUCTS
000 Metric Tons

| | Actual Imports | | | | | | | Forecast based on a 16-17% public and private investment growth rate + | | | | | | 12 - 10% growth rate |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1976 |
| **a) Non flat products** | | | | | | | | | | | | | | |
| 1) Reinforcing bars and rods | 32.8 | 72.0 | 41.6 | 8.1 | 28.6 | 69.3 | 82.4 | 95.6 | 112.0 | 130.0 | 151.0 | 175.0 | 203.0 | 166.7 |
| 2) Billets, bars, rounds, sections, profiles | 36.9 | 35.4 | 18.7 | 15.0 | 26.4 | 49.6 | 61.2 | 71.0 | 84.2 | 97.0 | 111.6 | 128.0 | 147.0 | 114.5 |
| 3) Wire of all types | 18.4 | 39.8 | 20.1 | 24.2 | 30.9 | 47.6 | 44.6 | 51.3 | 59.0 | 67.8 | 78.0 | 89.8 | 102.5 | 83.6 |
| Total nonflat (without structurals and rails) | 88.1 | 147.2 | 80.4 | 47.3 | 85.9 | 166.5 | 188.2 | 217.9 | 255.2 | 294.8 | 340.6 | 392.8 | 452.5 | 364.8 |
| **b) Flat products** | | | | | | | | | | | | | | |
| 4) Sheet and plate 1/ | 38.4 | 47.7 | 36.1 | 65.6 | 82.7 | 100.8 | 122.3 | 141.1 | 162.1 | 186.4 | 214.4 | 246.0 | 283.0 | 227.5 |
| 5) Tin plate | 33.7 | 4.6 | 7.5 | 9.5 | 18.1 | 29.6 | 38.4 | 44.2 | 50.8 | 58.5 | 67.3 | 77.5 | 89.3 | 71.8 |
| 6) Hoop iron | 2.4 | 2.8 | 1.2 | 2.6 | 2.1 | 3.5 | 4.7 | 5.1 | 5.6 | 6.2 | 6.8 | 7.5 | 8.2 | 8.2 |
| 7) Structural steel 2/ | | | | | | | 11.8 | 13.5 | 15.6 | 18.0 | 20.7 | 23.8 | 27.3 | 22.1 |
| c) 8) Welded pipe 3/ | 19.0 | 19.8 | 46.9 | 19.6 | 30.1 | 52.2 | 60.6 | 70.5 | 81.0 | 93.2 | 107.0 | 123.5 | 142.0 | 113.0 |
| Total flat products including Skelp for welded pipe | 73.5 | 74.9 | 91.7 | 97.3 | 133.0 | 186.1 | 237.8 | 274.4 | 315.1 | 362.3 | 476.1 | 488.3 | 549.8 | 442.6 |
| Total rolled products | 161.6 | 222.1 | 172.1 | 144.6 | 218.9 | 352.6 | 426.0 | 492.3 | 570.5 | 657.1 | 816.7 | 881.1 | 1,002.3 | 807.4 |

1/ The classification does not distinguish between sheet and plate, but since tin plate is shown separately, and considering the predominance of construction and ship building activities in the use of flat products it can be assumed that at least 2/3 of the volume would consist of plate of 3/16" and above.

2/ Statistics only available in 1970. Category has been included under flat products since many types of structural steel can be produced by welding plate.

3/ The statistical position does not distinguish between pressed, drawn or welded pipe. But drilling pipe is shown under a different category. It is assumed that welded pipe can be used for most other purposes, such as the transport of gases and liquids under pressure.

+ Growth rates assumed

| | | |
|---|---|---|
| 1) | Reinforcing bars | 16% |
| 2) | Billets | 16% |
| 3) | Wire | 15% |
| 4) | Sheet & Plate | 15% |
| 5) | Tin plate | 15% |
| 6) | Hoop iron | 10% |
| 7) | Structural Steel | 15% |
| 8) | Welded pipe | 15% |

Table 8.2

Capacity and Product Mix of an Integrated Steel Plant, Based on 1976 Demand Forecasts

(000 metric tons)

| | 16% Growth Rate | | | | | 12 - 10% Growth Rate | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1976 Demand Forecast | Deduct | Net Finished Product | Convert to Billet or slab | Convert to Crude Steel | Demand | Deduct | Net Finished Product | Convert to Billet or slab | Convert to Crude Steel |
| 1. Reinforcing bars and rods | 203.0 | -- | 203.0 | 220.0 | 240.0 | 166.7 | -- | 166.7 | 181.0 | 199.0 |
| 2. Bar, rounds, sections and profiles | 147.0 | 44.0 a/ | 103.0 | 115.0 | 125.0 | 114.5 | 34.5 a/ | 70.0 | 75.5 | 82.0 |
| 3. Wire rod and wire of all types | 102.5 | 5.0 b/ | 97.5 | 103.0 | 115.0 | 83.6 | 4.0 b/ | 79.6 | 86.5 | 94.0 |
| | 452.5 | 49.0 | 403.5 | | | | | | | |
| Total non flat products | | | | 438.0 | 480.0 | 364.8 | 38.5 | 316.3 | 343.0 | 375.0 |
| 4. Sheet and plate | 283.0 | 94.0 c/ | 189.0 | 205.0 | 223.0 | 227.5 | 76.0 c/ | 151.5 | 168.0 | 181.0 |
| 5. Tin plate | 89.3 | 89.3 d/ | | | | 71.8 d/ | | | | |
| 6. Hoop iron | 8.2 | 8.2 d/ | | | | 8.2 d/ | | | | |
| 7. Structural Steel | 27.3 | 12.3 | 15.0 | 17.0 | 19.0 | 22.1 | 10.0 e/ | 12.1 | 13.8 | 15.5 |
| 8. Welded pipe | 142.0 | 20.0 f/ | 122.0 | 132.0 g/ | 143.0 | 113.0 | 18.3 | 94.7 | 103.0 g/ | 116.0 g/ |
| Total flat products | 549.8 | 223.8 | 326.0 | 354.0 | 385.0 | 442.6 | 104.3 | 258.3 | 284.8 | 312.5 |
| Total | 1002.3 | 272.8 | 729.5 | 792.0 | 865.0 | 807.4 | 141.8 | 574.6 | 627.8 | 687.5 |

a/ Assumed to be high tensile strength, alloy steel and odd shapes.
b/ Assumed to be special types of wire.
c/ Assumed to be the share of sheet in that position.
d/ Tinplate, hoop as well as most of the sheet could be made from cold rolled coil. Cold rolling of imported coil on a tandem mill would be feasible at a capacity of about 200,000 tons of product annually. Location of that facility would be market oriented.
e/ Assumed to be the amount of structural steel not suitable for production from welded plate.
f/ Assumed to be the volume of pipe for which welded pipe would not be suitable.
g/ Conversion factor from pipe into skelp and from skelp into slab = .96 each.

Table 8.3

| | US $ million |
|---|---|
| 1) Midland Ross reduction plant, 400,000 tons per year indlucing pelletising unit, gas reformer, piping and internal material handling. | 10.00 |
| 2) Steel Melting shop and continuous casting plant including 2 x 80 tons electric arc furnaces and related electrical equipment, material handling and in plant transport, 2 x 4 strand continuous billet casting machines with in line degassing. | 13.00 |
| 3) Steam Power plant, 65 MW, 2 turbine generator alternator sets. 500 KW stand-by diesel generator, transformer, switch gear, primary distribution. | 8.00 |
| 4) Off sites and Utilities, including machine shop, laboratorium, inter-unit transport system, power distribution, lighting, sewerage and buildings. | 6.00 |
| 5) Engineering and construction | 12.00 |
| 6) Escalation | 6.00 |
| 7) Interest during construction | 7.00 |
| Depreciable assets | 62.00 |
| 8) Site, 80 ha at $2,000 per hectare, clearing and levelling at $10,000 per hectare. | 0.96 |
| 9) Permanent Working Capital | 7.04 |
| | 70.00 |

Assumptions: Cost estimates

1) The capital cost estimates are based on present US prices plus 30% to allow for shipping and for higher cost of construction overseas.

2) It is assumed that infrastructure investment outside the plant will be made out of public funds. To the extent that investments are made for exclusive use by the plant, e.g. for water supply, for port facilities or housing for labor, charges will be levied on their use sufficient to amortize the investment.

3) Permanent working capital is based on:

| | |
|---|---|
| 2 months supply of ore | $0.8 million |
| 1 month stocks at cost | $1.8 million |
| 1 month receivables | $2.44 million |
| consumable stores, spares | $2.00 million |

The working capital needs assume firm supply contracts for ore and fluxes, and equally firm sales contracts with two rolling mills.

Table 8.4

| | Quality | Quantity | Unit Price | $ 000 Annual Cost at 400,000 tons output Variable Cost | Fixed Cost | Total | $ Per ton of product Variable Cost | Fixed Cost | Total |
|---|---|---|---|---|---|---|---|---|---|
| **1) Reduction Plant** | | | | | | | | | |
| Iron Ore A/ | 63% FE | 700,000 tons | landed 22 cts per FE Unit | 9,702.00 | | | 24.25 | | |
| Natural Gas | | | | | | | | | |
| Pelletising Plant B/ | 1,000 BTU/scf | $35 \times 10^7$ scf | 0.20/Mcf | 70.00 | | | 0.20 | | |
| Reduction Plant | 1,000 BTU/scf | $.91 \times 10^8$ scf | 0.20/Mcf | 1,810.00 | | | 4.56 | | |
| Gas Reformer | | | | | | | | | |
| Water | Boiler fed | 1,800 MM Gal. | 0.025 | 45.00 | | | 0.11 | | |
| Labor | | 40 man years | 1,200.00 | | 48.00 | | | 0.12 | |
| Supervision | | 8 man years | 2,400.00 | | 19.20 | | | 0.05 | |
| Maintenance | | | 4% of depreciable | | 400.00 | | | 1.00 | |
| Stores, spares, misc. | | | 3% of assets | | 300.00 | | | 0.75 | |
| Overhead administration | | | 80% of labor supervision | | 53.80 | | | 0.12 | |
| | | | | 11,627.00 | 821.00 | 12,448.00 | 29.07 | 2.05 | 31.12 |
| **2) Melt Shop and Casting Plant** | | | | | | | | | |
| Natural Gas | 1,000 BTU/scf | $80 \times 10^6$ scf | 20 cts/Mcf | 16.00 | | | 0.04 | | |
| Water | cooling | 160 MM Gal. | 2 cts M Gal. | 3.20 | | | 0.01 | | |
| Electrodes C/ | | 2,000 tons | 700 per ton | 1,400.00 | | | 3.50 | | |
| Fluxes | | 30,000 tons | 15 per ton | 450.00 | | | 1.13 | | |
| Dolomite | | 3,000 tons | 15 per ton | 45.00 | | | 0.11 | | |
| Ferro Alloys | | 2,500 tons | 500 per ton | 1,250.00 | | | 3.01 | | |
| Refractories | | 3,200.00 | 200 per ton | 640.00 | | | 1.60 | | |
| Magnesite | | 1,800.00 | 60 per ton | 108.00 | | | 0.27 | | |
| Labor | | 310 man years | 1,200.00 | | 372.00 | | | 0.93 | |
| Supervision | | 12 man years | 2,400.00 | | 28.80 | | | 0.07 | |
| Maintenance | | | 4% of capital cost | | 520.00 | | | 1.30 | |
| Overhead Admin. | | | 80% of labor & Super. | | 320.60 | | | 0.80 | |
| Miscellaneous | | | | | 75.00 | | | 0.19 | |
| | | | | 3,912.20 | 1,316.40 | 5,228.60 | 9.78 | 3.29 | 13.07 |
| **3) Power Plant 65 MW** | | | | | | | | | |
| Natural Gas | 1,000 BTU/scf | $33 \times 10^8$ scf | 20 cts/Mcf | 660.00 | | | 1.66 | | |
| Water | mainly cooling | 800 MM Gal. | 2.5 cts M Gal. | 20.00 | | | 0.05 | | |
| Labor | | 43 man years | 1,200/man year | | 51.60 | | | 0.13 | |
| Supervision | | 7 man years | 2,400/man year | | 16.80 | | | 0.04 | |
| Maintenance | | | 2% depreciable assets | | 160.00 | | | 0.40 | |
| Adm. Overhead | | | 80% labor & Super. | | 54.70 | | | 0.14 | |
| Miscellaneous | | | | | 100.00 | | | 0.25 | |
| | | | | 680.00 | 383.10 | 1,063.10 | 1.70 | 0.96 | 2.66 |
| **4) Off Sites and General Facilities** | | | | | | | | | |
| Labor | | 70 man years | 1200/man year | | 84.00 | | | 0.21 | |
| Supervision | | 7 man years | 2400/man year | | 16.80 | | | 0.04 | |
| Miscellaneous | | | | | 50.00 | | | 0.13 | |
| Overhead & Admin. | | | 100% labor & super. | | 80.84 | | | 0.25 | |
| | | | | | 231.40 | 231.40 | | 0.58 | 0.58 |
| **Totals** | | | | | | | | | |
| 1) Reduction Plant | | | | 11,627.00 | 821.00 | 12,448.00 | 29.07 | 2.05 | 31.12 |
| 2) Melt Shop & Casting Plant | | | | 3,912.20 | 1,316.40 | 5,228.60 | 9.78 | 3.29 | 13.07 |
| 3) Power Plant 65 MW | | | | 680.00 | 383.10 | 1,063.10 | 1.70 | 0.96 | 2.66 |
| 4) Off Sites and General Facilities | | | | | 231.40 | 231.40 | | 0.58 | 0.58 |
| 5) Depreciation at an average rate of 8% on depreciable assets of 62 million | | | | 16,219.20 | 2,751.90 | 18,971.10 | 40.55 | 6.88 | 47.43 |
| | | | | | 4,960.00 | 4,960.00 | | 12.40 | 12.40 |
| | | | | 16,219.20 | 7,711.90 | 23,931.10 | 40.55 | 19.23 | 59.83 |

A/ Landed cost of ore. Balance of burden requirement, at 90% metallization, to be made up by mill return scrap.

B/ About 500,000 BTU per ton for pellet hardening
$13 \times 10^6$ BTU per ton of pellet input for metallization.

C/ Electrode consumption assumed as 5 kg. per ton of hot metal.

Table 8.5

## 250,000 TON ROLLING MILL
## INCOME PROJECTIONS

| Financial Year Ending December 31 | 4th Year After Beginning of Construction (4 Mos.) | One Full Operating Year | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Production (tons) | 40,000 | 165,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 |
| % of rated capacity A/ | 16% | 66% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% |
| Increase in inventories (tons) | 5,000 | 15,000 | | | | | | | | | | | |
| Sales Volume (tons) | 35,000 | 150,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 | 200,000 |
| Net Sales @ $140/ton | 4,900 | 21,000 | 28,000 | 28,000 | 28,000 | 28,000 | 28,000 | 28,000 | 28,000 | 28,000 | 28,000 | 28,000 | 28,000 |
| Cost of Production net of depreciation | 4,360 | 17,985 | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 | 21,800 |
| Depreciation | 1,440 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 1,600 | 960 |
| Increase in Inventories (tons) | (545) | (1,635) | | | | | | | | | | | |
| Operating earnings | (355) | 3,050 | 4,600 | 4,600 | 4,600 | 4,600 | 4,600 | 4,600 | 4,600 | 4,600 | 4,600 | 4,600 | 4,600 |
| Interest on long term debt | 1,320 | 1,500 | 1,350 | 1,200 | 1,050 | 900 | 750 | 600 | 450 | 300 | 150 | | |
| Earnings before tax | (1,675) | 1,550 | 3,250 | 3,400 | 3,550 | 3,700 | 3,850 | 4,000 | 4,150 | 4,300 | 4,450 | 4,600 | 4,600 |
| Income Tax | - - - - - - | - - - - - - | - - - - TAX | HOLIDAY | - - - - - - | - - - - - - -// | 978.8 | 1,800 | 1,867.5 | 1,935 | 2,002.5 | 2,070 | 2,070 |
| Net earnings | (1,675) | 1,550 | 3,250 | 3,400 | 3,550 | 3,700 | 2,871.2 | 2,200 | 2,282.5 | 2,365 | 2,447.5 | 2,530 | 2,530 |
| Operating earnings/Net Sales | | 14.5% | 16.4% | 16.4% | 16.4% | 16.4% | 16.4% | 16.4% | 16.4% | 16.4% | 16.4% | 16.4% | 16.4% |
| Pretax earnings/share capital | | 6.2% | 26% | 27.2% | 28.4% | 29.6% | 30.8% | 32% | 33.2% | 34.4% | 35.6% | 36.8% | 36.8% |
| Post tax earnings/share capital | | 6.2% | 26% | 27.2% | 28.4% | 29.6% | 23% | 17.6% | 18.3% | 18.9% | 19.6% | 20.2% | 20.2% |
| Times debt service covered | | 1.4 | 2.4 | 2.5 | 2.7 | 2.9 | 3.1 | 3.4 | 3.6 | 4.0 | 4.4 | no debt | no debt |

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A/ Capacity depends on rolling program. The assumption of 200,00 output assumes a less than optional rolling program and a 90% use of the capacity available in the mills at that program.

Table 8.6

## STEEL PLANT INCOME PROJECTION

| Financial Year Ending December 31 | 4th Year After Beginning of Construction (4 Mos.) | One Full Operating Year | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total production (tons) | 50,000 | 200,000 | 340,000 | 400,000 | 440,000 | 440,000 | 450,000 | 450,000 | 450,000 | 450,000 | 450,000 | 450,000 | 450,000 |
| % of rated capacity | 10% | 40% | 68% | 80% | 88% | 88% | 90% | 90% | 90% | 90% | 90% | 90% | 90% |
| Increase in inventories (tons) | 5,000 | 15,000 | 20,000 | | | | | | | | | | |
| Sales volume (tons) | 45,000 | 185,000 | 320,000 | 400,000 | 440,000 | 440,000 | 450,000 | 450,000 | 450,000 | 450,000 | 450,000 | 450,000 | 450,000 |
| Net sales @ $87/ton | 3,915 | 16,095 | 27,840 | 34,800 | 38,280 | 38,280 | 39,150 | 39,150 | 39,150 | 39,150 | 39,150 | 39,150 | 39,150 |
| Cost of production net of depreciation | 4,779.4 | 10,861.9 | 16,538.9 | 18,972 | 20,869 | 20,869 | 21,343.5 | 21,343.5 | 21,343.5 | 21,343.5 | 21,343.5 | 21,343.5 | 21,343.5 |
| Depreciation | 4,400 | 4,560 | 4,800 | 4,960 | 4,960 | 4,960 | 4,960 | 4,960 | 4,960 | 4,960 | 4,960 | 4,960 | 3,600 |
| Increase in inventories | (202.8) | (608.3) | (811.0) | | | | | | | | | | |
| Operating earnings | (5,061.6) | 1,281.4 | 7,312.1 | 10,868.1 | 12,451.0 | 12,451.0 | 12,846.5 | 12,846.5 | 12,846.5 | 12,846.5 | 12,846.5 | 12,846.5 | 12,846.5 |
| Interest on longterm debt | 2,520 | 3,900 | 4,200 | 3,780 | 3,360 | 2,940 | 2,520 | 2,100 | 1,680 | 1,260 | 840 | 420 | |
| Earnings before taxes | (7,581.0) | (2,618.6) | 3,112.1 | 7,088.1 | 9,091.0 | 9,511.0 | 10,326.5 | 10,746.5 | 11,166.5 | 11,586.5 | 12,006.5 | 12,426.5 | 12,846.5 |
| Income tax | ---------- | ---------- | Tax Holiday | ---------- | ---------- | 498.9 | 4,646.9 | 4,835.9 | 5,024.9 | 5,213.9 | 5,402.9 | 5,591.9 | 5,780.9 |
| Net earnings | (7,581.0) | (2,618.6) | 3,112.1 | 7,088.1 | 9,091.0 | 9,012.1 | 5,679.6 | 5,910.6 | 6,141.6 | 6,372.6 | 6,603.6 | 6,834.6 | 7,065.6 |
| Operating earnings/net sales | | 8% | 11.2% | 31.2% | 31.2% | 31.2% | 31.5% | 32.8% | 32.8% | 32.8% | 32.8% | 32.8% | 32.8% |
| Pretax earnings/share capital | | | 8.9% | 20.3% | 25.9% | 27.2% | 29.5% | 30.7% | 31.9% | 33.1% | 34.3% | 35.5% | 36.7% |
| Posttax earnings/share capital | | | 8.9% | 20.3% | 25.9% | 25.7% | 16.2% | 16.9% | 17.5% | 18.2% | 18.9% | 19.5% | 20.2% |
| Times debt service covered | | 1.5 | 1.7 | 2.2 | 2.5 | 2.7 | 2.9 | 3.1 | 3.4 | 3.7 | 4.1 | 4.5 | no debt |

Table 8.7

## ECONOMIC RATE OF RETURN
## STEEL PLANT

| Investment | Discounted at 24% | Discounted at 25% |
|---|---|---|
| 6,000 | 4,836.0 | 4,800.0 |
| 14,000 | 9,100.0 | 8,960.0 |
| 22,000 | 11,528.0 | 11,264.0 |
| 16,000 | 6,768.0 | 6,560.0 |
| 7,000 | 2,387.0 | 2,296.0 |
| 5,000 | 1,375.0 | 1,310.0 |
| 70,000 | 35,994.0 | 35,190.0 |

| Output Tons | Benefits ±/ | Discounted at 24% | Discounted at 25% | |
|---|---|---|---|---|
| 50,000 | 470.6 | 199.1 | 192.9 | |
| 200,000 | 10,138.1 | 3,457.1 | 3,325.3 | 1st year of full operation |
| 340,000 | 19,161.1 | 5,269.3 | 5,020.2 | |
| 400,000 | 23,028.0 | 5,112.2 | 4,635.9 | |
| 440,000 | 25,606.1 | 4,583.5 | 4,301.8 | |
| 440,000 | 25,606.1 | 3,687.3 | 3,431.2 | |
| 450,000 | 26,250.0 | 3,045.0 | 2,808.7 | |
| ↓ | ↓ | 2,467.5 | 2,257.5 | |
| | | 1,995.0 | 1,811.3 | |
| | | 1,601.3 | 1,443.8 | |
| | | 1,286.3 | 1,155.0 | |
| | | 1,050.0 | 918.8 | |
| | | 840.0 | 735.0 | |
| | | 682.5 | 603.8 | |
| | | 551.3 | 472.5 | |
| | | 446.2 | 367.5 | |
| | | 367.5 | 315.0 | |
| | | 388.8 | 236.0 | |
| | | 236.2 | 183.7 | |
| | | 183.8 | 157.5 | |
| 450,000 | 26,250.0 | 157.5 | 131.2 | 20th year of full operation |
| | | 37,517.4 | 34,704.7 | |

$24\% = \frac{37,517.4}{35,994.0} = 1.0423$

$25\% = \frac{34,704.7}{35,190.0} = \underline{0.9862}$

0.0561 = 1% discountrate difference

$\frac{0.0423}{0.0561} = 0.754\%$ Rate of discount 24.75%

±/ Calculated

$x = i.t_1 - (f+v+s)\ t_2$

x = benefits to the economy
i = landed cost of imports net of duty per ton
f = $\frac{\text{fixed cost}}{t_2}$
v = $\frac{\text{variable cost}}{t_2}$
$t_1$ = tons of imports
$t_2$ = tons of output and sales
s = cost to the economy of shipping billets from steel plant to rolling mill or landing place of imports - assumed at $5.0 per ton

$t_1$ assumed to be equal to $t_2$

Table 8.8

ECONOMIC RATE OF RETURN CALCULATION
STEEL PLANT AND TWO ROLLING MILLS

| COST | | | | | BENEFITS | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Steel Plant $ 000 | 1. Rolling Mill $ 000 | 2. Rolling Mill $ 000 | Total $ 000 | Discounted at 18% | Sales tons per year 1. Mill | 2. Mill | Benefits $ 000 | Discounted at 18% | |
| 6,000 | | | 6,000 | 5,082 | | | | | |
| 14,000 | 3,000 | | 17,000 | 12,206 | | | | | |
| 22,000 | 10,000 | | 32,000 | 19,488 | | | | | |
| 16,000 | 8,000 | 4,000 | 28,000 | 14,448 | 35 | | 2,409.0 | 1,243 | |
| 7,000 | 4,000 | 10,000 | 2,000 | 9,177 | 150 | | 10,324.5 | 4,511.8 | 1st year of full operation |
| 5,000 | | 9,000 | 14,000 | 5,180 | 200 | 90 | 19,960.7 | 7,385.5 | |
| | | 4,000 | 4,000 | 1,256 | 200 | 160 | 24,778.8 | 7,760.5 | |
| | | | | | 200 | 200 | 27,532.0 | 7,323.5 | |
| 70,000 | 25,000 | 27,000 | | | 200 | 200 | 27,532.0 | 6,194.7 | |
| | | | | | 205 | 205 | 28,220.3 | 5,390.1 | |
| | | | | | 205 | 205 | 28,220.3 | 4,571.7 | |
| | | | | | 205 | 205 | 28,220.3 | 3,866.2 | |
| | | | | | 205 | 205 | 28,220.3 | 3,273.6 | |
| | | | | | 205 | 205 | 28,220.3 | 2,793.8 | |
| | | | | | 205 | 205 | 28,220.3 | 2,370.5 | |
| | | | | | 205 | 205 | 28,220.3 | 2,003.6 | |
| | | | | | 205 | 205 | 28,220.3 | 1,693.2 | |
| | | | | | 205 | 205 | 28,220.3 | 1,439.2 | |
| | | | | | 205 | 205 | 28,220.3 | 1,213.5 | |
| | | | | | 205 | 205 | 28,220.3 | 1,044.2 | |
| | | | | | 205 | 205 | 28,220.3 | 874.8 | |
| | | | | | 205 | 205 | 28,220.3 | 733.7 | |
| | | | | | 205 | 205 | 28,220.3 | 620.8 | |
| | | | | | 205 | 205 | 28,220.3 | 536.2 | 20th year of full operation |
| | | | 122,000 | 66,837 | 6,150 | | 423,304.5 | 66,864.1 | |

$\frac{66346.1}{66837.0} = 1.0004$

Economic rate of return = 18 per cent

Benefit calculation: Economic cost of production

| | | | |
|---|---|---|---|
| Billet cost net of depreciation | $47.43 | Landed cost of imports net of duty | $140.00 |
| Add 10 per cent for scrap loss | 4.74 | % cost of production | 71.17 |
| Freight from plant to mill at cost to economy | 5.00 | | $ 68.83 |
| Conversion cost rolling mill | 14.00 | | |
| | $71.17 | | |

Table 8.9

Foreign Exchange Cost Per Ton of Sales 12 Years of Full Operation

| | | |
|---|---|---|
| Debt Service of Foreign Loans | | $ 7.46 |
| Dividends on $19 million at 17.4% (assuming full payout of profits) | | 5.46 |
| Reduction Plant - | Iron ore at 20 cts. per Fe unit c and f | 22.05 |
| | Stores, Spares, Misc. | 0.60 |
| | Maintenance | 0.75 |
| Steel Melting Shop - | Electrodes | 3.50 |
| | Ferro Alloys | 3.01 |
| | Maintenance | 1.00 |
| | Miscellaneous | 0.15 |
| Power Plant - | Maintenance & Miscellaneous | 0.50 |
| Offsites and Utilities - | Maintenance & Miscellaneous | 0.30 |
| Transport from steel plant to rolling mill | | 2.00 |
| Total foreign exchange cost | | 46.70 |

| Price of Local Billets at rolling mill | | Price of Imported Billets at rolling mill | |
|---|---|---|---|
| | $95.00 | | $110.00 |
| Less FE Cost | 46.70 | Less FE Cost | 46.70 |
| Value added locally | $48.30 | Part of import cost replaced by value added locally | $ 63.30 |

$48.30 : $63.30 = $ 0.76

Explanations:

To calculate the foreign exchange element of capital cost per ton, the following assumptions have been made:

1. The foreign exchange element in capital cost is 77%, roughly equivalent to the ratio estimated in the PUSRI Fertilizer Project. Foreign exchange cost would then be $54 million out of the total cost of $70 million.

2. The debt equity ratio is 1:1, equivalent to $35 million equity and $35 million debt.

3. It is assumed that total foreign exchange costs are obtained from outside Indonesia, $35 million as loan and the balance of $19 million as equity.

4. Loan money is to be repaid in ten equal installments of principal. The rate of interest is 10 per cent, below the rate of 12 per cent used in the financial projects but representing the rate at which Indonesia could obtain financing from abroad at conventional terms. The advantage Indonesia may have in obtaining finance at concessional terms is disregarded for the purpose of this calculation.

5. It is assumed that the foreign share holder receives his full share of profits available for distribution after tax.

6. The foreign exchange cost element in the shipping cost from steel plant to rolling mill has been assumed at $2 per ton as the estimated cost of steel, machinery and equipment imported to build the required ships in Indonesian shipyards.

# CHAPTER IX

## ENGINEERING INDUSTRIES

### Introduction

9.1 The engineering industries are concerned with the processing and the fabrication of steel and other base metals into useful products for the market. This study will cover in the main, the following industries: Agricultural, industrial and electrical machinery and equipment (except electronic equipment), transport equipment, and fabricated metal products. The definition covers literally hundreds of thousands of different products. These industries exert a powerful influence on overall national development in that they shape the productive capacities essential for the growth of national output, and they contribute possibly more than any other industry to fostering labor, technical and management skills. These factors combine to make engineering industries a bellwether of the industrial development of a nation.

9.2 A common characteristic of the engineering industries is that they are skill-based rather than natural resource-based. In the developing countries, the skills in design, manufacturing and management are an even more scarce commodity than capital, and herein lies the essence of the problems behind the aspirations of these countries to industrialize. Skills take time to develop, but the needs of industrialization are immediate. The nearest thing to an "instant skill" is joint venture with an experienced partner, but potential foreign partners would rather sell than make their products locally. The usual consequences are (a) increased import burden, (b) uneconomic manufacturing (assembly) operations, and (c) a general retardation of industrial development. Looking at the problems from another angle, in industrially advanced nations, engineering industries are characterized by a close link between the end-product sector, engaged in the final fabrication and assembly; and the supplier sector that manufactures an almost infinite variety of components and sub-assemblies. The final fabrication and assembly may typically account for 20-30 percent of the product value, with 70-80 percent going to the supplier side. The underdeveloped state of the supplier infrastructure in the developing nations can be cited as one of the more critical problems in their industrialization process.

9.3 Statistical trends of consumption and production provide a rough guide to development in this sector. Data from a number of countries have been analyzed in order to arrive at some simple relationships between per capita income and engineering industries production or total manufacturing production. The following table shows some of these relationships (data pertains to countries with population over 100 million).1/

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1/ Derived from United Nations, A Study of Industrial Growth, 1963, 63.II.B.2.

| | Per Capita Income in Dollars 100 | 200 | 400 | 800 |
|---|---|---|---|---|
| | Dollars | | | |
| Apparent consumption of engineering products (gross production value), per capita | 5.8 | 17 | 51 | 150 |
| Value added in engineering industries production, per capita | 2.8 | 11 | 44 | 173 |
| Value added in all manufacturing production, per capita | 23 | 59 | 153 | 396 |
| Value added in engineering industries production, percent of value added in all manufacturing | 12 | 19 | 29 | 44 |

Over the developing nations as a whole, per capita consumption of these products in 1964 was estimated at $17; Asia averaged $10. By comparison, per capita value added in engineering industries production was roughly $5; Asia averaged only $1.6. The table also shows that the share of engineering industries production in all manufacturing rises from 12 to 44 percent as per capita income grows from $100 to $800. For Asia, in 1965, the share averaged 18 percent. For the industrialized countries, the average was about 40 percent.

9.4 The estimated per capita consumption of engineering goods by the developing countries of $17 in 1964-1965 corresponds to a total consumption of $25 billion. The estimated per capita production of $5 (value added basis) in 1964-1965 corresponds to a total production of $15 billion. The deficit of $10 billion represented net imports.

9.5 Table 9.1 shows value added by the mechanical industry sector in Indonesia for the year 1970.1/ The figures cover value added for both small-scale shops and larger scale enterprises (small-scale shops designate those with less than 10 employees and engaged in some form of manufacturing). The industry shows a highly distorted structure, dominated by the "manufacture and repair" of transport equipment. It might further be noted that around 60 percent of the value added in transport equipment was contributed by small-scale shops of less than 10 employees. By contrast, small-scale shops were totally inactive in the electrical machinery sector. A comparison with similar statistics for the year

1/ Data supplied by Wilhelm Boucherie, May, 1971.

1963, taken from the Industrial Census of 1965 (last published census), is even more revealing as to the structural change undergone by the mechanical industry in the sixties, as is shown in Table 9.2. The metal products, machinery and electrical machinery sectors all registered a sharp relative decline; the transport equipment sector alone gained from 36 percent share of value added to 89 percent.

Table 9.1

Estimated Value Added by Engineering Industrial Sectors, 1970

| Industry | Value Added | | Share of Small Scale Industry, % of Value Added | Value Added in Millions of U.S. $ | |
|---|---|---|---|---|---|
| | Millions U.S. $ | % | | Small Scale Shops | Larger Enterprises |
| Fabricated metal products exc. machinery and equipment | 6.7 | 7.0 | 60.0 | 4.0 | 2.7 |
| Manufacture and repair of machinery exc. electric machinery | 2.4 | 2.4 | 50.0 | 1.2 | 1.2 |
| Manufacture and repair of electric machinery, appliances and supplies | 1.5 | 1.6 | - | - | 1.5 |
| Manufacture and repair of transport equipment | 85.8 | 89.0 | 60.0 | 51.5 | 35.3 |
| Total | 96.4 | 100.0 | 59.4 | 56.7 | 39.7 |

Table 9.2

Comparative Value Added Percentages by Mechanical Industrial Sectors, 1963 and 1970

| Mechanical Industry | Value Added, Percent | |
|---|---|---|
| | 1963 | 1970 |
| Fabricated metal products except machinery and equipment | 38.0 | 7.0 |
| Manufacture and repair of machinery, except electrical machinery | 18.0 | 2.4 |
| Manufacture and repair of electric machinery | 8.0 | 1.6 |
| Manufacture and repair of transport equipment | 36.0 | 89.0 |
| Total | 100.0 | 100.0 |

9.6 Value added in engineering industries products in Indonesia is estimated at 96.4 million dollars, or on a per capita basis, roughly 0.8 dollars in 1970 (estimated per capita income in 1970, $90). The average for the developing countries of Asia in 1964 was 1.6 dollars (estimated average per capita income in 1964, less than $100). These statistics would seem to reinforce the observation that the engineering industries in Indonesia are underdeveloped even by the standards of the developing countries of Asia.

## Priorities for Development

### Determination of Priority Sectors

9.7 Past studies of the Indonesian engineering industries have tended, by and large, to be surveys with superimposed corrective or rehabilitation programs. They tend to result in a shopping list of programs, all urgent, whose relative priorities are difficult to judge. Experiences in more advanced industrializing nations have shown that the best results are obtained not by a shopping list, but by focusing the objectives on developing a small number of products favored by the country's circumstances. This approach permits the nation to concentrate development planning on select high-priority programs around which other programs can grow or be built. The remarks would seem particularly relevant when tackling industries as extensive and heterogeneous as these. Accordingly, the first step in the planning process is to locate products that offer the most favorable possibilities. The following steps should be necessary:

- Establish a list of candidate development propositions.
- Gauge the feasibility of manufacturing these products in Indonesia.
- Forecast the development patterns to be expected from launching various preferred enterprises.
- Suggest the most favorable means of implementing and organizing industrial development plans.

9.8 An initial list of developmental products was compiled by reviewing standard lists of product categories, such as the U.S. Standard Industrial Classification (S.I.C.). The list shown in Table 9.3 involves items mostly at the four-digit level of S.I.C. classification. That is, they name product areas such as "agricultural equipment" rather than specific products. Major criteria used in the compilation are the statistics on labor intensity and labor content for various U.S. industries. Similar statistics on

Indonesian industries are not possible to compile, but data on labor content in Korea is presented for comparison. The labor intensity index was calculated from the value added per employee. The latter can be used as a measure of labor and capital intensity, because it reflects both the skill level of workers (labor costs) and their use of capital equipment (overhead and profit). The index of 1.00 is the average value added per employee for U.S. manufacturers, $13,200 in 1966. In the motorcycle and bicycle industry, for example, the value added per employee was $9,500 in 1966 or 72 percent of the average. The index is the inverse of this percentage or 1.39, which indicates a relatively high labor intensity in that industry. The labor content figures are percentages: Total payroll divided by total production costs. A premise in presenting the table is that products which are labor-intensive in the U.S. are also labor-intensive in the developing nations, while products with only average labor-intensity in the U.S. could be produced in a more labor-intensive manner in those countries. Also, products in the U.S. or Korea with high labor contents are potential candidates for production in areas where labor costs are lower.

9.9 The candidate list would need to be further reduced to a small number of the most-preferred product areas, or "building blocks," from which the manufacturing capability of the country can be forged. There are standard operations research techniques for accomplishing this, but the present state of the mechanical industry of Indonesia does not seem to warrant any elaborate analysis. Rather, a final list was determined through an examination of the available statistical resources, engineering considerations of the technical and manufacturing characteristics of the various product categories, estimates of required future growth rates, and pooled judgment of knowledgeable people both in Indonesia and the U.S.

9.10 The final selection of the industries or product lines that appear most desirable or advantageous for development in Indonesia was made on the basis of several criteria. The character and extent of future demand was appraised to determine that a demand sufficient to support a reasonably efficient scale of plant would be likely. The linkages backward to supplier industries was also considered of importance and the importance to other sectors, such as agriculture, was also given weight. The statistics on labor intensity and labor content provided a measure as to whether or not a given product could be made in Indonesia at reasonable costs. Technical judgment involved the consideration of the product complexity, the need for sub-assemblies, components and standard parts, the size of operation needed, the raw material availability, and the cost of importing technical know-how for starting up an operation. The following product areas are suggested as priority targets for national planning:

- Agricultural Equipment
- Construction Equipment
- Trucks and Buses
- Industrial Electrical Equipment
- Railcars
- Ships

The list covers the end products. Products in the supplier sector, eg., foundry products, fasteners, etc. are not listed separately as targets because they are not capable of independent development. They are, however, critically important to a balanced industrialization strategy as shown in the next section. Products in the light manufacturing category such as bicycles, sewing machines and home appliances are not included in the above list because of their capacity for development under private initiative and because of the relatively low rating in their industrialization effects on the nation. Automobiles are visibly important, but are excluded from the priority list for reasons given later.

9.11 The primary industrial-support base that must be developed can now be identified in terms of the priority targets. This is illustrated by a flow chart that shows some of the principal components and sub-assemblies that are essential to a viable industrial development. Figure 9.1 shows the progression of development from raw materials through the finished product for the proposed building-block list. This figure is not complete (such figures never are complet until every nut and bolt is counted); however, it does serve to illustrate the primary supporting industrial development potential inherent in the decision to manufacture these end products. There are both tangible

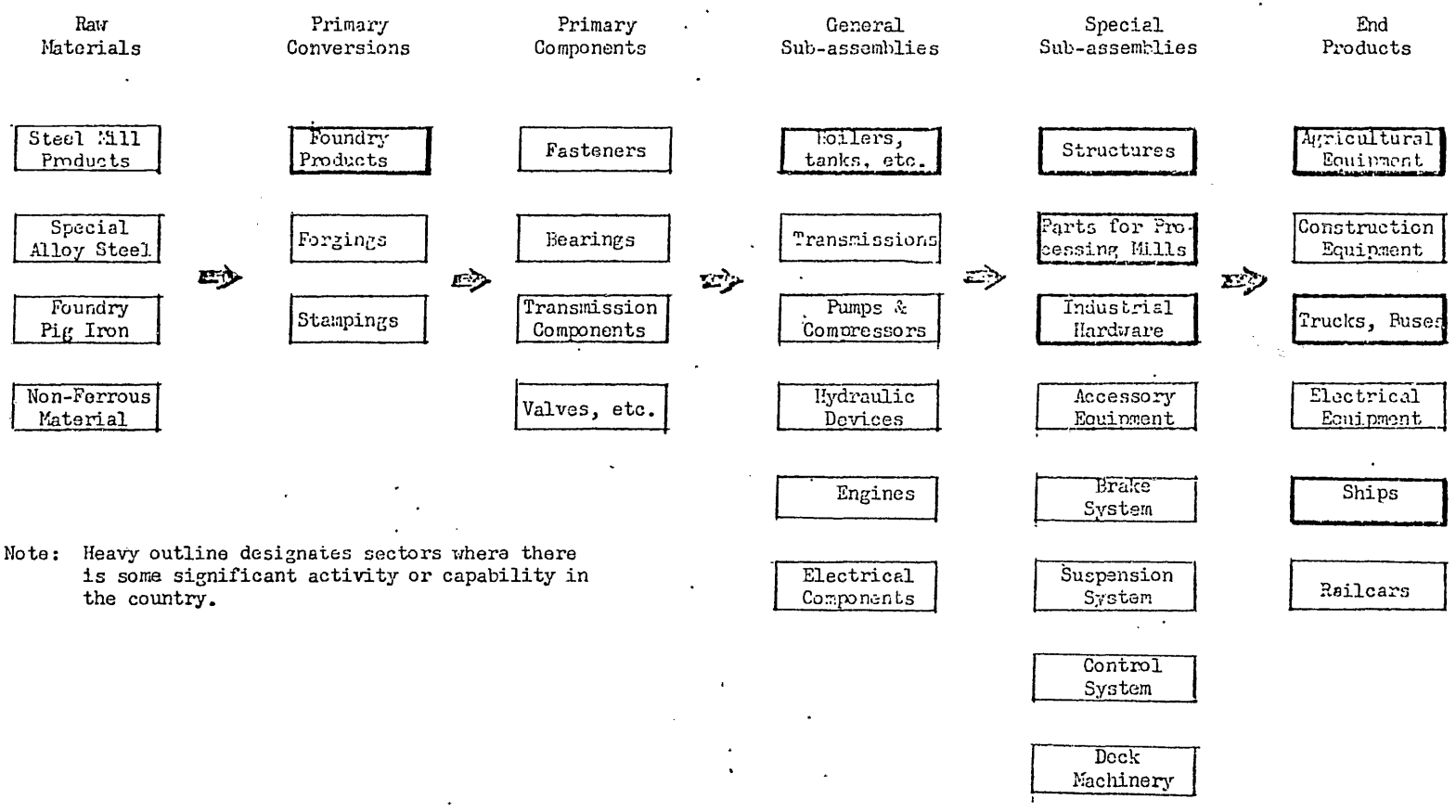
Table 9.3

Labor Intensity and Labor Content on Select Products

| Product Name | S.I.C. Number | Labor Intensity Index U.S. 1966 | Labor Content % U.S. 1966 | Labor Content % Korea 1968 |
|---|---|---|---|---|
| 1) Foundry Products | 3321 | 1.19 | 19 | 36 |
| 2) Hand Tools, Cutlery | 342 | 0.99 | 28 | 28 |
| 3) Heating and Cooling Equip. | 3433 & 3585 | 1.02 | | 21 |
| 4) Boilers | 3433 | 1.07 | 20 | 27 |
| 5) Fasteners | 3551 & 2 | 1.0 | 17 | 27 |
| 6) Springs | 3493 | 1.19 | | 44 |
| 7) Valves & Fittings | 3494 | 0.97 | | 30 |
| 8) Bearings | 3562 | 0.98 | | 33 |
| 9) Internal Combustion Engines | 3519 | 0.83 | 23 | 23 |
| 10) Farm Machinery | 3522 | 0.93 | 19 | 22 |
| 11) Construction Equipment | 3531 | 0.90 | 21 | 25 |
| 12) Machine Tools | 3541 | 0.90 | 27 | 34 |
| 13) Food Machinery | 3551 | 0.95 | | 29 |
| 14) Textile Machinery | 3552 | 1.31 | 27 | 32 |
| 15) Wood Working Machinery | 3553 | 0.99 | | 27 |
| 16) Paper Machinery | 3554 | 1.08 | 22 | 31 |
| 17) Mineral Crushing Machinery | 3559 | 0.99 | | 29 |
| 18) Pumps and Compressors | 3561 | 0.91 | 17 | 26 |
| 19) Blowers and Fans | 3564 | 0.98 | | 28 |
| 20) Transmissions | 3566 | 0.93 | 19 | 31 |
| 21) Office Machines | 357 | 0.70 | 18 | 22 |
| 22) Electric Motors | 3621 | 1.04 | 16 | 32 |
| 23) Home Appliances | 3631-3 | 0.96 | | 21 |
| 24) Sewing Machines | 3636 | 0.87 | | 38 |
| 25) Trucks and Buses | 3713 & 5 | 1.31 | | 23 |
| 26) Automobiles | 3717 | 0.72 | 23 | 14 |
| 27) Ships | 3731 & 2 | 1.39 | 25 | 41 |
| 28) Railway Vehicles | 3741 | 0.89 | | 20 |
| 29) Motorcycles & Bicycles | 3751 | 1.43 | 17 | 24 |
| 30) Mechanical Measuring Equipment | 382 | 1.04 | | 35 |

Figure 9.1

Building Block Flow Chart




Note: Heavy outline designates sectors where there is some significant activity or capability in the country.

and intangible effects of industrialization. The tangible effects are felt through the linkages to other industrial products. The intangible factors fostered in the industrialization process include general management skills, quality control skills, and labor pool development. Of course, these are necessary ingredients for the implementation of an industrialization process.

9.12 Connecting lines illustrating the linkages among the elements in this figure are omitted. With few exceptions each element in a given column in the figure can be connected to all the elements in the other column. Therefore, at first glance it might be thought that each element in the chart represents a potential singular industry which receives goods from those industries on its left and ships goods to each industry on its right. With such a structure, the end-product industries would involve assembly operations only. Such an organization is technically feasible. However, the viability of such an arrangement hinges on the size of the operation as well as on the compatibility of the manufactured product and the manufacturing processes and skills. As we move from left to right in Figure 9.1, the elements become more end-product specific; that is, similar elements destined for different end products lose commonality with each other. For example, an industry to manufacture engines could serve many end products, while a frame manufacturing industry, to serve all end-product industries, may not be as attractive because of the variability in both the product and the processes. This is an additional factor to be kept in mind in determining reasonable development strategies for the proposed end products.

Present State of Industry

9.13 With reference to Figure 9.1, some brief comments will be presented on the end products and their supporting elements as they pertain to the situation in Indonesia. Sectors where there are some significant activities in the country are shown in darker outline on the figure. In 1969, there were over 200,000 passenger cars, 95,000 trucks and 20,000 buses registered in Indonesia, with an estimated 60 percent of the fleet operational. The motorized 2-wheel vehicle fleet (motorcycles, etc.) exceeded 300,000 with about 70 percent operational. Since 1961, the registered fleet has grown on the average of about 6 percent per year, but the growth each year has been irregular (buses actually recorded negative growth in some years). On the average, passenger cars increased at 9 percent, trucks at 3 percent and buses at slightly above 2 percent. The market is fragmented among roughly 60 different makes from over a dozen countries. There is no significant manufacture of components and sub-assemblies. The dilemma Indonesia faces is how to avoid a course that has burdened the economy of many developing nations with a costly automobile industry.

9.14 In the agricultural sector, a few simple products are made on a limited scale--hand tools, hand sprayers, small irrigation pumps and processing mills (parts and assembly). The manufacture of farm tools

requires forging, a technology not very far advanced in Indonesia. The single most important item is patjols, the import of which is estimated at around one million pieces per year. Locally made tools sell for around half the price of imports, but they are not competitive in quality. Pump production is estimated at around 1,000 units, and roughly satisfies a quarter of the annual demand. The principal market is the Government. The demand for power equipment such as sprayers and tillers also depends largely on the government subsidy program in the small farming sector. Imports in 1969 under the heading of "agricultural machinery," but excluding pumps and mill machinery, totalled only a little over half a million dollars, a trivial volume for a farming nation of over 100 million people. It is noteworthy that the sole assembler of power tillers ceased operation in 1967. Activities in processing mills for rice and estate crops are limited in the main to repair and parts manufacturing.

9.15 The industrial electrical machinery sector in Indonesia can be summarized in one word--non-existent. For a country that annually imports several million dollars of motors and transformers, there is presently no active manufacture of these relatively simple products. In many developing countries, the electrical equipment industry tends to establish itself early in the industrialization process and predominates over the non-electrical machinery sector. In industrialized countries, the output of non-electrical machinery is generally higher than that of electrical machinery. One transformer manufacturing facility is presently under construction and expects to begin production late in 1971; plans are also underway for the production of cables and electric motors.

9.16 A variety of ship types operate on inter-island trade. It is estimated that 190 vessels with a total capacity of 200,000 dwt are effectively participating in the Regular Liner Service introduced by the government in 1969 for serving the islands, Singapore and a few Malaysian ports. The ocean-going general cargo fleet is estimated at around 50 ships with a dwt capacity of 430,000 tons. In addition, there are tankers operated by Pertamina and other special vessels. The general condition of the inter-island ships is poor, since they operate in the tropical waters and have been drydocked sporadically. There are ten major yards in Indonesia. Nearly all are government-owned and all are engaged in repair; the largest in Surabaja is capable of repairing ships up to 30,000 dwt. Capacity for new ship construction is limited to about 2,000 dwt ships, but only a few up to 700 dwt have been built in recent years.

9.17 The weakness of the supplier industries is one of the most serious internal problems of the engineering industries. The end products sector is only the visible tip of an iceberg; the absence of a supplier sector is like an iceberg without a base--the industry can hardly be expected to be stable. To date, original equipment parts have all been imported, and locally made replacement parts have not proven satisfactory in service. For example, some rubber plantations order remilling

rolls from Singapore despite the lower price of local products, which is about half that of the Singapore price. Since local quality provides only one-third the life of the imported product, import saves two complete tear-down and rebuild operations involving weeks of machine time loss and substantial labor cost.

9.18 In the primary conversion sector, the art of casting and fabrication has had a relatively long history in Indonesia, but it has not developed sufficiently. Foundry products are needed by the mechanical industry second only in quantity to rolled steel products, but the cost of local products is over twice that in the U.S. The market for castings has been estimated at 25,000 tons for cast iron and 10,000 tons for cast steel. Since the estimate is based largely on current outlook of the mechanical industry, it could well prove low by a factor of two or more.

9.19 In 1969, Indonesia imported $1.5 million worth of fasteners; over 70 percent of this value was bolts of all types (large structures are still bolted rather than welded). There are facilities for forging simple parts and sheet metal rollers for heavy fabricated equipment, but there are no facilities in the whole country for any relatively complicated forged or pressed parts. No gears are made today in the country. Even valves, flanges, elbows, etc. for water pipes are presumably all imported. Many large estates maintain their own shops and carry a substantial inventory of imported spare parts for their processing machines. Engines are much in demand to power the pumps and the various mobile and stationary equipment in agriculture and industry, and almost all are imported. The requirements generally fall into two well-defined power bands, 6-12 H.P. and 40-60 H.P. Attempts at local assembly of engines have not proven very successful, which is not surprising since engines are technologically complex and require precision in production well beyond the present experience or capacity of the Indonesia industry.

9.20 The buildup of the supplier industries through the natural market forces is a gradual process and could well hold up the whole process of industrialization. Special incentives for the supplier industries should probably be an important part of any industrial development strategy.

9.21 The state of the mechanical establishments is rather typical of the circumstances in the industrializing nations. The facilities and equipment are generally old, outmoded and inadequate. Operations are jobbing-oriented. Machines are misused and lack proper maintenance. The workers are untrained in modern production techniques, and at the top, there is a serious lack of supervisory or managerial talent. The shop managers are likely to point to a lack of orders and working capital as a source of most of their problems. Other observers have pointed to an apparent inability by the management to place the industry in a competitive position from the standpoint of cost, productivity, quality and delivery. The following are illustrative of the problems within and surrounding the industry.

(a) Casting costs are unreasonably high because of uneconomical scale and poor foundry practice. With labor costing less than one tenth that in the United States, costs double or triple that known in the developed countries cannot be defended, even allowing for the high import cost of coke and pig iron. A second example is equally revealing. The making of a pump part has been observed being done on a shaper and taking 5 hours each. At 200 Rps./hour, the cost for a production run of a hundred pieces is 100,000 Rps. The same operation on a horizontal mill by updated methods should take no more than 30 minutes each; there could be a cost saving of 90,000 Rps. per 100 pieces.

(b) Major government consumers of mechanical products (public works, electric power, railroads, large estates, etc.) import a substantial part of their needs from abroad, while machines stand idle in local shops. These production machines are expensive and their idle time in dollar equivalent represents a substantial loss to the nation.

(c) Raw material must be imported as needed requiring long lead times; yet there is no association or agency operating to help the industry buy in quantity to secure price benefits and improve delivery schedules. Another general problem is the power shortage. One Japanese survey team recently recommended delaying the production of cast steel in West Java until the electric supply situation improves.

9.22 The seriously depressed state of the industry has made it necessary for the major buyer industries to establish their own captive facilities, which are apt to be uneconomically small, or to turn to imports. Imports of mechanical products in 1969 totalled $250 million, an increase of $50 million over 1967. The amounts represent roughly one-third of all imports. Table 9.4 gives a breakdown of the imports by primary components (5%), sub-assemblies (20%) and end products identified on the flow chart, Figure 9.1 (34%). Table 9.5 lists the major locally-made products. In some cases, the item itself is produced or assembled (e.g., patjols, road rollers). More often, a component part is made (e.g., roll for a rubber mill), but not the complete unit. In many cases, an item listed may only be repaired or rehabilitated by a shop.

Table 9.4

Import of Mechanical Products--1969

| | Value Millions U.S. $ | % |
|---|---|---|
| All Imports | 780.7 | |
| All Mechanical Products | 247.9 | 100.0 |
| Primary Components | 13.2 | 5.3 |
| Sub-assemblies (40% is accounted for by internal combustion engines) | 49.2 | 19.8 |
| End Products | | |
| Agricultural Tools and Equipment | 21.5 | 8.7 |
| Construction and Mining Equipment | 26.3 | 10.6 |
| Trucks, Buses | 14.9 | 6.0 |
| Motors, Transformers, Switchgear | 8.6 | 3.5 |
| Ships, Fishing Vessels | 10.5 | 4.2 |
| Railroad Equipment | 3.0 | 1.2 |
| Others | 100.7 | 40.7 |

Table 9.5

Major Products of the Mechanical Industry

| Machinery and Equipment | 1969 Production |
|---|---|
| Processing mills for agricultural estates (mainly spare parts) | 2,400 tons |
| Parts for mining and textile machinery | |
| Road Rollers (assembly) | 200 units |
| Water pumps | 900 units |
| Hullers | 2,300 units |
| Hand sprayers | 20,000 units |
| Sewing machines (assembly) | 14,000 units |
| Automobiles (assembly) | 5,000 units |
| Motorcycles (assembly) | 21,400 units |
| Industrial machinery as ordered (e.g., machinery for pulp-paper mill) | unknown |
| Major fabricated structures | unknown |
| **Tools and Miscellaneous** | |
| Small tools | unknown |
| Hardware (home and industry) | unknown |
| Pipes | 2,000 tons |
| Storage tanks, boilers, drums, containers | unknown |
| Automotive and bicycle parts | unknown |

Present State of Planning

9.23 A number of programs have been proposed in Indonesia in the mechanical sector, and a few appear to be at advanced stages of planning. These include:

- Regional foundry centers: They have been ranked at or near the top in importance in past surveys by visiting experts; proposed production volumes seem conservative, possibly because the markets are not precisely identified. Table 9.6 provides a comparative summary of the plans.

- Machine tool rehabilitation center: A rehabilitation program of one type or another has been under active consideration for over ten years; the present plan calls for a center (possible location--Barata) serving the entire industry, a potentially difficult proposition even with mobile field units. It should also be understood that a program limited to physical rehabilitation of machinery does not get to the root of the problems, which are poor maintenance and improper tool selection and usage.

- Merger of several metal-working shops: This would appear to be a very significant reform, but unless the reform is made as part of an overall game plan, the problems that beset each individual enterprise could simply be compounded by the mergers. The mergers under consideration are the BBI Group composed of Bisma, Boma and Indra and the Barata Group composed of Barata, Sabang Merauke and possibly Peprida. More will be said on these groups later in connection with the recommended development programs.

- Reorganization of P.L.N., the State Electrical Authority: Although electric power is outside the scope of this mission, matters affecting P.L.N. are relevant since it controls the market for industrial electrical equipment. This electrical equipment sector today is remarkable for the total absence of any production activity. Planning underway will be discussed in the sections under electrical equipment.

- Incentives for light manufacturing and handicraft industries: Joint venture interest appear relatively strong in the assembly of certain light, durable consumer products, e.g., watches, sewing machines, bicycles; these industries should be capable of developing under private

Table 9.6

Comparison of Proposed Plans for Foundry Centers
(Thousands of U.S. Dollars)

| | Medan<br>5,000 t/y cast iron<br>2,000 t/y cast steel | | Djakarta<br>4,000 t/y cast iron | | Surabaya<br>10-12,000 t/y<br>of mixed castings | |
|---|---|---|---|---|---|---|
| **Total Investments** | | | | | | |
| Land and Buildings | 1,213 | | 348 | | 1,425 | |
| Machinery and Equipment | 727 | | 723 | | 725 | |
| Others (trial run, consulting services, etc.) | 249 | | 538 | | 250 | |
| Working Capital | 310 | | 126 | | 790 | |
| Total | | 2,499 | | 1,735 | | 3,190 |
| **Production Costs** | | | | | | |
| Material (Over 50% is import) | 959 | | 474 | | 1,440 | |
| Labor | 115 | | 37 | | 250 | |
| Other variable costs | 168 | | 32 | | 208 | |
| Fixed costs (depreciation, interests, etc.) | 478 | | 265 | | 520 | |
| Total | | 1,720 | | 808 | | 2,418 |
| **Total Sales** | | 2,000 | | 950 | | 4,000 |
| | Plan submitted by UNIDO advisor | | Plan submitted by Japan Consulting Institute | | Recent report for Barata by German Consultant discusses production plan for 3200 t/y cast iron and 1800 t/y cast steel, but gives no cost details. | |

initiative and entrepreneurship as the economic climate continues to improve, if industrial incentives plus financial and technical assistance are provided to purely domestic ventures.

- Rehabilitation programs in general: In a developing nation, rehabilitation programs are necessary and urgent industry-wide; however, they serve only as stop-gap measures aimed at braking the decline of the industry, and do not contain in themselves the driving force to move the industry.

9.24 A comparison of the Djakarta and Medan foundry plans in Table 9.6 gives the following costs in dollars per ton of output:

| | Material | Labor | Total Investment |
|---|---|---|---|
| Djakarta (cupola) | 118 | 9 | 434 |
| Medan (induction furnace) | 137 | 16 | 357 |

The discrepancy in investment costs is actually greater than shown, since (a) the Medan foundry is designed to produce both iron and steel castings, whereas the Djakarta foundry will produce only iron castings, and (b) the former uses the more costly induction furnace. The material costs on the other hand are reversed; for a given output, cupola should have a considerably higher material cost. There is also a large difference in labor costs that cannot be explained by the difference in melt process.

9.25 With reference to the foundry centers, considered critically important by many experts, they have the characteristic shared by all supplier industries in that they are "captive" to the end product manufacturing market. Recent production figures show that the largest producer of castings in 1970 was Barata with a volume of only about 1,000 tons. The Pindad Army Shop in Bandung was second with 500 tons. This lack of a stable and sustaining demand for foundry products was partly caused by the problems of the foundry sector itself, e.g., inefficient operation, poor quality and high cost of castings, but more fundamentally, it reflected a general weakness of the manufacturing sector. The proposed foundry centers can hardly be expected to have the leverage to correct the general situation. The need is quite apparent for the planning in the foundry sector to be made a part of the overall strategy in the mechanical sector. An integrated approach will make it possible to plan the scale and the facilities of the foundry centers to serve specific regional markets in terms of the type and size of castings, the material quality requirements, the length of runs, etc.

9.26 The proposed consolidation of metal-working establishments should eliminate multiplication of facilities and competition in what is essentially a small market and make possible larger production units. This step, it seems, has been overdue. Present plans call for first, changing P.N.'s into P.T.'s (essentially making these enterprises independent of the responsible government agency) and second, merging 5 or 6 shops into two groups: The Barata group consisting of Barata Sabang Merauke and possibly Peprida, and the B.B.I. group comprised of Bisma, Boma and Indra.

9.27 The Barata group will be dominated by Barata, the largest and possibly the best shop in the industry. Barata proposes to expand its road roller assembly into other construction equipment and it could well be the site for the proposed new foundry center in Surabaya. Sabang Merauke serves the textile industry and makes parts for other industrial machinery; Peprida is a government-owned construction company. Planning for the B.B.I. group seems to be at a more advanced stage and will be more critical, since it involves the merger of three troubled enterprises. Bisma is a crowded shop covering 2,600 square meters. It is engaged in platework and the building of structures and machines on job order. Eighty percent of its machines are over 30 years old and its small foundry has an output of about 100 tons/year. In 1970, its estimated value of output was U.S. $600,000. Its major asset appears to be an energetic and competent management. Boma has three plants, the largest at Bineka covering 20,000 square meters. The Bineka plant does repair/replacement work for sugar mills and tin mines. Its foundry has a minimum capacity of 1,000 tons, but produces only about 200 tons/year. The Turranga plant is a relatively new machine shop; it still produces some agricultural sprayers, but much of the plant is idle. The Wahana plant was built for the assembly of rolling stock; it has been idle for several years and its labor force all transferred to Bineka. Boma, in 1970, had an estimated total output of slightly over $600,000. Indra performs major supporting services to the sugar industry and the mines, but like Boma, it has a general shortage of work. The plant covers 3,300 square meters. The marine Diesel assembly shop has been idle, and the plate shop has a heavy press which is infrequently used. The foundry has a nominal capacity of 4,000 tons, but produces only some 300 tons/year including sugar mill rolls up to 8 tons finished weight. In 1970, Indra had an estimated output under U.S. $1 million. Both Boma and Indra have been very short of work. Only Bisma, the smallest among the three, has been reasonably busy. Under the merger plan, Bisma will specialize in rice processing machinery, Boma in structural steel work and agricultural tools, and Indra in light fabrications and pumps. Plans also call for concentrating the foundry of the group at Boma's Bineka plant; it is not clear how this will affect the proposed foundry center in Surabaya. Total capital cost of the plan, including cost of rehabilitation and increase of working capital, has been estimated at $1.8 million.

## Industrialization Strategy

9.28 The demand for mechanical products, apparently low at the present time, based on production and import statistics, will likely accelerate over the coming years both to satisfy the demand backlog and the normal expanding demand of the economy. Evidence from both a macro-view and a detailed look into the activities and products of the industry, show that the engineering industry in Indonesia has been generally stagnant over the past decade, while most other countries in Asia were making progress. On a per capita basis, the consumption of metal and mechanical products is just about the lowest in Asia, despite relatively high imports. For example, per capita consumption of iron castings in Indonesia is estimated at 0.1 Kg today, versus 5 Kg in India and 12 Kg in Taiwan (over 100 Kg in the U.S.).

9.29 At the policy level, the Government might in one extreme adopt a laissez-faire approach, that is, let the mechanical industry develop at its own pace. In these circumstances, Government actions will be largely limited to institutional and rehabilitation programs. This could be a minimal cost program over the short run, but it must be recognized that the industry does not have the inherent strength to advance itself. The problems in evidence today could conceivably get much worse before any improvement of the situation can be foreseen. In the meantime, the expanding economy will rely increasingly on imports, and this in turn could have a further depressing effect on the domestic industry.

9.30 It has been argued earlier in this report that Indonesia cannot forever remain an agricultural, resource-exporting and incidental manufacturing country, that the country should develop industrially, that the national market is big enough to support a substantial manufacturing activity; consequently, a more positive set of programs is required from the government planners. The priority of developing the engineering industries as the foundation of the industrialization process will need to be established. The following paragraphs outline, in general terms, a possible development process with reference to the end product list generated earlier. Relevant market forecasts and cost analysis for specific product lines or complexes will be presented in later sections. The mobile equipment sub-sector is suggested as the starting place for development because the existing motor vehicle industry offers a ready market for certain component and sub-assembly industries, and because most of the other mobile end products (construction equipment, farm equipment) require much of the same technology as the motor vehicles. Stationary equipment (industrial machinery, electrical equipment) and shipbuilding are suggested as parallel developments. A principal objective of the strategy will be the priming of the link between the supplier industry and end product assembly. In some instances this will mean a carefully planned integration of the manufacture of select components and of end product assembly in a single manufacturing complex.

It also means a deliberate channelling of industrial technology and skills into the supplier industries where they can most effectively contribute to the building of capabilities and to the domestic diffusion of manufacturing know-how. In general, the strategy is seen as composed of three stages extending over the next decade.

Stage 1: The first development stage involves expanding the production of trucks and buses and establishing the assembly of a limited line of construction equipment. The foundry industry, primarily for gray iron casting work, will be reorganized to provide castings at competitive costs. A power transmission industry will be established to assemble transmissions and other drive-line sub-assemblies. The foundry industry will be scaled to produce castings not only for the mobile equipment industry, but also for the existing stationary equipment industry (principally parts for textile machinery, pumps, and mills). The production of basic lines of motors and transformers will be established. Existing shipyards will be rehabilitated to service and build ships for the inter-island fleet; this will provide the learning period for building larger ocean-going ships. Gear sets, bearings, and precision components would be imported in this stage to be used in the sub-assemblies. Forging capability will be introduced to produce a variety of tools for the farm and industry.

Stage 2: At this stage, the construction equipment line will be expanded, and farm tractors will be added to the product mix. The manufacturing plans will draw upon the experience gained during Stage 1. Implementing this plan will require an expansion of the foundry industry both in size and in capabilities. Steel and non-ferrous casting facilities would be added. Also, a stamping industry could be established, initially concentrating on small stamping such as machine components. The automobile industry will have been reorganized and a limited program of increasing the domestic content of cars could begin. The most significant new program could be the building of ocean-going ships for the domestic fleet, following a study of the shipyard requirements.

Stage 3: This development stage primarily involves the establishment of a precision components industry, serving in the main the sub-assembly industries. This industry would set a new level of sophistication to the industrialization process in that the required skills and precision would surpass those of the other industries. Generally, the manufacture of machinery and equipment will become specialized. There will be large manufacturing complexes as well as small special makers of components and products. Also, the market should now be capable of supporting a machine tool industry.

9.31 The stages indicate a path to mechanical industrialization through the establishment of a complex of industries based on the building block products. Here, the use of the word "complex" is just a way of thinking about the organization of the plan; it does not necessarily mean that

production would only be in one or two plants, or that there would be a group of plants in one place, or even near each other. The idea is a complex of industries rather than a complex of factories. A possible complex is illustrated in Figure 9.2, as it would appear perhaps 10 years from now. Industrial operations are represented as enclosed areas with inputs of technology and material. Outputs are all directed to specific markets. Products not identified on the figure are to be derivatives of the primary products shown.

9.32 The supporting industries, called "mother" industries here, would typically produce foundry items, power transmission components and sub-assemblies, and fabricated structures. The "mother" industries supply the "satellite" industries, which make end items for the market. Mobile and stationary equipment makers would draw heavily on the "mother" industries; by comparison, the shipbuilding industry would only be a tenuously related "satellite," since its initial development, centered around hull construction, does not demand an extensive supplier network. The "satellite" industries could be expected to branch out and grow, and new ones could be added over a period of time. The mobile equipment product lines could be expanded and diversified. The stationary equipment is an especially broad category covering machine tools, textile machines, pumps and compressors, electrical equipment, etc. The shipbuilding industry could include boilers, locomotives, and fabricated structural steel as well as railcars.

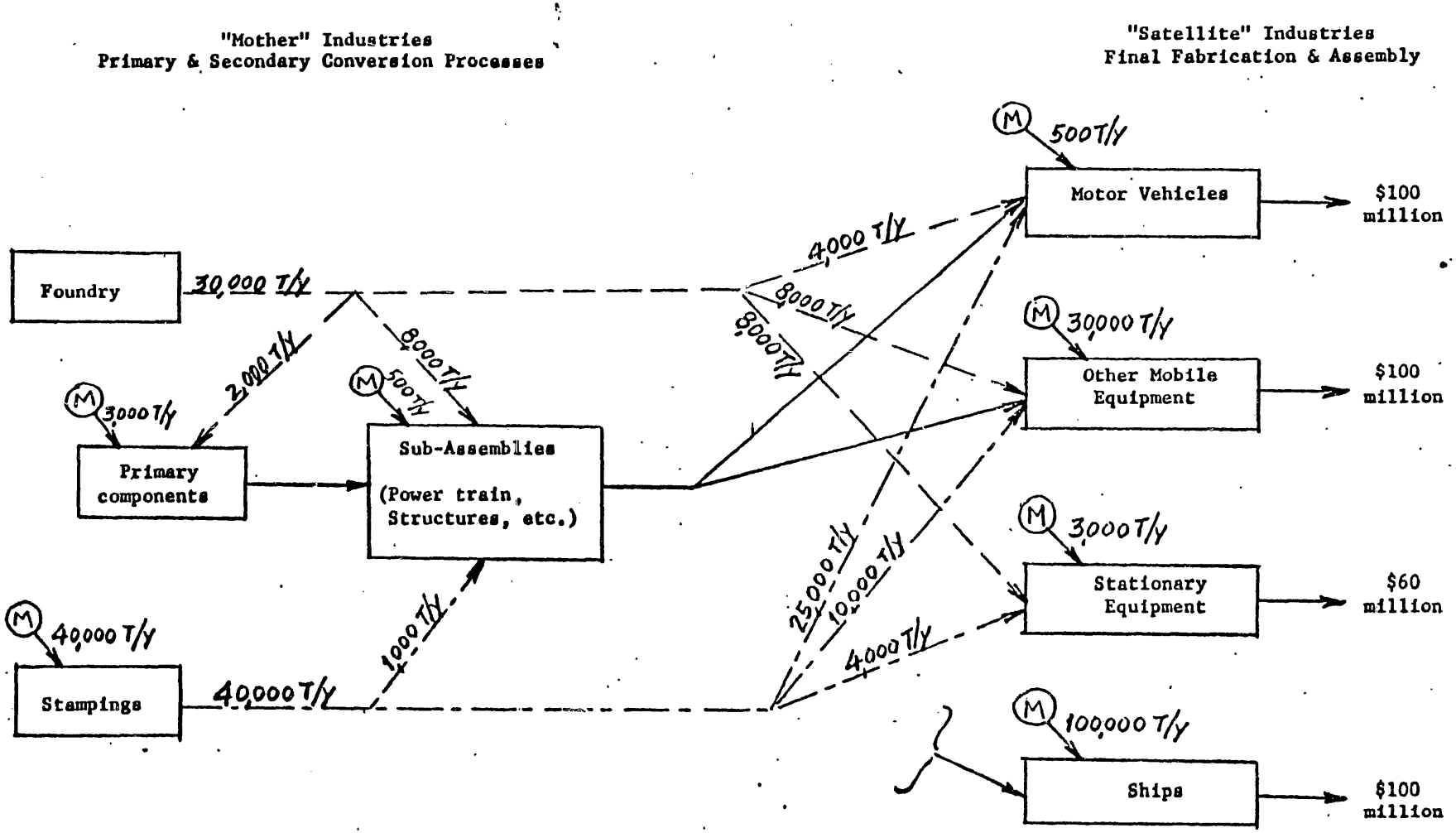
9.33 This statement of stages of development for the engineering industries is necessarily in general terms, although the delineation in Figure 9.2 indicates the extent of the interrelations. It is not possible in this report to present detailed plans and precise quantitative relationships among all of the industries. That should be the task of the planning exercise for the next five year plan. However, in succeeding pages we have analyzed major engineering complexes that are judged to be feasible now and that should constitute a basis for continued development of the engineering industries. A shift in the orientation and product composition of the automobile industry is also suggested.

## Motor Vehicle Industry Development

9.34 The industry is represented on the priority product list by trucks and buses. Automobiles are assembled today in Indonesia, but were not included on the list. Automobiles are probably the most complex and technologically demanding products in the mechanical sector. It is noted that even a small car averages 2,500 major parts and sub-assemblies, or over 20,000 parts if every nut and bolt is counted. A standard engine averages up to 1,000 parts and about 15,000 separate machining and treatment processes to turn steel shapes, forgings and castings into finished engine components. Hundreds of different types of metals and nonmetallic materials are required. With all these, there must be rigid specifications and standardization, essential to

Figure 9.2

Industrial "Complex" - beyond 1980




NOTE: All shipment figures are annual

(M) denotes steel mill products

mass production. To an international auto maker, an assembly affiliate in a developing country represents a sizable customer for components, sub-assemblies, manufacturing equipment as well as technology. To a developing nation, it can be stated categorically that automobile manufacture does not make short-term economic sense no matter on what basis it is established--assembly only or backward integrated--because of the essential capital intensiveness of the industry and the impossibility of achieving scale economies. This generalization holds regardless of any labor cost advantage the developing nation may enjoy. In spite of this fact, many developing nations including Indonesia are manufacturing (assembling) cars. Furthermore, it is evident that they will continue to do so in spite of the near-term diseconomies that analysis readily shows are invariably occurring. The motivation for this practice must lie in benefits of national pride, the opportunity to factor the designs in small ways to the local conditions and anticipated long-term economic benefits. The expected long-term benefits could be the most persuasive. They involve the expectation that the nation will develop industrially overall so that, eventually, through the achievement of scale and integrated technological capability, the diseconomies of automobile production will disappear. They also recognize the strong industrializing effect that auto manufacturing can have, in greater measure than any other single product area classification. Thus, for the near future, the policy question is how to approach the process of building up the industry and utilizing the industrialization potential. One extreme is to subsidize or protect the industry very heavily; technology has to be imported and investments must be made in uneconomic manufacturing facilities. The result of this approach is cost multiplication, already observed in many developing nations. The other extreme is to allow economic forces free play, with the local (import) price acting as the control function determining the rate of increasing local content. This could mean that the local content will remain low for the forseeable future. Most policies in developing nations fall between these two extremes.

9.35 A comprehensive study of the Indonesian motor vehicle industry was undertaken recently 1/. The registered motor vehicle fleet was estimated to have grown on the average of about 6% per year since 1961--cars at 9%, trucks at about 3% and buses at only slightly over 2%. The number of vehicles in operation in 1968 was estimated at 198,000 with the following breakdown:

| | | |
|---|---|---|
| Cars (sedans, jeep-type vehicles, taxis, etc.) | | 64% |
| Trucks | small (under 3 tons) | 6% |
| | large (over 3 tons) | 24% |
| Buses | small | 1% |
| | large | 5% |

1/ "Indonesia: The Motor Vehicle Industry," J.R. Hansen, Dec. 29, 1970.

The low number of small trucks (12,500 vehicles) and small buses (1,600) is noteworthy. A rough demand forecast, based on past growth pattern, showed that the number of operational 4-wheel vehicles by 1975 will roughly double that in 1968, with the same percent breakdown by type. Yet it seems likely that the demand for trucks and buses shoulds shift the composition of output in their favor rather than in favor of passenger cars. A policy of encouraging production of the latter rather than the former may not be the best choice. The history of development of the motor vehicle industry in Japan provides an interesting case study. Around 1940, annual production reached its pre-war peak of 46,000 vehicles, 98 percent of which were trucks. After World War II, production of motor vehicles was resumed with trucks and buses, the emphasis shifting to passenger cars by the late fifties. However, even as late as 1966, when the total output exceeded 2 million vehicles, only about 38 percent of this total were passenger cars.

9.36 It is suggested that a strong case can be made for Indonesia to shift the development emphasis from cars to trucks and buses. Truck and bus manufacturing is fairly labor intensive, and since their components are generally simpler (e.g., sheet metal), the establishment of the supplier sector should prove economically more feasible. It should be possible to develop a low-cost manufacturing source for frames, van bodies, assembled chassis and a closely related product, shipping containers.

9.37 It is not possible to set a precise output target for trucks and buses, but the shift in output could be substantial, particularly in the case of small trucks and buses, since the potential market is judged to be fairly large. A shift away from passenger cars should also have the effect of decreasing imports of components; the simpler requirements of trucks and buses can, as mentioned above, be more easily met by local manufacture. In addition, the comparative disadvantage of Indonesia in the manufacture of trucks and buses (measurable roughly by the difference between domestic price and import price) is less than for passenger cars, so that there should be a net economic benefit from the shift. It is suggested that this shift could be accomplished by negotiation, plus some changes in import regulations and tariffs.

## Mobile Equipment Industry Development

9.38 The major products under this category are construction equipment, farm tractors, and large trucks and buses. This product group would appear to offer the best proving ground for establishing a major manufacturing operation in Indonesia, particularly in terms of leading the development of the supplier sector. The demand for these products is estimated to be large enough to support a domestic production operation, but the lack of data makes it difficult to forecast demand exactly with great assurance.

9.39 The mobile equipment in the agricultural sector consists principally of products in the tractor family. Tractors (35-60 H.P.) are mostly used in the big estates, and they are all imported. The agricultural machinery census of 1963 gives the number of tractors in the country as 4,120, and the number today may not be much above this value. The demand is difficult to project, but is estimated to be at least a few hundred units a year. The demand backlog is unknown, but could be quite large. Even with a limited market, the proposition to manufacture tractors could prove feasible, since they fit well into a production complex with construction equipment.

9.40 The construction equipment category covers a broad range of product possibilities. Domestic production is very limited, the only significant activity in the nation being road roller assembly. The number and types of equipment in use are not known, but some years back, it was estimated that Caterpillar had 5,000 pieces of equipment in Indonesia, with less than half in operating condition. Recent statistics suggest that the import of construction and mining equipment totalled around $10 million in 1967, and the figure roughly doubled in 1969. Future equipment demand is expected to keep pace with investment and output in the construction sector. Indonesian industry should be quite capable of learning to produce a balanced line of construction equipment within a few years, with over 50 percent local content, since a large portion of the manufacture is concerned with the fabrication and the assembly of plates, shapes and castings.

9.41 A rough estimate of demand is possible from the projected investments in the construction sector. Statistics from other developing countries show that generally the amount spent on machinery and equipment is typically high in highway construction (40-70% of construction value) and low in building construction (20-30%). An average of 40% might be reasonably assumed for all construction. Of this total, about a quarter will be spent on medium to heavy mobile equipment (bulldozers, road rollers, dump trucks, etc.). Thus, an estimated 10% of the total investment in construction can be taken as the basis for projecting the mobile construction equipment demand. The results of the calculation for Indonesia are shown in Table 9.6 The figures for demand rise from 4,800 pieces of mobile equipment to 11,400 by 1980.

Table 9.6

Requirement for Mobile Construction Equipment

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| All Construction, million $ | 300 | 600 | 1,000 |
| Spending on Mobile Equipment, million $ | 30 | 60 | 100 |
| Bulldozers/tractors, million $ | 12 | 24 | 40 |
| Other mobile equipment, million $ | 18 | 36 | 60 |
| Bulldozers/tractors* at $10/hr., pieces | 600 | 1,200 | 2,000 |
| Other equipment* at $5/hr., pieces | 1,800 | 3,600 | 6,000 |
| Total requirement, pieces (% operative) | 4,800 (50%) | 8,000 (60%) | 11,400 (70%) |

*Normal service life of 12,000 hours or 6 years has been assumed. Components will need more frequent replacement; typically, a track set may have a life span of 3,000 hours, but will need rebuilding after 1,500 hours on the average. These estimates are probably generous for the Indonesian climate.

9.42 Based on these estimates of demand, a mobile equipment manufacturing enterprise will be analyzed as to its capital requirement and production cost in Indonesia. A typical product mix for the enterprise might be hauler/dump trucks, bulldozers and farm tractors. The selection of a particular equipment type will not be critical to the analysis, which is based on the volume of material flow through the plant. Product identification will be necessary, however, when equipment prices are considered. Nevertheless, each type of equipment in the product mix of this study can be regarded as representative of a class of products of similar weight and material composition--in other words, the product mix has a degree of flexibility.

9.43 For the purpose of this exercise, the annual output at full production consists of:

A. End Products

| | Unit Weight (Ton) | Annual Output (Pieces) | Total Weight (Ton) |
|---|---|---|---|
| Bulldozer | 12 | 240 | 2,880 |
| Farm Tractor | 2 | 720 | 1,440 |
| Heavy-duty Truck | 4.5 | 720 | 3,240 |

B. Intermediate products for outside sale

| | |
|---|---|
| Industrial transmission sub-assembly | 1,200 tons |
| Fabrication (welded structures, etc.) | 2,000 tons |

The production schedule is set as follows:

Preparatory Period - 2 years

planning and construction

1st Stage - 2 years

limited production, domestic content 20%

| | |
|---|---|
| Bulldozer | 60/year |
| Truck | 360/year |
| Transmission | 400 t/year |
| Fabrication | 1,000 t/year |

2nd Stage - 2 to 3 years

Full production, domestic content 40%

3rd Stage - expansion of product lines, domestic content 60% or higher

The key step in the analysis of the production costs is a breakdown by material weight of each product. Table 9.7 gives a representative breakdown. For the end products, an average composition is shown for simplicity, with the cautionary note that the variation in composition can be quite large for seemingly similar products (for example, the amount of forgings in a power shovel is less than 10% by weight, but can exceed 20% in the case of bulldozers). The estimated current prices of castings, structural shapes, etc. are shown in the table. A further consideration is the "make versus buy" decision on each component, from nuts and bolts to engines. The purchases will be mostly imports, but there will be some domestic procurement. The cost to plant of imports is simply estimated from the import content, using the f.o.b. prices of products in the U.S. as a point of reference. The domestic procurement is estimated as a percentage of the domestic content. The results are shown in Table 9.8. As stated earlier, pricing requires rather precise identification of products. F.o.b. prices in the U.S. are indicated within brackets. The bulldozer is an intermediate range equipment rated at 100 H.P. with standard gear shift ($20,000). The farm tractor is a Diesel model in the power range of around 30 H.P. ($3,000). The truck is a standard, intermediate-size dump truck (cabin and chassis, $7,100; body, $900; and hoist $1,000).

Table 9.7

Product Breakdown by Material Weight and Cost/Ton

| | | Castings Iron | Castings Steel | Forgings | Plate & Sheet | Structural Shapes | Bar Shapes C Steel | Bar Shapes Alloy Steel | Total |
|---|---|---|---|---|---|---|---|---|---|
| Mobile equipment product mix | Composition % | 20 | 15 | 15 | 20 | 20 | 5 | 5 | |
| | Tons | 1,512 | 1,134 | 1,134 | 1,512 | 1,512 | 378 | 378 | 7,560 |
| Transmission* | Composition % | 15 | 5 | 10 | - | - | 5 | 65 | |
| | Tons | 180 | 60 | 120 | - | - | 60 | 780 | 1,200 |
| Fabrication* | Composition % | | | | 60 | 30 | 5 | 5 | |
| | Tons | - | - | - | 1,200 | 600 | 100 | 100 | 2,000 |
| Total Material, tons | | 1,692 | 1,194 | 1,254 | 2,712 | 2,112 | 538 | 1,258 | 10,760 |
| Total material requirement with 25% allowance for processing loss, tons | | 2,115 | 1,492 | 1,568 | 3,390 | 2,640 | 673 | 1,572 | 13,450 |
| Cost per ton, U.S. $ | | 250 | 400 | 300 | 150 | 150 | 190 | 260 | |
| Total Material Cost, 000 U.S. $ | | 529 | 597 | 470 | 510 | 396 | 128 | 410 | 3,040 |

*The quantities shown do not include in-plant consumption.

Table 9.8

Value of Purchased Parts

| Product | Base Price for Computation Purpose | Base Value of Production (million $) 1st Stage | 2nd Stage | 3rd Stage |
|---|---|---|---|---|
| Bulldozer | 15,000 | 0.90 | 3.60 | 3.60 |
| Farm Tractor | 3,000 | - | 2.16 | 2.16 |
| Truck | 6,500 | 2.34 | 4.68 | 4.68 |
| Transmission | 900/ton | 0.36 | 1.08 | 1.08 |
| Fabrication | 500/ton | 0.50 | 1.00 | 1.00 |
| Total | | 4.10 | 12.52 | 12.52 |
| Import content, % | | 80 | 60 | 40 |
| Imported parts, million $ | | 3.28 | 7.51 | 5.01 |
| Domestic parts, % of domestic content | | - | 10 | 15 |
| Value | | | 0.50 | 1.13 |

9.44 With reference to the production schedule given earlier and to Tables 9.7 and 9.8, the cost of raw material and purchases are summarized below.. Costs under Stage 1 are for a limited production.

| | Stage 1 | Stage 2 | Stage 3 |
|---|---|---|---|
| Raw Material | 0.15 | 1.22 | 1.82 |
| Domestic parts | - | 0.50 | 1.13 |
| Imported parts | 3.28 | 7.51 | 5.01 |
| Total | 3.43 | 9.23 | 7.96 |

The labor costs may be estimated based on the following salary and productivity figures. Productivity is assumed at a low 20% of U.S. productivity at Stage 1 and at 40% at Stages 2 and 3.

| | | |
|---|---|---|
| Salary: | Direct worker | $700/year |
| | Supervisory personnel | $1,200/year |

Productivity in tons/man-year:

| | U.S. | 1st Stage | 2nd and 3rd Stages |
|---|---|---|---|
| Machine shop | 45 | 9 | 18 |
| Fabrication shop | 45 | 9 | 18 |
| Assembly shop | 100 | 20 | 40 |

In estimating the investment costs, it is noted that the production facilities will consist in the main of a machine shop that includes heat treating and forging facilities, a fabrication shop and an assembly plant. A foundry has not been included within the enterprise, assuming that castings will be purchased from a regional foundry center. The machine shop is planned as a separate building from the fabrication and assembly building. The total investment, including contingency fund and working capital, is estimated at $19.1 million. The working capital is estimated at 25% of the variable costs plus 2 months receivables. The total sales is determined, allowing a 20% return on investment. The computation results are summarized in Table 9.9, when the operation has attained Stage 3 level. A typical supplier plant is also shown.

Table 9.9

| | Typical Supplier Plant | Mobile Equipment Manufacturing Enterprise--Output 10,000 Tons of Product Mix | | |
|---|---|---|---|---|
| | Fastners 2,000 T/Y | Machine Shop | Fabrication and Assembly Shop | Total |
| Total Investment | 1.3 | | | 19.1 |
| Land | 0.2 | | | 0.5 |
| Buildings | | 1.0 | 1.5 | 2.5 |
| Equipment and Machinery | 0.5 | 5.0 | 3.5 | 8.5 |
| Contingency | 0.4 | | | 1.0 |
| Working Capital | 0.2 | | | 6.6 |
| Production Costs | 0.9 | | | 11.8 |
| Material | 0.5 | | | 8.0 |
| Labor | 0.1 | | | 1.2 |
| Variable Overhead | | | | 0.5 |
| Depreciation: Machine Equipment, 15 years | | | | 0.7 |
| Building Facilities, 25 years | | | | |
| Interest at 12% on fixed and working capital | | | | 0.9 |
| Other costs--sales promotion, training, etc. | | | | 0.5 |
| Sales (estimated) | $550/ton | | | (Total)15.6 |
| Return on Investment | 15% | | | 20% |

9.45 The following table summarizes the operation of the enterprise through the three stages:

(million $)

| | 1st Stage | 2nd Stage | 3rd Stage |
|---|---|---|---|
| Sales total | 4.73 | 15.60 | 15.60 |
| (Sales/ton) | ($1,810) | ($1,450) | ($1,450) |
| Production | | | |
| Material | 3.43 | 9.23 | 7.96 |
| Labor | 0.39 | 1.06 | 1.24 |
| Other variables | 0.30 | 0.40 | 0.50 |
| Fixed costs | 2.10 | 2.10 | 2.10 |
| Total | 6.22 | 12.79 | 11.80 |
| (Cost/ton) | ($2,340) | ($1,190) | ($1,100) |

The per ton values are not a fair basis for evaluating this type of manufacturing operation; nevertheless, the sales price of $1,450 per ton would seem to compare favorably with the international prices for the line of equipment considered. A weakness in the analysis is a lack of reliable information about the market and actual product mixes, but it is estimated that the future demand for medium to heavy mobile equipment will be considerably larger than in the past. The market may be limited for individual items; however, the product mix of construction equipment, agricultural tractors and trucks is judged to have the potential to lead industry-wide development that will generate a degree of "volume" market for the supplier sector to grow. Opportunities for sub-assembly operations could exist in equipment attachments and hardware, tool systems, tracks, hoist, cabin-chasis, and eventually to primary components. It is suggested that this program might be particularly timely for consideration in Indonesia in view of the plans to restructure the metal-working industry, and specifically, the plans to establish a foundry center and the Barata Group in Surabaja, Figure 9.3. The figure shows a possible configuration of development in the Surabaja region centered around the mobile equipment program and the agricultural equipment program to be discussed next.

## Stationary Equipment Industry Development

9.46 The stationary equipment covers a broad category of products--industrial machinery, pumps, electrical equipment and machine tools, in addition to such durable consumer goods as sewing machines. In the agricultural sector, production in 1969 was limited to the following:

| | |
|---|---|
| Processing mills for agricultural estates (mainly spare parts) | 2,400 tons |
| Irrigation pumps | 900 units |
| Hullers | 2,300 units |
| Hand Sprayers | 20,000 units |
| Small Farm Tools (patjols, etc.) | 350,000 units |

No industrial electrical equipment is made or assembled in the country; and presumably, all requirements of the power sector are imported. The prospects for domestic manufacture, or even assembly of industrial machinery and machine tools is not apperent at this time. Sewing machines are currently assembled, and could become the leading industry for the development of a wide range of light mechanical products under private entrepreneurship (a possible role of the government here is the establishment of a light industrial estate comprised of parts makers and assemblers of these products).

### Agricultural Machinery

9.47 With the agricultural sector first in national priorities, the manufacture of farm and estate machinery has received the special attention of machinery makers. The direction of the present efforts is to expand the production of small farm tools, hand sprayers and irrigation pumps, and to start the production, beginning with assembly, of rice processing machinery. The demand for power equipment such as sprayers and tillers will depend on the government subsidy program in the small farming sector and, unless the government is prepared to implement a massive subsidy program for the small farmers, the market for power equipment should continue to be small, limited by the farm income. Import in 1969 under the heading of "agricultural machinery," but excluding pumps and mill machinery, totalled only a little over half a million dollars.

9.48 From a strategy standpoint, pumps are judged to be the most promising product in the agricultural machinery sector in the sense of contributing to the development of the engineering industry. In addition to the irrigation market, the pump manufacuting industry can expand into a wide variety of pumping systems demanded by the chemical, marine and other industries, and it can stimulate the development of the supplier industries.

9.49 Within the irrigation program alone, estimates of the market range from 2,000 to 4,000 pumps per year. Production in 1969 was under 1,000 pumps, and 1,000 pump sets and all engines were imported. Although the domestic pumps are generally cheaper than imports, they cannot as yet compete in quality. The principal buyer is the Government through the Land Development Agency and the Department of Agriculture. The end-users are the farmers and the cooperatives. Financing has been a major bottleneck, since the pumping system is most needed by those who can least afford it, the ones with arid land. Pump alone accounts for only about 20 percent of the total cost of a pumping system. A 6-inch centrifugal pump costs about $250 in Indonesia; engine costs about $800 and the pump set about $1,400.

9.50 The market for irrigation pumps should be capable of supporting an industry scaled to produce about 5,000 pumps a year, but the realization of this market requires an effective program by the government to put the pumps in the hands of the end-users. The principal types of pumps in immediate demand are cast iron centrifugal pumps in the horsepower range of 10 to 50 H.P. The cost of producing 1,000 pumps of 8-inch nominal diameter is roughly analyzed. The material breakdown and costs follow:

| | Quantity (ton) | Cost/ton | Total Cost ($) |
|---|---|---|---|
| Iron Castings (body, housing, covers) | 300 | 250 | 75,000 |
| Bronze Casting (Impellor) | 20 | 1,200 | 24,000 |
| Steel Products | 10 | 200 | 2,000 |
| Purchased Components (5% of cost) | | | 5,000 |
| Total | | | $106,000 |

The production processes consist essentially of machining, assembly and finishing operations. Machining productivity may be assumed at 14 tons/man-year and assembly at 30 tons/man-year, which are about 30% of U.S. values. The total investment may be estimated at $1 million. The annual production cost is:

| | |
|---|---|
| Materials | $106,000 |
| Labor (40 men) | 28,000 |
| Variable overhead | 50,000 |
| Depreciation & other fixed costs | 50,000 |
| Interest at 12% | 60,000 |
| Total | $294,000 |
| Cost/pump | 294 |

The c.i.f. value of import is reported at around $450. Assuming that the domestic units would sell at 20% below the c.i.f. price, the sales price is $360. A key factor in the operation is the availability of quality iron castings at the assumed cost of $250/ton. The present cost in Indonesia is over $400/ton. The lower cost has been estimated for the output of the proposed foundry centers, and was used in the analysis.

9.51 In the merger plan of the B.B.I. Group, there are plans for specialized production of rice processing equipment, hand sprayers and irrigation pumps. The proposition to assemble and progressively enter into the manufacture of rice processing equipment is more complicated than in the case of hand sprayers or pumps, but should be technically feasible, again if the market can be assured. The technical problems are judged to be within the general experience level of the metal-working industry, although no large mills have been built in the country in recent years. The B.B.I. merger combines three relatively weak enterprises, but yet its formation should have a singularly important impact on the industrialization process by creating the first major maker of agricultural equipment in the country. In this sense, the merger plan merits careful review and support with the objective of assuring the success of the operation.

Electrical Equipment

9.52 The electrical equipment product category includes those electrical products excluding electronic equipment and communication devices. Following is a rough classification, identifying typical products in each classification:

Industrial

A. Heavy

a. Generators
b. Power Transformers
c. Motors
d. Electric Locomotives

B. Light

a. Distribution Transformers
b. Light Motors
c. Switchgear
d. Circuit Breaker

General

a. Home Electrical Appliance
b. Lighting Equipment
c. Electrical Accessories

In industrial electrical equipment, the demand for power generation and distribution equipment is largely determined by the Government policy on electric power, and the major buyer is the power authority. The market for consumer products could expectedly be closely related to the nation's living standards. The distinction between heavy and light industrial equipment applies to differences in size as well as in power or voltage range. The heavy equipment is usually custom-designed, calling for highly skilled workmanship, special equipment for manufacture and testing, and higher quality components. Technical consideration would suggest that Indonesia might best concentrate at the start, on light industrial equipment, and thereby gain experience before planning for even a limited entry into the manufacture of heavy equipment.

9.53 Electrical energy production in Indonesia in 1967 was 1,600 million KWH; the average growth rate between 1962 and 1967 was only about 6 percent per year. By comparison, energy production in the neighboring countries such as India, Philippines and Thailand expanded at a rate of around 15 percent over the decade from 1955 to 1964. The operating time of power-generation facilities (ratio of energy production over installed capacity) in Indonesia was also one of the lowest in South East Asia. Public supply of electric power in Indonesia is administered by Perusahaan Listricle Negara (PLN), the national power authority. The supply is unreliable, though there has been some substantial improvement. It has therefore become a standard practice for manufacturing concerns and other large establishments to have their own Diesel generating sets for use during power cuts. Investment in the power sector to date by PLN has concentrated on power generation, with apparent lesser priority on the rehabilitation and development of transmission lines and distribution network. As a result, in parts of Java, the power bottleneck is in the distribution system. The West, Central, and East Java each have its own distribution system, with West Java serviced by 150 KV line and the rest of the island by 70 KV line. There are practically no transmission lines on the other islands. According to government sources, the annual investment in power generation over the next few years will level off at around 15 million dollars a year, with a possible 15 to 30 million dollars a year going into the transmission/distribution sectors.

9.54 Import of electric motors and transformers totalled $4.6 million in 1969. The figure presumably does not include units imported as part of machinery or equipment import. No data is available on the total demand for major electrical equipment in recent years. If it is assumed that (a) all motor and transformer demand was met by import, and (b) the motor and transformer demand comprised roughly 25 percent of all industrial electrical equipment demand, then the size of the market for industrial electrical equipment in recent years can be roughly estimated as shown below:

(millions of U.S. $)

| | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|
| Electric Motors and Transformers | 2.1 | 3.0 | 4.4 | 4.3 |
| Industrial Electrical Equipment | 8.4 | 12.0 | 17.6 | 17.2 |

9.55 An estimate of future demand for electrical equipment might be made on the assumption that the demand will parallel the rate of growth of electric power generation. The results for growth rates of 10 percent, 15 percent, and 20 percent are shown:

Demand for Electrical Equipment
(millions of U.S. $)

| Growth | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|---|
| 10% | 18.8 | 20.8 | 22.8 | 25.2 | 27.6 | 30.4 |
| 15% | 20.0 | 22.8 | 26.4 | 30.4 | 34.8 | 40.0 |
| 20% | 20.8 | 24.8 | 29.6 | 35.6 | 42.8 | 51.2 |

Taking the figure of $40 million in 1975, assume that half or $20 million represents the demand for the light industrial equipment. It will be assumed further that the demand breaks down as follows:

| | | |
|---|---|---|
| Distribution transformers | 25% | 5 million |
| Motors | 25% | 5 million |
| Switchgear | 15% | 3 million |
| Others | 40% | 8 million |

In the case of transformers, taking an average value of $20/KVA, $5 million translates into a market for 250,000 KVA installed capacity in 1975. For motors, at $100/motor, the demand is for 50,000 motors in 1975. These are not forecasts, but guesses of the order of magnitude of the potential market for the domestic manufacturing industry.

9.56 Some steps are being taken to establish an electrical equipment industry. A transformer plant (Unindo) is under construction in Djakarta and scheduled to begin production by late 1971 of one line of distribution transformers (25-630 KVA, up to 20 KV). It is a joint venture between a French concern and PLN. The initial production target is 1,000 transformers a year. As a sole source of low tension distribution transformers in Indonesia, the plant seems small, particularly with reference to the market projected earlier. Early indications are that the product will cost approximately 40% higher than in West Europe (France). A rough comparison gives:

| | Cost, France | Index of Comparative Costs | Cost, Indonesia |
|---|---|---|---|
| Material | 50 | 160 | 80 |
| Labor | 30 | 100 | 30 |
| Other costs | 20 | 150 | 30 |
| | 100 | | 140 |

Planning is also at an advanced stage for the establishment of a large-scale cable manufacturing palnt (Kabel Indonesia). The cable plant appears will eonceived both in terms of plant size and product mix--telecommunication cables, power cables, wires and conductors. It should contribute importantly to the growth of the infant electrical industries as a supplier of one of the main materials needed by the latter.

9.57 There is a preliminary plan to produce motors (Metrika, July 15, 1971). The production plan calls for 16,000 electric motors and 2,000 small generators per year at full production. The motors are 1/2 H.P. single pahse and 3/4 to 5 1/2 H.P. three phase. Presumably, these are squirrel cage induction motors intended for use mainly in household products. Estimates of the production costs of motors follow:

| | Thousand $ |
|---|---|
| Materials | 334 |
| Labor | 77 |
| Overhead | 43 |
| Depreciation and Interest | 158 |
| Total | 612 |

The average unit cost comes out to $38, which is roughly half the c.i.f. value of equivalent imports. The total investment required is $2.5 million. The facilities will consist of machining, winding, press, and assembly areas. In addition, a foundry is included, but it is not clear whether die-casting is intended. Sale of motors is estimated to total $1.12 million. The materials/sales ratio of 30% could be low compared with similar plants in other developing countries. The

plan does not give any breakdown of the material cost, but roughly 50% of this cost is special steel sheet and copper wire. The profitability of the operation will depend largely on the cost to plant of these materials and the effectiveness of the material supply. It should be significant that there will soon be a major domestic source of copper wires.

9.58 Earlier market projections suggest that the electrical equipment industry could build towards an industrial output of the following scale by 1975-1976:

| | |
|---|---|
| Distribution transformers | 100,000 to 150,000 KVA Installed capacity |
| Electric motors, up to 30 H.P. | 20,000 to 25,000 units |
| Low tension switchgear, switchboards, circuit breakers, etc. | $3 million output |

This is a modest target, but its attainment will not be easy when the present low base of this industry and the uncertain situation in the electric power sector are taken into account. These factors are probably reflected in the cautious planning at Unindo. The plan at Metrika should probably be reviewed as to the appropriateness of its production plan, in particular the initial mix of motors and generators. Ordinarily, it should be an opportune time for the country to establish a general maker of light electrical equipment, with a product mix comprised of a combination of some of the above-listed products, but the desirable line of development of the industry is far from clear. A special study is suggested; this study should include an evaluation of the effect on the equipment market of any changes in the administration of public power, e.g., financial participation by the power authority in the manufacture of electrical equipment, capacity limitation by law of private generating plants, equipment procurement and maintenance policies, etc.

9.59 The infant electrical equipment industry that will emerge in the Djakarta area, as the previously noted three plants go into production, is shown in Figure 9.4. It is a modest start, but from the standpoint of national industrial development, it represents a step in the right direction. Missing in the figure are some important industrial products that connect the electrical equipment industry with the other major engineering sectors, such as power switching and regulating equipment, switchboards and industrial motors.

## Shipbuilding Industry Development

9.60 Shipbuilding is a representative labor-intensive industry and ships are relatively high in labor content even when built in modern yards. It is expected that the world market for ships will continue to expand in the seventies. Faced with increasing labor cost compounded by shortage of labor, many major shipbuilding countries have met rising costs with increased productivity. In Japan, labor productivity expressed in man-hour/gross ton went down from 55 man-hours in 1961 to 20 man-hours in 1967, but is expected to level off at around 15 man-hours in the 1970's. It might be anticipated that the position of leading shipbuilding countries could become relatively less dominant in the future.

9.61 Indonesia is a seafaring nation. The country is an archipelago of over 13,000 islands (about 1,000 are inhabited) extending over an area of 3,200 miles east-west and 1,500 miles north-south. Much of her goods move by sea. Her fleet composition is as follows:

a) Sailing vessel and local shipping fleet

The sailing vessels serve the coastal areas, smaller islands and the eastern archipelago. Their number is estimated at 17,000 with a total tonnage of under 400,000 tons. The local shipping fleet serves the short local trade and as feeder vessels for the larger inter-island ships. These are small motor vessels, numbering 780 and totalling about 68,500 dwt.

b) Inter-island shipping fleet

Inter-island shipping is and will continue to be the mainstay of the nation's domestic transport system. The inter-island fleet is variously estimated at between 250 and 350 vessels, with a dwt capacity of 350,000 to 450,000 tons. The actual number of vessels in regular operation is not known since the physical condition of the fleet is very poor and most shipowners do not register their vessels. It is estimated that 190 vessels with a total capacity of 200,000 dwt are effectively participating in the Regular Liner Service (R.L.S.) system. The average age of vessels is about 16 years, but most ships have not docked for years and their condition is judged to be far worse than would be normal for the age. Ship operation is expectedly inefficient, traceable to physical as well as institutional problems. The ratio of sailing time to port time is about 1:2, and the average production is estimated at 7-8 tons of originating freight per year per dwt capacity; the former should desirably be 1:1 and the latter doubled. Simple enforcement of standards by the Government could precipitate capacity shortage

since the shipowners lack the financial means to rehabilitate their ships.

c) Ocean-going shipping fleet

The ocean-going fleet of Indonesia consists of around 50 ships with a dwt capacity estimated at 430,000 tons. This does not include the fleet of tankers operated by Pertamina and other special vessels. The following table compiled by the Ministry of Communications shows the transporting ratios between the domestic-flag and the foreign-flag ships in the country's foreign trade. The table covers the first quarter of 1969 and does not include oil and lumber. It shows, with the exception of Australia, the low share of freight carried by domestic ships, particularly in export where the country may be presumed to have a competitive advantage. The announced Government policy is to expand the fleet capacity "as rapidly as feasible" to carry 50 percent of her overseas cargo.

| | Indonesian Ships | | Foreign Ships | |
|---|---|---|---|---|
| Service to/from | Import | Export | Import | Export |
| Japan | 31 | 7 | 69 | 93 |
| Hongkong | 20 | 23 | 80 | 77 |
| Singapore | 15 | 20 | 85 | 80 |
| Europe | 51 | 11 | 49 | 89 |
| United States | 9 | 11 | 91 | 89 |
| Australia | 59 | 74 | 43 | 26 |

Estimate of Ship Demand

9.62 Because of lack of essential data, only a very rough estimate of ship demand will be attempted. The demand estimates will be limited to the inter-island R.L.S. fleet and the ocean-going general cargo fleet.

R.L.S. Fleet. The total inter-island trade for 1969 is reported as 5 million tons, which includes 1.9 million tons of trade with Singapore/Malaysia. Of the 5 million tons total, about 1.6 million tons were carried by R.L.S. ships and the balance by non-R.L.S. vessels. In the demand projection, the domestic portion of the inter-island trade is assumed to increase at an annual 10 percent through 1973 and 15 percent after 1973. The Singapore/Malaysia trade is assumed to increase at a steady 5 percent. It will also be assumed that, as a policy measure aimed at strengthening the R.L.S. system, the growth in inter-island trade will be channelled mainly into expanding the R.L.S. fleet, with the share of trade serviced by the non-R.L.S. vessels kept under 4 million tons. The average performance is assumed to increase from the present 8 cargo tons/dwt per year to 15 by 1974. Table 9.10 shows the results of the demand analysis. It is seen that the R.L.S. fleet will remain at a level 200,000 to 250,000 dwt through 1974 and expand steadily after that year, roughly doubling in tonnage by 1978. By comparison, government sources project a systematic reduction in the inter-island R.L.S. fleet from 200,000 dwt in 1969 to 160,000 dwt by 1974. 1/ It is suggested that the basis of the demand projection of this study is quite reasonable--that the total inter-island trade will more than double in volume by around 1978, and that the R.L.S. fleet will carry twice the volume of cargo carried by the non-R.L.S. fleet by 1978 (a reversal of the present situation). It is further suggested that a review of the existing plans should be in order. A similar note of caution on the reduction of the R.L.S. fleet was expressed by the Indonesia Maritime Mission. 2/

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1/ Report of Directorate General of Sea Communications, 1971.

2/ Report of Indonesia Maritime Mission, June 14, 1971., Vol. 2.

Table 9.10

Projection of Inter-Island R.L.S. Fleet
(1,000 tons) (1,000 dwt)

| Year | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1976 | 1978 | Note |
|---|---|---|---|---|---|---|---|---|---|
| Cargo trade, domestic | 3,100 | 3,410 | 3,750 | 4,130 | 4,540 | 5,220 | 6,900 | 9,490 | Estimated to increase at 10% rate til 1973, and 15% after 1973. |
| Cargo trade, Singapore/Malaysia | 1,900 | 2,000 | 2,100 | 2,210 | 2,320 | 2,440 | 2,690 | 2,960 | Estimated to increase at 5%. |
| Total Inter-island trade | 5,000 | 5,410 | 5,850 | 6,340 | 6,860 | 7,660 | 9,590 | 12,450 | |
| Cargo, non-R.L.S. | 3,400 | 3,500 | 3,600 | 3,700 | 3,800 | 3,900 | 4,000 | 4,000 | Growth in inter-island trade channelled into R.L.S. fleet; share of non-R.L.S. vessels kept under 4 million tons. |
| Cargo, R.L.S. | 1,600 | 1,910 | 2,250 | 2,640 | 3,060 | 3,760 | 5,590 | 8,450 | |
| Performance Cargo ton/dwt | 8 | 8 | 9 | 10 | 12 | 15 | 15 | 15 | |
| R.L.S. Fleet | 200 | 240 | 250 | 264 | 255 | 250 | 372 | 560 | |
| Previous Projection of R.L.S. Fleet | 200 | | | 177 | | 160 | | | Report of Directorate General of Sea Communications, 1971 |

Ocean-going Fleet. Estimates of the present ocean-going general cargo fleet range from 230,000 dwt to 475,000 dwt. For the purpose of this computation, the figure of 430,000 dwt was chosen. The share of ocean freight carried by domestic-flag vessels was estimated at 25% in 1969-1970, corresponding to ocean freight volume of 6-7 million tons. In the demand projection, the ocean freight is assumed to increase annually at 15% (a rather conservative figure in the light of an almost standstill in the nation's total foreign trade during the sixties and the vigor of the current economic recovery), and the domestic bottom ratio is progressively increased from the estimated 25% today to 45% by 1978. The translation of cargo tons into ships require information on the average yearly number of voyages for each commodity on the major routes; in the absence of such information, best-guess estimates were used in computing the ship tonnage. The resulting demand forecast is shown in Table 9.11.

Table 9.11

Projection of Ocean General Cargo Fleet

| Year | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1976 | 1978 | 1980 |
|---|---|---|---|---|---|---|---|---|---|
| Ocean Freight (1,000 tons) | 6,000 | 6,900 | 7,930 | 9,120 | 10,490 | 12,060 | 15,930 | 21,100 | 27,900 |
| Domestic Bottom Ratio | 25 | 25 | 26 | 28 | 30 | 33 | 39 | 45 | 45 |
| Ocean-going Ships (1,000 dwt) | 430 | 430 | 460 | 510 | 630 | 790 | 1,240 | 1,900 | 2,510 |

R.L.S. Shipbuilding Program

9.63 The state of the inter-island fleet and shipyards, and the scope of current government plans are discussed in adequate detail in the Indonesia Maritime Mission report.1/ Table 9.12 shows an estimate of the rehabilitation and replacement schedules of the R.L.S. fleet in that report, allowing a decline in fleet strength to 210,000 dwt by 1974 and 190,000 dwt by 1978. Table 9.10 suggests that the fleet strength should be kept at 240,000 to 250,000 dwt level through 1974. The implication of the difference in forecast to the shipbuilding sector is that, assuming the same "out of service" rates as in Table 9.12, the estimate of new ships to be built by 1974 would need to be more than doubled from 36,000 to 80,000 dwt. Since new ships in the inter-island range cost roughly ten times the cost of rehabilitation, a more desirable option would probably be a significant revision upward of the proposed ship rehabilitation program. The differences in projection show up even more dramatically when the 1978 figures are compared. With the higher estimated demand for new ships, the feasibility of building more of these ships in domestic yards deserves attention. The higher schedules of ship rehabilitation and new ship construction also reinforce the case for an early program of repair and improvement in efficiency of the existing yards.

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1/ Report of Indonesia Maritime Mission, June 14, 1971.

Table 9.12

Preliminary Projection of R.L.S. Fleet 1974-1978*

(Based on 1970 ships of over 500 dwt)

| Age | Fleet at 1970 DWT Ships | 4 yr. out of service rate | DWT out of service | Less Rehab-ilitate | Net out of service | DWT 1974 |
|---|---|---|---|---|---|---|
| 0 - 4 yrs. | 1,000 | .08 | -- | -- | -- | 36,270 (New bldg.) |
| 5 - 8 " | 32,291 | .20 | 6,470 | 4,000 | 2,460 | 1,000 |
| 9 - 12 " | 70,771 | .55 | 39,000 | 29,000 | 10,600 | 29,630 |
| 13 - 16 " | 58,590 | .75 | 44,000 | 30,000 | 14,000 | 60,700 |
| 17 - 20 " | 38,708 | .90 | 34,600 | 17,000 | 17,600 | 44,600 |
| + 20 " | 40,974 | .95 | 38,800 | 15,000 | 23,800 | 34,300 |
| | 242,000 | | 162,860 | 95,000 | 67,860 | 206,500 |
| | Fleet at 1974 | | | | | DWT 1978 |
| 0 - 4 yrs. | 36,270 | .06 | 2,175 | 2,175 | -- | 30,000 (New bldg.) |
| 5 - 8 " | 1,000 | .10 | -- | -- | -- | 36,270 |
| 9 - 12 " | 29,630 | .20 | 5,926 | 3,000 | 2,900 | 1,000 |
| 13 - 16 " | 60,700 | .40 | 24,000 | 12,000 | 12,000 | 26,730 |
| 17 - 20 " | 44,600 | .60 | 26,760 | 10,000 | 16,700 | 48,700 |
| + 20 " | 34,300 | .85 | 25,700 | 10,000 | 15,700 | 46,440 |
| | 206,500 | | | 37,175 | 47,360 | 189,140 |

Notes: (a) "Out of Service Rates" are estimated from curves. It is only the 9-16 year group which would be variable substantially in the first calculation. The "out of service" rate is forecast to improve in the second period as a result of general fleet operational improvement.

(b) Rehabilitation can exceed the levels shown according to current dockyard capacity which is around 150,000 dwt in four years.

*Report of Indonesia Maritime Mission, Vol. II, June 14, 1971.

Ocean Shipbuilding Program

9.64 The ocean sector differs from the inter-island sector in that the domestic-flag carriers must compete with foreign-flag ships. Arguments in favor of expanding the domestic fleet such as protection of service disruption, influencing conference decisions, etc. could be important considerations. However, the key economic factor is the balance-of-payment effect. Table 9.13 shows projected freight payments to foreign-flag carriers for two cases: (a) The domestic bottom ratio attains 40% by 1976, and (b) old ships are rehabilitated or replaced, but the domestic fleet is maintained at the 1969-1970 level. For purposes of illustration, a shipping rate of $20 per ton has been assumed. It is noted that the freight payments in the table do not represent the net savings. There will be losses from disbursements overseas and other foreign exchange losses. If it is assumed that these losses total 50% of the apparent saving in freight payments, the net effect on balance of payments would be half the figures shown in Table 9.13. This exercise shows that in case (a) the net foreign exchange payments will increase from under $60 million in 1971 to over $95 million by 1976, despite a tripling of the domestic ocean-going fleet to attain the 40% share. Total payment over the five-year span 1972-1976 will exceed $400 million. In case (b) where the fleet is kept at the present size, the total payment to foreign ships over 1972-1976 will be $550 million. In 1976 alone, payment will amount to almost $150 million; the share of domestic bottom will have fallen to under 10%. These figures are not offered as a conclusive evidence that the domestic fleet tonnage should be increased; the question deserves a far more comprehensive study. This chapter is more narrowly concerned with the question of shipbuilding. The issue of relevance here is not the shipping fleet per se, but whether or not the ocean sector provides an opportunity for the domestic shipbuilding industry, or more precisely, for the operation of a modern yard capable of building ships in the 5,000 to 20,000 dwt range.

Table 9.13

Freight Payment to Foreign Flag Vessels

(million U.S. $)

| | Year | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | Total '72-'76 |
|---|---|---|---|---|---|---|---|---|
| 1 | Domestic Bottom Ratio | 26 | 28 | 30 | 33 | 36 | 40 | |
| | Freight Payment | 117.2 | 131.2 | 146.6 | 161.6 | 177.2 | 191.0 | 807.6 |
| 2 | Domestic Bottom Ratio | 19 | 16 | 14 | 12 | 11 | 9 | |
| | Freight Payment | 128.6 | 152.4 | 179.8 | 231.2 | 247.2 | 288.6 | 1,099.2 |

Case 1 Domestic bottom ratio attains 40% in 1976.

Case 2 Replace old ships only and maintain ocean-going fleet at the 1969-1970 level.

9.65 Any proposition for a major yard in Indonesia to build ocean-going ships would have to be measured against the largely negative background of the ship-building industry. Nevertheless, on the positive side, one might cite the labor factor, the market factor and the import factor. To the nation, there is also the general but very important factor of the potential contribution of shipbuilding to its industrialization process. To project a market size, it will be assumed that the domestic shipbuilding operation will supply 10% of the ocean fleet requirement in 1973; this share will be increased to 30% by 1976 and kept at 30% beyond that year. The balance will represent ship import. The following table shows the possible scale of domestic shipbuilding operation:

| | | 1973 | 1974 | 1975 | 1976 | 1978 | 1980 |
|---|---|---|---|---|---|---|---|
| Total New Demand, 1000 dwt for Ocean Ships | | 120 | 160 | 210 | 240 | 360 | 330 |
| Domestic Supply | % | 10 | 20 | 20 | 30 | 30 | 30 |
| | 1000 dwt | 12 | 32 | 42 | 72 | 108 | 110 |

It is seen that the domestic shipbuilders can anticipate an ocean ship market of around 100,000 to 110,000 dwt per year beyond 1976. This means that there could be a basis for a program that will realize a production capacity of 150,000 to 200,000 tons beyond 1976, assuming an average capacity utilization rate of 60%. Presumably, the largest ship built will be 20,000 dwt. These estimates do not take into consideration the repair market for the domestic as well as the foreign-flag ships, and in this respect, the capacity projection is conservative.

9.66 A preliminary cost-benefit analysis, based on the new shipbuilding program alone, is presented below. It is assumed that the program will be established over a six-year period 1973-1978. Ship export has not been considered in the analysis, although it is not ruled out as a long-term prospect.

(Million US $)

| | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | Total '73-'78 |
|---|---|---|---|---|---|---|---|
| Costs | | | | | | | |
| Fixed investment | 7.0 | 3.0 | 7.0 | -- | -- | -- | 17.0 |
| Working capital | 0.7 | 1.2 | 0.6 | 1.8 | 1.1 | 1.1 | 6.5 |
| Loans on domestic ships | 2.4 | 6.5 | 8.5 | 14.6 | 18.2 | 21.9 | 72.1 |
| Total | | | | | | | 95.6 |
| Benefits | | | | | | | |
| Residual value, ships | 1.6 | 4.9 | 7.1 | 13.3 | 17.9 | 23.2 | 68.0 |
| Residual value, fixed investment | | | | | | | 13.6 |
| Value added in maritime industry | 0.6 | 2.2 | 4.2 | 10.4 | 12.4 | 17.8 | 47.6 |
| Total | | | | | | | 129.2 |

Under costs, the fixed investment includes docks, buildings, machinery and other yard facilities. The construction, scheduled in two stages, is to be completed in 1975 corresponding to the ship demand-supply projection discussed earlier. The working capital is estimated at $60 per dwt increase in ship construction to cover salaries, general expenses and material costs. The loan amount has been computed on the basis of 75% of the ship price. For estimation purposes, the cost of ship construction has been assumed at $230 per dwt, and the sales price at $270 per dwt. The assumed construction cost implies that Indonesia by 1975 should attain the production cost level of Korea today. The sales price is based on sample recent international contracts; a 6,250 dwt ship was reported as contracted at $1,870,000 and a 21,500 dwt Fortune class ship at $5,720,000 for delivery in 1975. After 1976, the estimated cost and sales figures should provide an annual return on investment of 17%. Under benefits, the residual

values of ships and facilities have been computed on the basis of 15 years of service life for ships and 20 years for facilities. The value added in maritime industry by the domestic-built ships is shown in equivalent value of net reduction in payments to foreign-flag vessels. The analysis shows that the simple (undiscounted) benefit-cost ratio will be about 1.35.

9.67 The proposition for a major modern yard in Indonesia poses a number of additional questions, such as:

1. What is the relative priority between the inter-island fleet program and the ocean fleet program?

2. Should a new yard be built, or should an existing yard be modernized?

3. Why consider another yard, when the existing yards are largely idle?

4. Is any new shipbuilding program over 5,000 DWT premature for the country?

5. How does shipbuilding relate to other programs within the national industrialization strategy?

Taking the above questions in order:

1. What is the relative priority between the inter-island fleet program and the ocean fleet program?

The emphasis today on the inter-island fleet is justified from the standpoint of the importance of the fleet to the domestic transport system. Also, from the shipping standpoint, the inter-island fleet is a separate matter from the ocean fleet. However, from the shipbuilding standpoint, the two programs are not separate and technically, a 10,000 ton hull is no different from a 1,000 ton hull. A learning period, however, should be necessary, and speaking for the industry as a whole, the program for rehabilitating and building the larger inter-island ships should provide this learning opportunity for building the ocean-going ships.

2. Should a new yard be built, or should an existing yard be modernized?

Information on the existing major yards in Indonesia indicate that a considerable capital investment would be required to rehabilitate the yards into effective repair and limited shipbuilding installations. A short-term rehabilitation program for DOK Tandjung Priok has been estimated to require about $2 million, and a similar program for DOK Surabaja about $5 million. In the final analysis, any consideration to upgrade an existing yard (either of the above yards or possibly the partially constructed Kapin or Pelita Bahari)

to build ocean-going ships will hinge on the joint venture possibility with a foreign shipyard. Possibly, a well-designed new yard without any accumulated problems would appeal best to a potential venture partner.

3. Why consider another yard, when the existing yards are largely idle?

Reasons are complex as to why the existing yards have been idle, but they ultimately boil down to the state of the economy of the past years. With the current marked improvement in the general economy and the urgency of the programs in the inter-island shipping sector, the yards should soon be filling their docks. By 1974, the repair requirements for ships of all sizes has been conservatively estimated by government sources to exceed one million dwt.

4. Is any new shipbuilding program over 5,000 dwt premature for the country?

The question might be rephrased to state whether the industrial infrastructure is too weak to support a major shipbuilding effort in Indonesia. It should be noted, first, that the proposition on ocean shipbuilding calls for a rather modest program. Second, shipbuilding is primarily a steel fabrication and construction operation and can become a healthy industry of true local economic value without a significant input from the domestic supporting industries. The breadth of required sub-industry input is very large, yet the depth in any single sub-industry is typically quite shallow. It might also be noted that a shipbuilding enterprise is not linked to ships as a final product to the same degree that an automobile industry is linked to automobiles. Its manufacturing processes, skills, and equipment are not specifically end-product oriented. Therefore, a shipbuilding facility can be thought of as being closer to a primary industry than to an end-product manufacturer.

5. How does shipbuilding relate to other programs within the national industrialization strategy?

From a technical viewpoint, an industrialization plan centered around mobile and stationary equipment, and an industrialization plan centered around shipbuilding can be developed quite independently from one another, without the necessity of phasing priority between the two. They are obviously complementary. Certain foundry products, stampings, power transmission sub-assemblies, consistent with the capabilities of the mobile equipment industries, will be required by the shipbuilding industry. Furthermore, these sub-industries are expandable. For example, the power-train sub-assembly industry could manufacture ship pumps, compressors, blowers, and other related equipment. Therefore, the linkage will grow as the industrialization proceeds. Initial plans for shipbuilding could be developed on the premise that this industry would construct the hull and superstructure and certain fabricated deck machinery, while engines, controls and other sub-assemblies would be imported.

9.68 The case for launching an ocean-going shipbuilding program has been outlined in some detail as part of the Mission's purpose to examine potential areas of development opportunities for Indonesia. A central point brought out by this study is that the planning in the shipbuilding sector, principally focused on the inter-island fleet at the present time, should be extended to include the ocean-going fleet so that an integrated approach to development can be worked out. It would appear that the proposition to establish a modern yard for building ocean-going general cargo ships for the domestic fleet has sufficient near-term merit to warrant a feasibility study aimed at providing a sounder basis for planning. It could well be that the combined inter-island and ocean ship program will contain sufficient leverage to transform the shipbuilding industry into a vital and competitive industry. With reference to the creation of an Indonesian Maritime Bank recommended by the Maritime Mission, consideration should be given to extending its scope to cover the financing of ocean ships. The proposed feasibility study should cover:

a. Ocean freight statistics and forecasts
b. Performance of the present ocean fleet
c. Comparative merits of shipbuilding versus ship import
d. Material supply and cost
e. If building of ocean-going ships can be justified, the type and size of ships to be built
f. Location and layout of the shipyard, with due regard to joint venture possibilities.

## Summary and Conclusions

9.69 The underdeveloped state of the engineering industries, even by the standards of the developing countries of Asia, is the bottleneck of industrialization. An assessment of the priorities of this sector should be necessary in the planning exercise for the next five year plan. In contrast to rehabilitation programs that serve in the main to brake industrial decline, strategic programs are needed to provide the driving force to advance the industry. The strategy calls for three parallel developments:

A. Mobile equipment industry development
   a. Expand production of small trucks and buses
   b. Establish production of construction equipment, tractors and heavy duty trucks

B. Stationary equipment industry development
   a. Expand production of farm equipment
   b. Develop production of light industrial electrical equipment

C. Shipbuilding industry development

9.70 The industries and programs relevant to the strategy were examined in the chapter and are recapitulated below:

1. Supplier sector

   Extremely weak; build-up through natural market forces is a slow process and could hold up industrialization; promote through backward linkage in strategic product sectors.

2. Regional foundry centers

   Important, but planning must be closely tied to markets they serve; planning should be for future, not past markets.

3. Light manufacturing sector

   Capable of developing under private initiative; possible government role in establishment of a light industrial estate.

4. Automobile assembly industry

   Suggest a shift of development emphasis from passenger cars to trucks and buses.

5. Mobile equipment program

Key is finding compatible product mix satisfying market demand; typical product mix suggested and analyzed; Baraata group could be sole enterprise capable of undertaking program; orient planning towards building supplier sector.

6. Agricultural equipment program

Build program around irrigation pumps; government assurance of market essential. B.B.I. group could undertake program and become first major maker of agricultural equipment in country.

7. Electrical equipment industry

Encouraging beginning, but industry at too early state for major program; market and technology apparently favor development, but situation in electric power sector must first clarify.

8. Shipbuilding program

Ocean shipbuilding deserves close look; inter-island and ocean fleet logically separate from shipping viewpoint, but need not be separate from shipbuilding viewpoint; direction of committment to ocean shipbuilding will determine future character of this industry.

9.71 It is not surprising that the above programs almost naturally polarize around the two major industrial centers in the country--Surabaja and Djakarta. Surabaja will be the logical focal point for the developments in mobile equipment and agricultural equipment, whereas Djakarta will be the center for the developments in light manufacturing, automobile industry and electrical equipment industry. Shipbuilding will be divided between the two locations. The supplier industries as well as the regional foundries will naturally reflect the respective character of the industries in each region.

END

# PLANNING FOR INDUSTRIAL DEVELOPMENT IN INDONESIA

## Chapter X

## Petrochemicals

BASIC DATA

(original with Chapter I)

# CHAPTER X

## PETROCHEMICALS

10.1 This chapter will present a concise view of the potential for petrochemicals in Indonesia. This will include a brief examination of the current status of the products in this industry, together with a summary of the petroleum industry. A stable petroleum industry is the basic ingredient needed for starting a petrochemical industry. The petrochemical growth potential for Indonesia and for areas that are tributary will be presented; these growth projections will be compared to other historical patterns elsewhere. Linear programming, the investment evaluation technique used in this review will be discussed and the results of over twenty alternative investment cases covering the time period 1977-1984 that appear to be of interest will be presented in some detail. A detailed discussion of the specific petrochemical data used in the linear programming model will not be undertaken but is included as part of the description of the model which is shown in the appendix. All data and methods are presented and explained so that other analysts could use this model for further work. In addition, an organizational plan for essential foreign and Indonesian collaboration will be suggested and an outline of how it might be accomplished will be presented. Recommendations concerning future work, timing, and cost will be offered.

### Current Status of Petrochemicals

10.2 The current status of the petrochemical industry in Indonesia is confined almost entirely to a few processing plants. These are essentially small labor intensive factories where purchased plastics and resins are made into consumer products. Of the active processing plants less than half a dozen are more than rudimentary cottage industries. One plant went into receivership not long ago due to "inadequate" management. A moderate size plant in Djakarta is typical of the type of processing operation that must be multiplied many times to supply future needs. The Djakarta plant represents an investment of about $1,000,000, employs 300 people and has a capacity of about 2,500 MT/year of plastic consumer items for the Indonesian market. The quality of the products made is adequate for Indonesia, which is not yet quality sensitive, but the quality is not suitable for export. Similar products made in Hong Kong and Singapore are noticeably superior to products made in Indonesia. Due to quality problems the commercial market and the engineering plastics market are almost completely underdeveloped. These represent new use opportunities and demand will grow rapidly in the future. Judging from a survey of retail prices of the consumer articles it appears that the processing operation is very profitable. It was impossible to obtain an income statement or balance sheet. The future development or stimulation of an additional 100 small to medium processing plants is a reasonable goal for a country as diverse and densely populated as Indonesia. To effect the stimulation, however, it will

be necessary to build on the current narrow base and to protect new fledging businesses by restricting competition for a few years. It will probably be necessary to encourage the establishment of plastics processing plants to provide them with protection by whatever measures are most suitable for a limited period of time. This form of stimulation will be necessary so there will be a normal market outlet for the monomers and polymers produced at the core facility.

10.3 The only current activity to manufacture a petrochemical product is the polypropylene plant which is now being built by Pertamina at Palembang. There is also the possibility of a caprolactum plant at Surabaja, but this appears to be a weak venture. No doubt it would be possible to graft other small petrochemical manufacturing industries into various existing facilities; however, this should not be pursued as it will inevitably lead to uneconomic-sized plants that will be a burden in the future. Unfortunately, for developing nations, manufacturing the monomer and the polymerization of it are extremely capital intensive. It is only the processing step that is not so demanding of capital in relation to the number of people employed. An additional caveat is that capital intensive industries are also technical intensive, and it is often more difficult to entice technology than it is to entice capital. The total absence of competent technology (and in depth) is primarily responsible for the slow growth in plastics; it is not basically a lack of effective demand. The entire industry, however, is currently at such a low level of development that it is lacking in the ability to develop rapidly, even though the use of plastics continues to grow rapidly through imports. Although there are obvious shortcomings in tehcnology, in moulding equipment acquisition, maintenance, and in management, etc., a common complaint voiced by local managers is the depressing effect of tight money, i.e. 2½ percent per month for working capital is a normal charge. The relatively low level of processing plant activity is not apparently caused by lack of demand or by any difficulty of introducing plastics into the market. The factors previously cited, i.e. management, technical knowhow, high interest rates, etc., relatively poorer quality than imports, all have contributed to holding back local activity but this has not, except indirectly, constrained the acceptance of plastics by consumers. Price is a major factor, but surprisingly several spot surveys showed that some imported products were selling better than products made locally even though the imported product was 50% to as much as 100% higher in price. Furthermore, the demand for some items not made locally, but which could be made locally (i.e. film for wrapping) without a quality problem, appeared to be in tight supply. This indicates that there is an unsatisfied demand for some of the more rudimentary products, and this is just what is needed to form a good demand base for a petrochemical core facility.

10.4 A look at the current situation, and the obvious manifold shortcomings, is not balanced until the natural advantages of geography and resources are placed in perspective. Indonesia is favorably

situated geographically. Indonesian products (petrochemicals and oils) can move economically to the West (Africa and the Indian subcontinents), the North (where 800 million people live), the South East (Australia, New Zealand) and even to Japan. Furthermore, Indonesia, in contrast to Japan, is abundantly endowed with hydrocarbons, (exports of 50 million tons versus Japanese imports of 150 million tons) some of which can be manufactured into petrochemicals without diminishing other petroleum sales. In effect, therefore, domestic value added can be increased through the selective use of these hydrocarbons (which currently have minimum alternate value due to fact they are unexploited gas reserves) to produce petrochemicals in competition with Japan and from a geographical center more favorably situated (the freight advantage is 25$/MT to some locations now served by Japan). The favorable geography and the very low alternate value feeds must be supplemented by manufacturing know-how, a suitable financial and tax structure, and an exportable blend of products. The manufacturing know-how is available from foreign sources. Favorable financial and tax features will require government action similar to incentives now offered other industries, and it will take government as well as commercial planning to launch a project that can meet domestic Indonesian requirements and export requirements at minimum cost. The new petrochemical core can easily co-exist with petroleum activities and in fact, they will complement each other technically and commercially.

## Background for Evaluating Petrochemical Development

10.5 The Indonesian petroleum industry was developed over a period of 50 years by the major oil companies, and is now operated by Pertamina, an agency in the Ministry of Mining. When Pertamina acquired the oil operations the basic activities of crude oil production and refinery were concentrated on the islands of Sumatra and Kalimantan. In the last 5 years many new areas of exploration and development have been opened. The future of the industry is exceedingly bright. The largest reserves of crude oil are still those operated by Caltex in Central Sumatra (the Minas field) and some estimates place the recoverable reserves in the range of 10 billion barrels. This is a very large field by any standard. Currently, this field produces about 750,000 BD, and the concession extends to the year 2001. As a source of petrochemicals feed the Minas field is "undersaturated" and, therefore, cannot be thought of as a source of gas. In South Sumatra, where crude oil production also exists along with two refineries, there are commercial gas fields, and the gas is in use for the manufacture of fertilizer, as well as for fuel. The gas in South Sumatra was discovered some years ago. There have been some extensions in reserves as well as new indications, but it is questionable if a single field of sufficient size to support a petrochemical complex is likely to be discovered in this area. However, there have been discoveries of gas in other parts of Indonesia on which a petrochemical industry could be based. In any case, large petroleum reserves do exist, and the ultimate development of a

petrochemical industry is assured. The timing and extent of the development are uncertain and study is needed to point-up the risks and the opportunities. As is shown in this chapter, Indonesia is now at the point where decisions can be taken regarding the timing and the extent of investment and development of petrochemicals; furthermore, it is also now appropriate to establish a new format for introducing a highly sophisticated industry, like petrochemicals, into an economy and country that is going to need help from outside for a number of years.

10.6 Indonesia is the largest producer of crude oil in Asia. The current production rate is approximately 1,000,000 B/D, and there exists the potential for 2 million B/D by 1980. Along with the rapid rise in crude oil production, there have also been recent discoveries of gas in Java, Sumatra, and Kalimantan that lend credence to expectations that large gas reserves soon will be added to the oil reserves. The limited information released indicates that the Kalimantan gas discovery is the largest so far. One well tested at over 30 million standard cubic feet per day, but no data have been released on estimated reserves or quality. Considering the geology in the area it is reasonable to expect at least a trillion cubic feet reserve, but there is no firm information as yet on the quality. However, the existence of gas in North Sumatra has long been established, and some of the recent exploration efforts appear to have found promising new reserves, although the extent remains uncertain. Some industry sources antipate that within the next year gas reserves will be sufficiently defined to show if large scale commercial development is warranted and of what type. A large petrochemical complex should not be started on gas reserves of less than one-half to a trillion cubic feet, depending on the quality and location. This appears to be reasonably certain of achievement in one or more locations.

10.7 A proven reserve of gas is the single most important factor needed toward developing a petrochemical indrustry. If the new gas reserves turn out to be mostly methane, (i.e. more than 60%) a use better than petrochemicals can likely be developed. For instance, methane is more useful as an export or in fertilizers, on in steel manufacturing (e.g. see Chapter VIII) than as a petrochemical feed. A petrochemical industry can be based on natural gas, natural gas liquids, or on refinery by-product gases. It can also, to a limited extent, be founded on methane-rich gas but in the cases we are considering, the basis of feed is ethane or heavier.

10.8 Large crude oil reserves and the existence of refining capacity can be supportive to a petrochemical industry, but they are not essential in this instance. Gas is the predominate feed in the U.S.A. but naphtha prevails in Japan and in Europe, and in some areas the advantages of various feeds change frequently. The favored feed depends on geography as well as on natural resources, and the proximity to markets. Refinery streams that might serve as a feed are not a factor in Indonesia at this stage of economic development. Japan, on

the other hand, depends on its refining industry to make naphtha to feed the petrochemical plants. In Japan feed costs are 18-20$/MT for naphtha, whereas the maximum alternative value for ethane or propane gas in Indonesia is probably 10$/MT (about 20¢/MM BTU). The point is that crude oil fractions such as naphtha or gas oil which could serve as primary feedstocks to a petrochemical facility, are not a real factor in this case. For Indonesia, the refinery by-product approach is not a serious alternative to associated rich gas. For example, the current value of Indonesian crude oil in the export market is between 2.50 - 2.70$/BBL, depending on the market and on the use. Expressed in terms of the cost of heat, this is about $.40/million BTU or roughly twice the value Pertamina currently places on gas. Naphtha and gas oil values would be even higher (20 to 30$/MT) and petrochemical yields would be less attractive than they would be for gas. If appropriate gas reserves are confirmed, the growth of a petrochemical industry can proceed without in any way detracting from exports from the oil industry and with a much lower feed cost than is available to competition elsewhere in Asia or Japan.

10.9 Three distinct categories of activities are involved in the development of a petrochemical industry. The three are monomer production (i.e. ethylene), the manufacture of the polymer (e.g. polyethylene), and the processing of the polymer i.e. injection molding to toothbrushes, bottles, building materials and many other products. Each step is necessary, and there are major cost advantages to planning the production of the monomer and the polymer jointly. Processing of the polymer into consumer goods can be nurtured as a smaller-scale industry; therefore its development, although essential, is not preplanned to the extent monomer and polymer production is. Furthermore, the smaller resource entrepreneurs will be able to finance and manage processing operations, but the planning, financing, technology, and operation of polymer and monomer facilities are not within the reach of the private domestic Indonesian sector.

## Model for the Analysis of Petrochemical Development

10.10 The purpose of the analysis that follows is to demonstrate the conditions that will permit the introduction of a petrochemicals industry on a sound economic footing and to explore the effects that alternative assumptions about costs, product prices, plant capacities, etc. have on the level and timing of investment. The analysis shows the various options open to the Government and interested foreign investors. After considering the many different approaches available to carry out the pre-feasibility study and to insure leaving behind a methodology that could be followed by those seriously interested in undertaking further detailed work, it was decided to build a mathematical model of the options, opportunities, and constraints and to use the model as the basis of the pre-feasibility study. Thus any interested party or group can reproduce our results quickly or test variations that will become important as the project matures. The

model, which is described subsequently, is relatively simple in concept at this juncture, but it is broad enough to reveal the scope, economics, and staging of the development. The aspects considered in the model cover all the conventional parameters important to any new venture.

10.11 Building the model entails the acquisition of marketing volume and quality data, product pricing information at point of sale, product variety requirements, transportation costs to the markets from the plant, manufacturing options with respect to the feeds (inputs) and yields (output) for each activity in the scheme and all associated variable and fixed costs, and it also requires information on investment, tax, and other financial matters that are important in optimizing the model. Models can be built that are extremely complex and large, containing many elements from many activities. Large complex models are useful when the data is accurate and current, and when there are many complex interactions that are known to effect the optimal solution. Ultimately a large complex model (i.e. on the order of several thousand activities and constraints) will probably be needed for the analysis of the Indonesian petrochemical complex. However, until the data concerning markets, etc. can be improved on (through more detailed study) it would not be productive to attempt the construction of a large model. Therefore, the model that we have constructed is designed to provide us with first level insights as to what are the most important relative elements. The model is fairly small; it has roughly 200 activities and constraints. We are primarily concerned with the expected magnitude of investment and its profitability; the sensitivity of investment and product mix to product price changes; the extent to which maximum foreign exchange earnings or savings are consistent with maximizing the economic rate of return; for instance, maximum income does not necessarily result in maximum rate of return. We also examine the effects of minimizing investment on profitability and manufacturing costs. The model will also provide product "transfer-price" information that can be used to indicate the buy and sell levels for every monomer and polymer transfer point in the petrochemical complex. The mathematical technique we are using is known as linear programming.

10.12 A brief word on linear programming is in order for those unfamiliar with it. A full discription of the model and the solution techniques is given in annexes to this chapter. In general, linear programming is a method for finding the strategy or the course of action that will lead to the allocation of a limited resource at maximum profit or minimum cost. In our situation we want to program the development of a petrochemical industry so that it will yield the best rate of return under specified conditions on the demand in domestic and export markets. Hence our use or linear programming is for investment planning, and we will attempt to find an overall strategy that not only satisfies the physical realities of the market, with respect to quantity of product needed and price (using world market prices), but we will also impose technical limits that must be met concurrently and, without violating any of these

constraints, we will find the maximum rate of return that can be earned, and the investments needed. Very little recent construction has taken place on which to base investment cost estimates and the same ignorance exists relative to local operating costs. Consequently, we have used contractor estimates of both construction and operating costs in other areas, and in general have raised these by 20-30% on average to reflect conditions in Indonesia.

10.13 One of the pivotal aspects in our model is the product demand information and the pricing of the products. Unfortunately, there is virtually no reliable data concerning consumption of even basic goods, and the demand or consumption information on plastics, a minor consumable, is a hopeless loss. To fill this gap from Japanese and U.S. sources we obtained good quantity (but less relaible price) information on Japanese and U.S. exports to Indonesia. This was supplemented with data from Pertamina, various Banks, and from importers of plastics, resins, etc. As a class, locally produced products from petrochemicals are relatively new to Asia. The first monomer and polymer plants were started in Japan in 1957. In the first years after that the growth rate was explosive, with consumption often doubling or tripling each year. Following the initial explosive growth period there has been a steady and high rate of growth in Japan proper and among the nations that Japan serves in South East Asia, including Indonesia. However, the demand for petrochemicals in Indonesia is currently very small, i.e. less than 50,000 metric tons per year for all items; yet three years ago the demand (as measured by imports) was less than one third as much as it is now.

10.14 The estimated normal or most likely growth rate for petrochemicals demand in Indonesia is shown as Figure 10.1. From a very low base at the end of 1970 we project that domestic consumption of basic petrochemicals i.e. polyethylene (LD and HD), polypropylene, polystyrene, and polyvinyl chloride will reach 275,000 MT/year in 1980 and 540,000 M T/year by 1985. The curves are consistent with an income elasticity of about 1.7 and a trend elasticity of .2. These are judged reasonable for Indonesia. The growth rates for individual products are shown below:

| | 1972/1980 |
|---|---|
| Polyethylene | 19% |
| Polypropylene | 17% |
| Polystyrene | 14.5% |
| Poly Vinyl Chloride | 18% |

The projected growth rate shown above represents a concensus among information supplied by Japanese companies, studies made by international chemical companies, interviews in Indonesia and the mission's

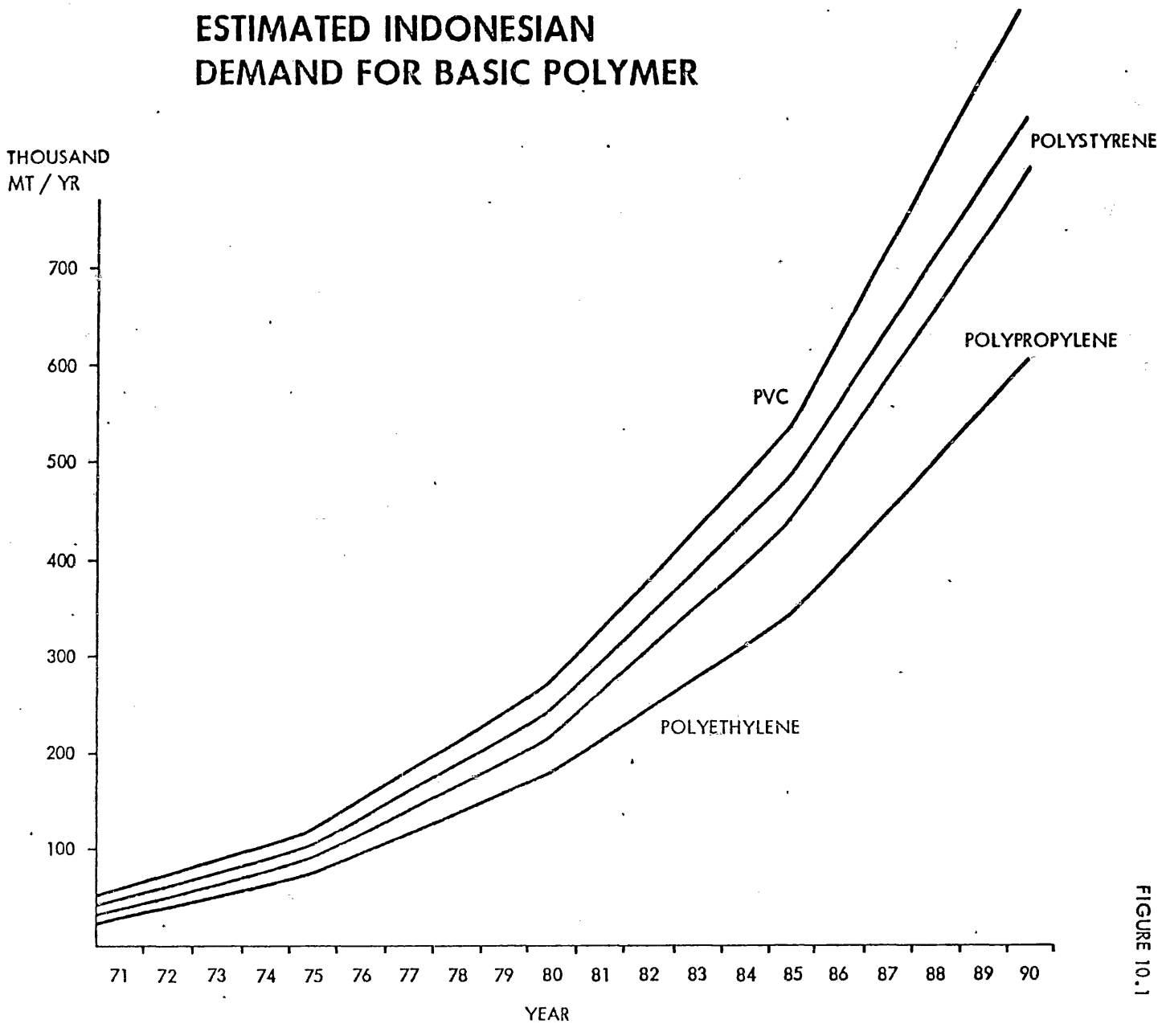


FIGURE 10.1

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own estimates of trends of industrial development. On balance, however, it is likely that the estimates of future growth are low as opposed to optimistic, again because of the very low current base in relation to population and potential usage. Even so, as is shown below, some of the model runs use a demand estimate that is 40 percent below these estimates. By comparison the growth rates expected in other nations are:

| | P.E. | Styrene | Vinyl Chloride | Other | Total Ethylene |
|---|---|---|---|---|---|
| U.S.A. | 10 | 8 | 11 | 8 | 9 |
| Europe | 10 | 8 | 15 | 9 | 10 |
| Japan | 12 | 11 | 13 | 8 | 12 |
| Iran | 15 | 10 | 15 | - | - |

10.15 A growth rate for Indonesia that is nearly double the rate of industrialized nations is not surprising in view of: (a) the very low current base; (b) the large population with a growing income; (c) the large variety of substitutable plastic applications (d) the high rate of growth in the last three years; and (e) the historical performance of demand in other Asian nations. There is, however, a need to recognize that the projected growth rate is founded on the outlook that Indonesia will develop economically, free of political unrest and essentially enjoying close cooperation between state planning and free enterprise. As long as these conditions can be maintained, Indonesia's special advantages of raw material and geography will permit a petrochemical industry to thrive. Implicit, however, in this growth is the continued infusion of sufficient foreign technical know-how capable of planning and operating petrochemical facilities as well as appropriate steps to export products not needed inside Indonesia during the early years of the project. The funds to start the industry must likewise be provided in large part by foreign investors. It is also fairly evident that the demand inside Indonesia is not likely to provide a large enough market to justify a project alone, at least in early years, but there are substantial tributary markets that Indonesia can export to until the local demand develops to a level that would either justify backing out of the export market or expanding the facilities to maintain or increase exports. Thus for the initial petrochemical facility Indonesia will need to rely on sizeable export markets (this means supplanting Japanese and US exports) and in fact she must aggressively seek out and cultivate these markets long before the sale can be made. At the same time exports are cultivated, the domestic market must be encouraged because this is the essential market with respect to a "break even" on the facilities once they are in operation. On occasion, it may be necessary to avoid meeting dumping competition head-on, and when this takes place it will fall on the domestic Indonesian market to provide "breakeven" sales. No doubt, conservative planning can obviate some of these risks, however,

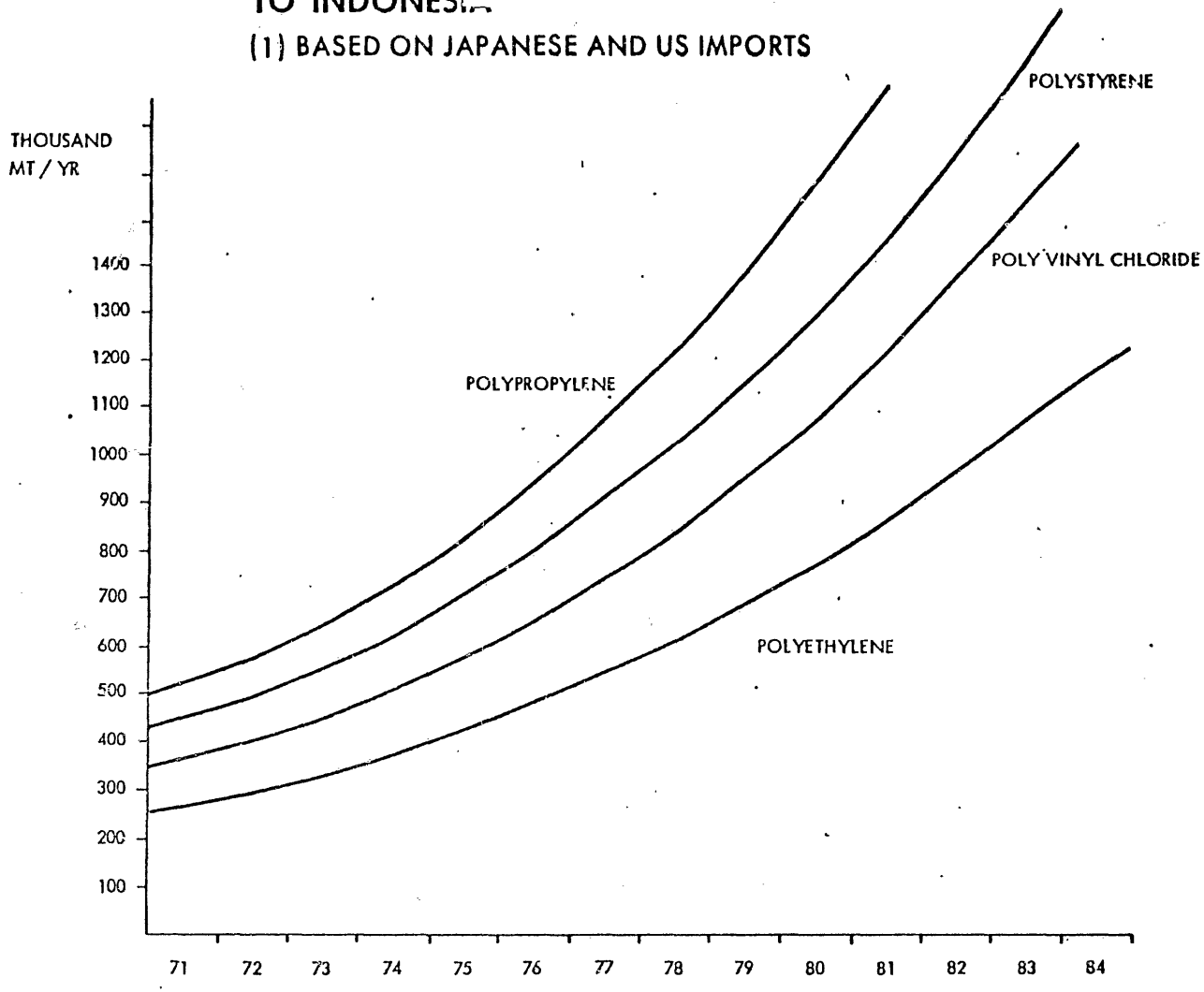
facilities that are planned on free market economics can become a social burden if all the risks are not adequately provided for. The exports that Indonesia can capture a portion of will be in Hong Kong, Thailand, Philippines, Burma, Malaysia, Singapore, Australia, and New Zealand. Spot sales might also take place to Africa, India, Pakistan, and the Middle East. In some instance exports to Japan and the U.S. can be visualized, but these should not be relied upon in future planning.

10.16 Figure 10.2 shows the estimated demand of basic petrochemicals for countries tributary to Indonesia. The estimates are projections of the 1970 (first six months) demands based on statistical data showing exports from Japan and from the U.S. To the extent that supplies from other nations come into these countries the estimate understates the demand. The mission was not able to get accurate import information from each country. Interviews with industry and government representatives are the basis for the growth projections. The countries forming the export base for Indonesia are non-petrochemical producing, except Australia. Consequently, there are few restrictive tariff or duty regulations, and certainly there is no reason to expect that any of these nations would favor Japan or the U.S. over Indonesia as a source of monomer or polymer. It is well known, however, that Thailand, Singapore and the Philippines have petrochemical projects of their own under study, and it is to be expected these nations will raise barriers to imports that threaten their own production. The mission is not sufficiently familiar with plans in each country to know if there is some area of industrial collaboration that might be feasible, but the possibility should certainly be explored. For instance, Indonesia might export ethylene, styrene or vinyl chloride to each or all of these countries at very attravtive prices, and buy back a variety of polymers of other derivatives. Unfortunately, it has not yet been possible to develop any meaningful economic multinational cooperation in Asia, and the mission has concluded that it is impractical to base any part of this evaluation on any condition so problematical. Although Japan and the U.S. are the main competitors now, it is very likely that Iran (with Japan) will be a major petrochemical exporter by 1975. Just how far East Iran will reach for markets is not known, but Indonesia will enjoy an advantage east of Ceylon.

10.17 Due to the demand growth rate, and the effect it might have on the timing or the size of the petrochemical facility, it was decided to divide the demand projections into three time periods. The years 1977, 1980, and 1984 were selected. Probably it would be about 1977 before a major petrochemical complex could be fully operational; a plant could be completed by 1975 but this is considered unlikely. The estimated Indonesian market in each of these years is shown below:

## ESTIMATED DEMAND TRIBUTARY TO INDONESIA

(1) BASED ON JAPANESE AND US IMPORTS




(1) Thailand, Singapore, Malaysia, Hongkong, Philippines, Burma, Australia & New Zealand

FIGURE 10.2

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| | (Metric Tons) | | |
|---|---|---|---|
| | 1970 | 1980 | 1984 |
| Polyethylene | 150,000 | 175,000 | 310,000 |
| Polypropylene | 30,000 | 60,000 | 90,000 |
| Polystyrene | 25,000 | 30,000 | 40,000 |
| Polyvinyl Chlorice | 40,000 | 50,000 | 60,000 |
| Ethyl Alcohol | 5,000 | 10,000 | 15,000 |
| Benzene | 10,000 | 10,000 | 10,000 |
| Toluene | 6,000 | 6,000 | 6,000 |
| Xylene | 5,000 | 5,000 | 5,000 |
| Vinyl Chloride | 10,000 | 10,000 | 10,000 |
| Styrene | 5,000 | 5,000 | 5,000 |

In preparing these demand estimates for the linear programming model each was treated as an upper limit rather than as a fixed requirement. Consequently, in the subsequent discussion of case results, a shortfall in meeting a demand is indicative of a product being undervalued and hence uneconomic to produce, i.e. it is better to continue to import. The first five major product demand estimates are based on better data than the last five, and it is for this reason that the estimates for all three years is the same, plus the fact that at this level these products do not constrain the model solutions. However, since demand estimates are always subject to error we have also studied the conservative case of demands at 60% of the foregoing; these and other results will be discussed later.

10.18 Next to importance to product demand information is realistic price information. The price information used will be discussed later.

10.19 In addition to particular demand and price information the organization of the model can be described as being composed of the following major parts:

1. Feeds or raw materials - type available and cost
2. Petrochemical plants and yields or outputs
3. Operating costs
4. Investment costs
5. Market demands - Indonesian and export
6. Market prices.

The feeds or raw materials considered are as follows:

1. Methane - as a fuel only
2. Ethane
3. Propane
4. Butane
5. Naphtha
6. Gas Oil.

Each of these feeds produces a different range of olefin products, and each is subject to its own set of operating and investment economics. Since the most suitable site for a petrochemical complex is open to question at this time, and since the exact composition of the gas is not known, the case studies are based on selecting any of the foregoing, rather than on a fixed composition. When an actual gas analysis is available, the ratios can be fixed. As will be seen later there is not too much overall cost advantage for one feed (gas) over the other, in this particular Indonesian situation. Naphtha and gas oil were included in the feed options but actual case studies on these potential feeds have not yet been made. Regarding price of the feed the mission was advised to value the gas at the equivalent of .20 $/million BTU's; however, we also determined the directional effect on the economic optimum for a gas price twice as high, that is, .40 $/million BTU. Availability of feeds was assumed to be unlimited. In fact, however, it is likely that the location of a large petrochemical complex would have to coincide with a gas reserve of about one trillion cubic feet (37 million metric tons) to insure a 40 year supply of the proper quality. A reserve of half a trillion cubic feet would probably suffice if the reserves were determined conservatively and if the general area was promising for further development.

10.20 The variety of petrochemicals plants included in the model has been restricted to basic type plants and includes:

1. Gas separation
2. Naphtha and gas oil feed prepation
3. Steam cracker * 200,000 MT/YR
4. Aromatics extraction and separation * 10,000 MT/YR
5. Polyethylene plant * 100,000 MT/YR
6. Vinyl chloride unit * 40,000 MT/YR

| | | |
|---|---|---|
| 7. | Poly vinyl chloride unit | * 20,000 MT/YR |
| 8. | Ethyl alcohol unit | * 10,000 MT/YR |
| 9. | Sturene unit | * 20,000 MT/YR |
| 10. | Polystyrene plant | * 20,000 MT/YR |
| 11. | Butadiene extraction | |
| 12. | Styrene butadiene rubber unit | |
| 13. | Polypropylene plant | * 15,000 MT/YR |

The model is permitted to select which units it wishes to build and the selection is made on the basis of the costs and prices of inputs and outputs. None of the units is "forced" into the solution; however, due to the fact that it is generally uneconomic to build plants that are "too small," the model is not permitted to select certain units unless they exceed a certain minimum size. The units with an asterisk are constrained by a minimum economic size. The minimum sizes are shown opposite the asterisk.

10.21 There is a cost of operation connnected with each petrochemical unit when it is built and produces output. Normally the main cost elements are included in one of the following:

Labor, supervision, overhead, etc.
Maintenance
Catalyst
Chemicals
Utilities
Royalty
Fuel
Insurance and local taxes (not income)
Foreign technical assistance

Also when it becomes feasible the utilities item can be subdivided in more detail to:

Electricity
Boiler Feed Water
Steam (high and low pressure)
Cooling water
Bags and Packaging

When better information about a specific site is available the foregoing can be estimated with accuracy for each petrochemical unit and for the offsite investments. However, in the meantime, we have utilized the overall category of utilities for most of the foregoing (except electricity which was assumed unavailable at any location) and all costs are based on similar costs for similar units in other

parts of the world. The actual operating costs used are shown in the model matrix in an annex to this chapter.

10.22 The investment cost of each unit has been estimated and is dependent on size. Due to the fact that large units produce at low cost and since Indonesia will be required to compete in the world market it was anticipated that the individual units would be large to compete and costs were estimated accordingly. Shown below are the minimum and maximum sized units and the approximate onsite investment for the unit, both at minimum and maximum size:

| | Minimum | | Maximum | |
|---|---|---|---|---|
| | MT/YR | $ MM | MT/YR | $ MM |
| Steam Cracker | 152 1/ | 20.0 | 454 1/ | 72.0 2/ |
| Aromatics | 10 | 1.7 | 200 | 22.2 |
| P.E. Unit | 100 | 53.2 | 300 | 87.0 |
| VICL | 40 | 8.0 | 200 | 33.6 |
| P.V.C. Unit | 20 | 5.8 | 200 | 33.9 |
| Alcohol Unit | 10 | 5.6 | 200 | 20.6 |
| Styrene | 20 | 3.6 | 200 | 18.9 |
| Polystyrene | 20 | 3.6 | 200 | 18.9 |
| S.B.R. Unit | - | - | 50 | 19.8 |
| Buthadiene | - | - | 20 | 9.0 |
| Polypropylene | 15 | 6.0 | 100 | 23.0 |

1/ Based on ethylene products yield.
2/ For a gas oil feed. The minimums are based on ethane feed.

10.23 The estimated investment costs have been made based on world wide experice with an escalation to represent likely conditions for Indonesia. Even so the costs must be considered as approximate and preliminary; but it should also be noted that they are appreciably higher than would be anticipated if bids were being obtained today. These investments are for onsites only (battery limits) and offsite investment costs can and do add appreciably to the total costs. Location is a major unknown factor in attempting to determine what should be included for offsites. In the U.S.A., Europe, and Japan the offsites can range from 40% of the onsites to 120%. There isn"t any valid procedure to estimate offsites accurately; only when the site

is known and considerable design is completed is it realistic to judge offsite costs. We can, however, define a representative offsite package, roughly for North Sumatra or East Kalimantan; but it should be clearly noted that this is not based on any particular site. Accordingly the offsites might be defined for a small, a medium and a large facility as follows:

| | Small 1/ | Medium 2/ | Large 3/ |
|---|---|---|---|
| | ($ millions unless otherwise indicated) | | |
| Gas transmission | 16" | 20" | 24" |
| 50 miles, $ MM | 5.6 | 9.7 | 10.2 |
| Gas storage | 5.0 | 7.0 | 9.0 |
| Tankage (5 $/BBL) | 5.0 | 10.0 | 15.0 |
| Power | 2.5 | 3.0 | 4.0 |
| Water | 0.4 | 0.6 | 1.0 |
| Pollution control | 1.0 | 1.6 | 1.9 |
| Housing (staff) | 3.0 | 4.0 | 5.0 |
| Shops (Maintenance) | 20 | 2.5 | 3.0 |
| Docks and harbor | 10.0 | 15.0 | 20.0 |
| Site preparation | 2.0 | 2.5 | 2.7 |
| TOTAL | 36.5 | 55.9 | 71.8 |
| Contingency 30% | 11.0 | 16.8 | 21.5 |
| | 47.5 | 72.7 | 93.3 |

1/ Up to 110.0 $ MM onsites
2/ Up to 180.0 $ MM onsites
3/ Up to 250.0 $ MM onsites

It should be emphasized that any estimate of offsites is highly speculative at this time.

10.24 Market prices used in the linear program are based on (a) recent shipments to Indonesia obtained from reliable industrial sources in Indonesia (b) published export prices from Japan adjusted for freight, and (c) exports from the U.S. to Indonesia and other countries in South

East Asia. We believe the prices upon which we have made future projections are actual world trading prices in most instances for this sector of the world. There is, however, a degree of caution necessary, first because delivered prices are sometimes tied-in with other sales or with financing and secondly, there is, on occasion, reason to declare and import at higher prices than actual; this permits easy export of capital and tends to minimize local tax obligations. However, we believe that through interviews, confidential sources, and information on world prices the prices used in the model are realistic and, furthermore, we have adjusted these so that they reflect our best estimate of the "low" that will be reached in the 1977-1984 period. The low prices have been used in order to be conservative in our evaluation. The following tabulation shows the prices used.

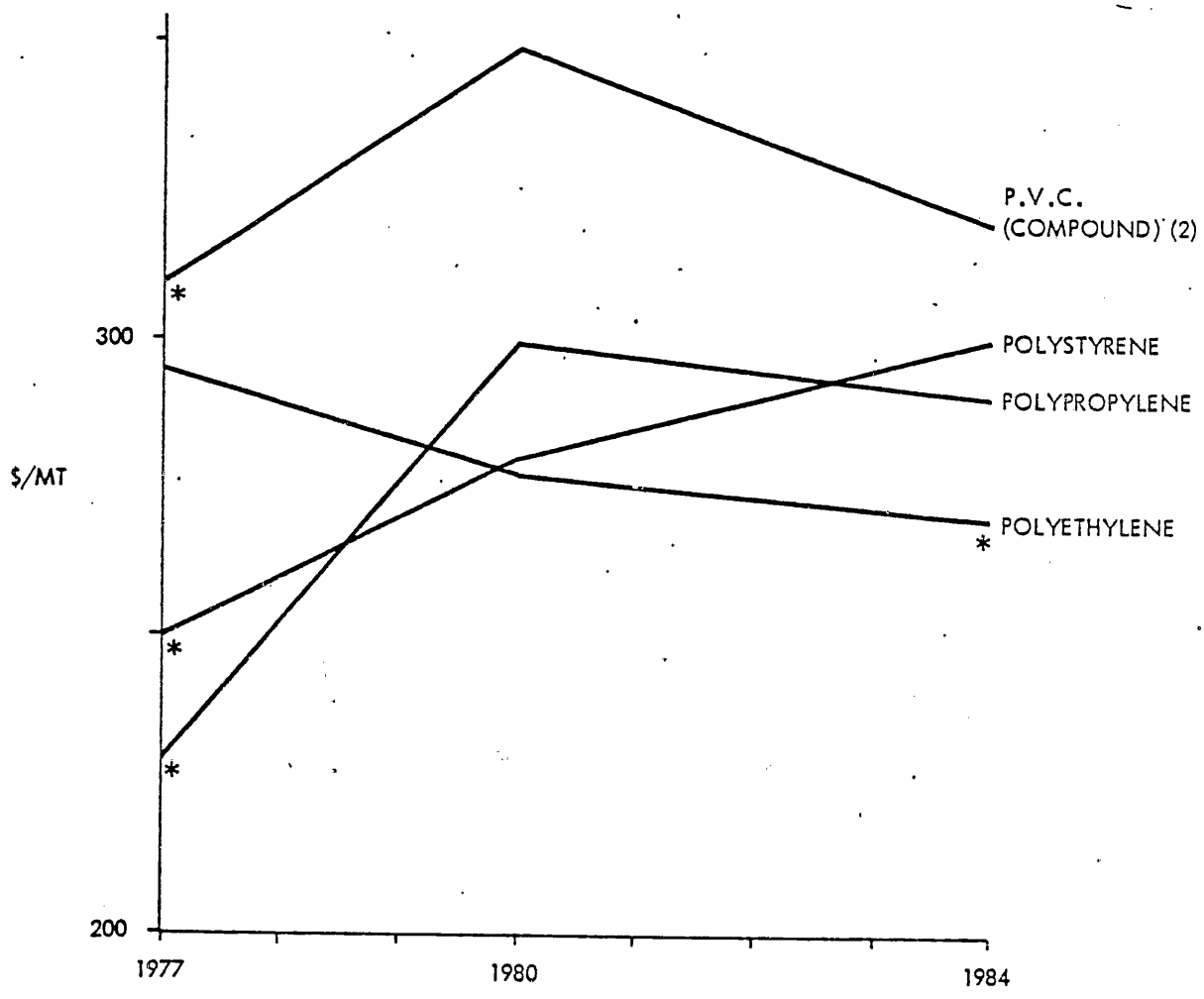
| | Domestic 1/ $/MT | Export 2/ $/MT |
|---|---|---|
| Ethylene | - | 44 |
| Polyethylene (LD) | 270 | 250 |
| Propylene | 18 | - |
| Polypropylene | 230 | 200 |
| Butanes | 35 | - |
| Gasoline | 30 | - |
| Fuel Oil | 17 | - |
| Xylene | 49 | 22 |
| Toluene | 50 | 25 |
| Benzene | 90 | 70 |
| Vinyl Chloride | 150 | 125 |
| Poly Vinyl Chloride | 230 | 210 |
| Ethyl Alcohol | 250 | 200 |
| Styrene | 250 | 200 |
| Polystyrene | 320 | 235 |
| Butadiene | 150 | 132 |
| Butylene | - | 30 |
| SBRubber | 265 | 250 |

1/ Domestic prices are adjusted from C.I.F. duty paid data obtained from actual purchasers and confirmed by trading companies. In those cases where such information was not available we estimated prices at equivalent world rates adjusted for location.

2/ Export prices are based on meeting competition from the U.S. and Japan.

FIGURE 10.3

# OUTLOOK FOR DOMESTIC PRICES (1)




* PRICE USED IN MODEL

(1) Export Prices Approximately 20 $ / MT Lower

(2) Resin 80 $ / MT Lower

IBRD 6095

## The Results: Investment Levels and Timing, and Rates of Return

10.25 A wide variety of "optimal" solutions are possible. Each optimal depends on the constraints of product mixture (which varies with time), the cost of feeds, the domestic and export values of products, the operating costs and characteristics of the petrochemical units in the complex and of course, the capital costs associated with building the units, including ancillary (offsite) facilities. The model recognizes approximately 200 activities along with about the same number of constraints and contains about 1,000 non-zero entries in the matrix. Although this is a relatively modest-sized linear programming model, it is more than adequate to provide directional guidance as to when and what kind of petrochemical complex should be evaluated in greater detail.

10.26 A total of 15 types of cases are summarized in Table 10.1. Three additional cases are presented immediately following the table. The basic organization followed in deciding the minimum number of cases to scan required dividing the time period into three parts, namely 1977, 1980 and 1984. Furthermore, since there is considerable uncertainty about the demand growth rate, it was felt prudent to look at "normal demands," resulting from our best predictive effort, and to also evaluate a greatly reduced growth rate. We arbitrarily defined the reduced growth rate as being approximately 60% of the normal rate. The effect of absolute investment on rate of return was the other major parameter that varied. This means that we attempted to determine when there were opportunities to obtain a high rate of return at relatively low investment costs (i.e. by eliminating activities yielding returns below some specified rate.) This is a somewhat difficult point and deserves further explanation. An increase in the size of an investment in petrochemicals usually means adding activities that change (usually decrease) the enterprise's rate of return on investment; consequently, we have tried to find the investment size (for any given set of other characteristics of demand, prices, etc.) that maximizes this rate of return, when, however, it is specified that certain cut-off rates determine a minimum acceptable. In the tabulation of cases that is shown later, a column is shown headed "R.O.I." (return on investment) with sub-cases ranging from 1 to 6; these represent increasing pressure to raise the rate of return. As pressure increases, the size of the investment normally decreases, because less profitable activities are dropped off, or there are switches among inter-related activities. The actual enterprise rate of return in any case is determined by the effects of these kinds of changes in onsite investment plus the offsite investment that is independently estimated.

10.27 The effect of feed cost can often be very significant in projects (as can the by product valves) of this nature, consequently several cases were run to show the effect in this situation. We

found, that although feed cost is an important variable, its effect was not enough to alter any of the cases in any really important way. Hence, only a few cases were run that reflect different feed costs. Frequently, in evaluation work of this nature, realistic solutions depend on building certain units above a certain capacity; and this entails modeling the problem to allow use of integer techniques, along with the normal routines, which are known as continuous techniques. Thus for most of the cases, we have two solutions; one is continuous and does not recognize that only a certain minimum size unit is permitted. The other is the integer solution. Integer solutions are, in an economic sense, more realistic than the continuous solutions, but on the other hand, they never show as high a rate of return as the continuous, and usually the results are substantially different due to the restriction of only minimum sizes for certain key activities. The tabulation shows the cases described and included in Table 10.1:

10.28 The fifteen cases shown in Table 10.1 cover a wide range of alternatives with respect to demand, cost of feed stocks, investment pressure and product prices. Total investment varies from a low of $79.3 million (Case F) in 1977 for reduced demand levels and a non-integer solution to a high of $346.9 million (Case A) for normal demand and an integer solution. As mentioned earlier, an integer solution always involves a higher investment cost in contrast to a continuous solution because of the indivisibilities involved in bringing units into production; but it is probably also more realistic. The range of products also varies widely among the cases. In some cases only polyethylene and gasoline are produced for the domestic market and only the former is exported. In other cases a full range of twelve products is produced for domestic use and many of them are exported. In the linear programming solutions the price of the product is the major driving force and the demands determine the upper limit that can be made at one of the foregoing prices. In most cases studied, the domestic price is higher than the export price, as would be expected. As a result, the domestic demands will be filled first and then if the marginal cost of production is less than the export price, the export requirement will be either partially or completely filled. When an export demand is only partly filled it means that the marginal cost is greater than the price for additional amounts.

10.29 More cases were not warranted at this time since the scope of the current effort is to find a viable approach rather than a specific design basis. The analysis of the cases attached shows that the 1977 cases with acceptable[1] rates of return are as follows:

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1/ we have arbitrarily defined 11.5% as the minimum acceptable financial rate of return. The rates of return determined by the L.P. evaluation technique are after tax. The rates of return will be higher due to tax holidays and accelerated depreciation. A case showing the effects of these factors is included later in the chapter.

## Tabulation of Linear Programming Cases

| Yr. | Case | Open | Demand 'Normal' | Demand Reduced | R.O.I. Levels 1 | R.O.I. Levels 2 | R.O.I. Levels 4 | R.O.I. Levels 5 | R.O.I. Levels 6 | Solution Type Cont. | Solution Type Int. | Feed Cost High | Feed Cost Low |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1977 | A | | X | | | | X | | | X | | | X |
| | A | | X | | | | X | | | | X | | X |
| | B | X | | | X | | | | | X | | | X |
| | B | X | | | X | | | | | | X | | X |
| | C | | X | | | | X | | | X | | X | |
| | C | | X | | | | X | | | | X | X | |
| | D | | | X | | | | | X | | X | X | |
| | E | | X | | | | | | X | X | | X | |
| | E | | X | | | | | | X | | X | X | |
| | F | | | X | | | | | X | X | | X | |
| | F | | | X | | | | | X | | X | X | |
| | G | | | X | | | | X | | X | | X | |
| | G | | | X | | | | X | | | X | X | |
| | H | | | X | | | | | X | | X | X | |
| | I | | | X | | | X | | | X | | X | |
| | I | | | X | | | X | | | | X | X | |
| 1980 | J | | X | | | X | | | | X | | X | |
| | J | | X | | | X | | | | | X | X | |
| | K | | X | | | | X | | | X | | X | |
| | K | | X | | | | X | | | | X | X | |
| | L | | X | | | | | | X | X | | X | |
| | L | | X | | | | | | X | | X | X | |
| | M | | | X | | | | X | | X | | X | |
| | M | | | X | | | | X | | | X | X | |
| 1984 | N | | X | | | | X | | | X | | X | |
| | N | | X | | | | X | | | | X | X | |
| | P | | | X | | | | X | | X | | X | |
| | P | | | X | | | | X | | | X | X | |

| | Case | Solution | Income, $MM | Investment, $MM | Rate of Return |
|---|---|---|---|---|---|
| 1977 | A | Continuous | 95 | 342 | 16.1 |
| | | Integer | 90 | 346 | 15.1 |
| | E | Continuous | 30 | 106 | 16.2 |
| | | Integer | 44 | 203 | 11.5 |
| | G | Integer | 41 | 186 | 12.2 |

One interesting point of this comparison is that these are two very different cases with respect to the needed investment, i.e. A versus E, which appear to be on a par economically with a 15-16% of return. Although "Case E - continuous" is not at the integer level it is achievable technically without difficulty, and it is only one third the cost of "Case A - integer". Case E - continuous is, however, based on a normal demand projection but is largely keyed to meet only domestic requirements, except for vinyl chloride and ethyl alcohol. When Case E proceeds to any integer level the economies show that added polyethylene capacity to meet the export market is more attractive than the production of vinyl chloride. Thus "Case E - integer" is on balance about 3.6% less attractive than "Case A - integer". The investment required is diminished by 143 $MM, but income is also reduced by 46 $MM per year. Probably, if there were no scarcity of investment funds and if the expectation of realizing a normal demand situation were less uncertain, the decision would be to elect Case A - integer as the starting basis. However, in the interest of conservatism and because it is more prudent to expand from a sound base (rather than to be saddled with over capacity) the choice must be between Case E - integer and Case G - integer, where G is a reduced demand case.

10.30 The only real physical difference between Case E and G is the size of the ethyl alcohol unit; all other units are essentially the same. However, the economic difference is interesting because it shows that even if the domestic Indonesian polyethylene market is only 90,000 t/year, rather than a normal 150,000 t/year it remains economical to build a 300,000 t/year capacity plant and to export polyethylene at 11.3¢/lb. (ethylene costs 2.488¢/lb. in this case). Thus the average value of polyethylene in Case E is 11.8¢/lb. while in Case G it is 11.6¢/lb. or a slightly more conservative balance. The reduction in the amount of alcohol made is relatively unimportant, 20,000 tons per year in Case E versus 12,000 tons in Case G. Case G - integer, therefore, is a rational selection as a starting situation for 1977 in Indonesia. It now becomes necessary to examine 1980 and 1984 cases to see how the project should be expanded to keep up with demand and export capability. Naturally, cases for 1980 and 1984 should be consistent with Case G, or rather Case G should be readily expandable to 1980 and 1984.

TABLE 10.1
Alternative Cases of Petrochemical Investments

CASES

| Basis | A | | | | B | | | | C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feed Cost | Low | | | Low | Low | | | Low | High | | | High |
| Demand Year | 77 | | | 77 | 77 | | | 77 | 77 | | | 77 |
| Demand Basis 1/ | N | | | N | Open | | | Open | N | | | N |
| Integer | No | | | Yes | No | | | Yes | No | | | Yes |
| Prof | 4 | | | 4 | 1 | | | 1 | 4 | | | 4 |
| Products, MT/yr | Dom | Export | Dom | Export | Dom | Export | Dom | Export | Dom | Export | Dom | Export |
| Ethylene P.G. | | 23 | | 26 | | 200 | | 200 | | | | 26 |
| Polyethylene | 150 | 128 | 150 | 128 | 120 | 65 | 120 | 65 | 150 | 128 | 150 | 128 |
| Propylene 2/ | 203 | | 203 | | 237 | | 237 | | 119 | | 203 | |
| Polypropylene | 30 | | 30 | | 32 | 9 | 32 | 9 | 30 | | 30 | |
| Gasoline | 135 | | 152 | | 158 | | 158 | | 85 | | 153 | |
| Fuel Oil | 6 | | 6 | | 9 | | 9 | | 3 | | 6 | |
| Xylenes | 3 | | - | | 2 | | 2 | | 3 | | - | |
| Toluene | 6 | | - | | 4 | | 4 | | 6 | | - | |
| Vinyl Chloride | 10 | 25 | 10 | 25 | 160 | | 160 | | 10 | 25 | 10 | 25 |
| P.V.C. | 40 | 150 | 40 | 150 | 23 | 20 | 23 | 20 | 40 | 150 | 40 | 150 |
| Ethyl Alcohol | 5 | 15 | 5 | 15 | 50 | 50 | 50 | 50 | 5 | 15 | 5 | 15 |
| Styrene | 5 | | - | | - | | | | - | | - | |
| Polystyrene | 7 | | - | | 8 | | 8 | | 8 | | - | |
| Butadiene, Butylene | - | | - | | - | 10 | | 10 | | | | |
| Prod. Value $M | 75.752 | 83.571 | 74.445 | 83.714 | 92.450 | 43.550 | 92.450 | 43.550 | 68.826 | 70.250 | 68.495 | 71.414 |
| Onsite Invest. $M | 249.182 | | 252.924 | | 223.308 | | 231.337 | | 220.781 | | 235.674 | |
| Offsite Invest. $M | 93.000 | | 94.000 | | 89.700 | | 91.600 | | 89.300 | | 91.400 | |
| Total (A) | 342.182 | | 346.924 | | 313.008 | | 322.937 | | 310.081 | | 337.074 | |
| Gross Rev. $M | 160 | | 158 | | 136 | | 136 | | 139 | | 139 | |
| Feed Cost | 11 | | 11 | | 13 | | 13 | | 17 | | 21 | |
| Operating Cost | 54 | | 57 | | 46 | | 46 | | 54 | | 57 | |
| Gross Margin (B) | 95 | | 90 | | 77 | | 77 | | 68 | | 61 | |
| Rate of Return | 16.1 | | 15.1 | | 15.2 | | 13.0 | | 11.5 | | 9.3 | |

1/ N - NORMAL
R - REDUCED
OPEN - Case B reflects effect of exporting large amounts of polymer grade ethylene and propylene, and a reduced polyethylene demand, and large vinyl chloride monomer exports. Substantial monomer exports are dependent on installation of polymerization plants in surrounding nations.

2/ Propylene is valued as fuel due to uncertain market; it is however, polymer grade.

(Footnotes apply to all cases)

CASES

| Basis | D | | E | | | | F | | | | G | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feed Cost | High | | High | | | High | High | | | High | High | | | High |
| Demand Year | 77 | | 77 | | | 77 | 77 | | | 77 | 77 | | | 77 |
| Demand Basis | R | | N | | | N | R | | | R | R | | | R |
| Integer | Yes | | No | | | Yes | No | | | Yes | No | | | Yes |
| Prof. | 6 | | 6 | | | 6 | 6 | | | 6 | 5 | | | 5 |
| Products, MT/yr | Dom | Export | Dom | Export | Dom | Export | Dom | Export | Dom | Export | Dom | Export | Dom | Export |
| Ethylene P.G. | | | | | | | | | | | | | | |
| Polyethylene | 90 | 49 | 150 | | 150 | 127.5 | 90 | | 90 | 188 | 90 | 188 | 90 | 188 |
| Propylene | 7 | | 7 | | 12 | | 5 | | 11 | | 11 | | | |
| Polypropylene | | | | | | | | | | | | | | |
| Gasoline | 10 | | 12 | | 19 | | 7 | | 18 | | 20 | | 19 | |
| Fuel Oil | | | | | | | | | | | | | | |
| Xylenes | | | | | | | | | | | | | | |
| Toluene | | | | | | | | | | | | | | |
| Vinyl Chloride | | | 10 | 25 | | | 10 | 25 | | | 10 | 25 | | |
| P.7.C. | | | | | | | | | | | | | | |
| Ethyl Alcohol | | | 5 | 15 | 5 | 15 | 3 | 9 | | | 3 | 9 | 3 | 9 |
| Prod. Value $M | 25,009 | 12.187 | 43.785 | 6.875 | 42.778 | 35.625 | 26.899 | 5.375 | 25.525 | 46.875 | 29.620 | 52.250 | 25.510 | 49.125 |
| Onsite Invest. $M | 73.535 | | 71.212 | | 133.232 | | 44.384 | | 126.470 | | 115.571 | | 121.299 | |
| Offsite Invest. $M | 37.500 | | 35.500 | | 70.000 | | 35.000 | | 66.500 | | 62.500 | | 65.000 | |
| Total (A) | 111,035 | | 106.712 | | 203.232 | | 79.384 | | 192.970 | | 178.071 | | 186.299 | |
| Gross Rev. $M | 37 | | 51 | | 78 | | 32 | | 72 | | 82 | | 75 | |
| Feed Cost | 4 | | 5 | | 7 | | 3 | | 7 | | 10 | | 9 | |
| Operating Cost | 14 | | 16 | | 28 | | 10 | | 27 | | 29 | | 25 | |
| Gross Margin (B) | 19 | | 30 | | 44 | | 19 | | 38 | | 43 | | 41 | |
| Rate of Return | 8.7 | | 16.2 | | 11.5 | | 13.0 | | 10.0 | | 13.7 | | 12.2 | |

CASES

| Basis | H | | I | | | | J | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Feed Cost | High | | High | | High | | High | | High | |
| Demand Year | 77 | | 77 | | 77 | | 80 | | 80 | |
| Demand Basis | R | | R | | R | | N | | N | |
| Integer | Yes | | No | | Yes | | No | | Yes | |
| Prof. | 6 | | 4 | | 4 | | 2 | | 2 | |
| Products, MT/yr | Dom | Export | Dom | Export | Dom | Export | Dom | Export | Dom | Export |
| Ethylene-P.G. | | | | | | | | 15 | | 15 |
| Polyethylene | 90 | 188 | 90 | 188 | 90 | 188 | 175 | 103 | 175 | 103 |
| Propylene-P.G. | | | | | | | 36 | | 36 | |
| Polypropylene | | | 18 | | | | 60 | 120 | 60 | 120 |
| Gasoline | 19 | | 8 | | 25 | | 112 | | 112 | |
| Fuel Oil | | | | | | | 6 | | 6 | |
| Xylenes | | | 1 | | | | 4 | | 4 | |
| Toluene | | | 1 | | | | 6 | 3 | 6 | 3 |
| Vinyl Chloride | | | 10 | 25 | 10 | 25 | 10 | 25 | 10 | 25 |
| P.V.C. | | | 24 | 120 | 24 | 120 | 50 | 140 | 50 | 140 |
| Ethyl Alcohol | | | 3 | 9 | 3 | 9 | 10 | 20 | 10 | 20 |
| Styrene | | | 5 | | | | | | | |
| Polystyrene | | | 1 | | | | 17 | | 17 | |
| Butadiene & Butylenes | | | | | | | 14 | | | 14 |
| Prod. Value $M | 24.895 | 46.875 | 37.991 | 77.475 | 32.710 | 77.450 | 87.883 | 89.519 | 87.883 | 89.519 |
| Onsite Invest. $M | 115.296 | | 163.481 | | 170.732 | | 325.647 | | 338.818 | |
| Offsite Invest. $M | 62.500 | | 78.800 | | 80.900 | | 99.200 | | 99.500 | |
| Total (A) | 177.796 | | 242.281 | | 251.632 | | 424.897 | | 438.318 | |
| Gross Rev. $M | 72 | | 115 | | 110 | | 176 | | 176 | |
| Feed Cost | 9 | | 12 | | 11 | | 21 | | 21 | |
| Operating Cost | 24 | | 50 | | 48 | | 56 | | 71 | |
| Gross Margin (B) | 39 | | 53 | | 51 | | 99 | | 84 | |
| Rate of Return | 11.5 | | 11.5 | | 10.8 | | 13.0 | | 10.0 | |

CASES

| Basis | K | | | | L | | | | M | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feed Cost | High | | High | | High | | High | | High | | High | |
| Demand Year | 80 | | 80 | | 80 | | 80 | | 80 | | 80 | |
| Demand Basis | N | | N | | N | | N | | R | | R | |
| Integer | No | | Yes | | No | | Yes | | No | | Yes | |
| Prof. | 4 | | 4 | | 6 | | 6 | | 5 | | 5 | |
| Products, MT/yr | Dom | Export | Dom | Export | Dom | Export | Dom | Export | Dom | Export | Dom | Export |
| Ethylene-P.G. | | | | 20 | | | | | | | | |
| Polyethylene | 175 | 103 | 175 | 103 | 175 | | 175 | 103 | 105 | 173 | 105 | 173 |
| Propylene-P.G. | 85 | | 169 | | 9 | | 12 | | | | | |
| Polypropylene | 60 | | 60 | | | | | | 11 | | | |
| Gasoline | 84 | | 153 | | 14 | | 20 | | 20 | | 20 | |
| Fuel Oil | 3 | | 6 | | | | | | | | | |
| Xylene | 3 | | | | | | | | | | | |
| Toluene | 6 | | | | | | | | | | | |
| Vinyl Chloride | 10 | 25 | 10 | 25 | 10 | 25 | | | 10 | 25 | | |
| P.V.C. | 50 | 140 | 50 | 140 | | | | | | | | |
| Ethyl Alcohol | 10 | 20 | 10 | 20 | 10 | 20 | 10 | 20 | 6 | 12 | 6 | 12 |
| Styrene | 5 | | | | | | | | | | | |
| Polystyrene | 8 | | | | | | | | | | | |
| Prod. Value $M | 84.833 | 63.150 | 90.612 | 64.030 | 51.672 | 8.125 | 50.555 | 30.625 | 34.308 | 49.250 | 30.168 | 46.125 |
| Onsite Invest. $M | 239.130 | | 253.418 | | 83.555 | | 134.659 | | 116.655 | | 121.730 | |
| Offsite Invest. $M | 92.800 | | 94.100 | | 45.000 | | 70.500 | | 63.000 | | 65.200 | |
| Total (A) | 331.930 | | 347.518 | | 128.555 | | 215.159 | | 179.655 | | 186.930 | |
| Gross Rev. $M | 148 | | 148 | | 60 | | 82 | | 84 | | 76 | |
| Feed Cost | 17 | | 21 | | 5 | | 8 | | 10 | | 9 | |
| Operating Cost | 57 | | 60 | | 17 | | 27 | | 30 | | 26 | |
| Gross Margin (B) | 74 | | 67 | | 38 | | 47 | | 44 | | 41 | |
| Rate of Return | 12.2 | | 10.0 | | 17.0 | | 11.5 | | 13.7 | | 11.5 | |

CASES

| Basis | N | | | | P | | | |
|---|---|---|---|---|---|---|---|---|
| Feed Cost | High | | | High | High | | | High |
| Year | 84 | | | 84 | 84 | | | 84 |
| Demand Basis | N | | | N | R | | | R |
| Integer | No | | | Yes | No | | | Yes |
| Prof. | 4 | | | 4 | 5 | | | 5 |
| Products, MT/yr. | Dom | Export | Dom | Export | Dom | Export | Dom | Export |
| Ethylene-P.G. | | | | 14 | | | | |
| Polyethylene | 277 | | 277 | | 186 | 92 | 186 | 92 |
| Propylene-P.G. | 51 | | 136 | | | | | |
| Polypropylene | 90 | | 90 | | 11 | | | |
| Gasoline | 84 | | 153 | | 20 | | 20 | |
| Fuel Oil | 3 | | 6 | | | | | |
| Xylene | 3 | | | | | | | |
| Toluene | 6 | | | | | | | |
| Vinyl Chloride | 10 | 25 | 10 | 25 | 10 | 25 | | |
| P.V.C. | 60 | 130 | 60 | 130 | | | | |
| Ethyl Alcohol | 15 | 25 | 15 | 25 | 9 | 15 | 9 | 15 |
| Styrene | 5 | | | | | | | |
| Polystyrene | 8 | | | | | | | |
| Prod. Value $M | 121.966 | 36.675 | 126.654 | 37.271 | 56.817 | 29.750 | 52.695 | 26.625 |
| Onsite Invest. $M | 257.480 | | 271.162 | | 117.740 | | 122.638 | |
| Offsite Invest. $M | 94.300 | | 96.000 | | 63.700 | | 65.000 | |
| Total (A) | 351.780 | | 367.162 | | 181.440 | | 187.638 | |
| Gross Rev. $M | 159 | | 162 | | 87 | | 79 | |
| Feed Costs | 17 | | 21 | | 10 | | 9 | |
| Operating Cost | 61 | | 64 | | 30 | | 26 | |
| Gross Margin | 81 | | 77 | | 47 | | 44 | |
| Rate of Return | 13.0 | | 10.8 | | 14.4 | | 13.0 | |

10.31 An examination of cases for 1980 and 1984, with reduced demands (Case M and P) shows that the type and size of the petrochemical complex remains essentially unchanged from Case G for 1977. The product output of polyethylene gradually changes from export to domestic usage, and there is an increased incentive to expand polyethylene capacity. There is also a favorable increase in alcohol demand. The incentive to fill this demand does not diminish. It is clear that vinyl chloride is the most attractive production monomer but essentially the same plant that sufficed in 1977 would suffice in 1984. Thus our course of action is to build Case G and then stay with it. A calculation of the economic and financial rates of return is shown below.

| Year | $MM Capital | Income | Expense | Total | Depreciation | Tax 1/ 45% | Net Income | Cash 2/ Flow |
|---|---|---|---|---|---|---|---|---|
| 74 | -18.0 | | | -18.0 | | | | -18.0 |
| 75 | -37.0 | | | -37.0 | | | | -37.0 |
| 76 | -113.0 | | | -113.0 | | | | -113.0 |
| 77 | -18.0 | 37.0 | -20.0 | -1.0 | | | -1.0 | -1.0 |
| 78 | | 76.4 | -34.0 | 42.4 | | | 42.4 | 42.4 |
| 79 | | 76.8 | -34.0 | 42.8 | | | 42.8 | 42.8 |
| 80 | | 77.2 | -34.0 | 43.2 | | | 43.2 | 43.2 |
| 81 | | 77.8 | -34.0 | 43.8 | | | 43.8 | 43.8 |
| 82 | | 78.6 | -34.0 | 44.6 | | | 44.6 | 44.6 |
| 83 | | 78.7 | -34.0 | 44.7 | 18.0 | 12.0 | 14.7 | 32.7 |
| 84 | | 78.7 | -34.0 | 44.7 | 18.0 | 12.0 | 14.7 | 32.7 |
| 85 | | 78.7 | -34.0 | 44.7 | 18.0 | 12.0 | 14.7 | 32.7 |
| 86 | | 78.7 | -34.0 | 44.7 | 18.0 | 12.0 | 14.7 | 32.7 |
| 87 | | 78.7 | -34.0 | 44.7 | 18.0 | 12.0 | 14.7 | 32.7 |
| | 186.0 | 817.3 | 360.0 | 271.3 3/ | 90.0 | 60.0 | 121.3 | 211.3 |

1/ Five year tax holiday from first full year of operation
2/ Assumes 100% equity, hence no interest expense
3/ Economic rate of return is 16.4%

10.32 This case shows an economic rate of return of 16.4 percent and a financial rate of return of 14.3 percent after tax and depreciation, based on a five year tax holiday and 10% annual depreciation. This assumes that no major charges or substantial capital additions are made to the project through 1987. In determining the financial rate of return it should be noted that it is based on 100% equity and is exclusive of interest charges. Leverage, of course, will improve the return on equity, provided the borrowing cost is less than rate of return.

10.33 Cases G, M & P for 1977, 1980 and 1984 respectively, are all based on reduced product demands. To confirm there would be no unusual changes in the event demands are higher (normal). The computer summary printout for normal demand cases equal to G, M and P, labeled Q, R, and S are included.

10.34 An alternative to maintaining a minimum investment case throughout the whole period, 1977-1984, is a staged expansion starting from Case G in 1977 and building to a major petrochemical complex by 1984. A normal demand case by 1984, assuming the ultimate objective of the staging is to meet all domestic demands for major petrochemicals the minimum output targets would be:

| | |
|---|---|
| Polyethylene | 310,000 metric tons |
| Polypropylene | 90,000 " |
| Polystyrene | 40,000 " |
| Poly Vinyl Chloride | 60,000 " |
| Ethyl Alcohol | 15,000 " |

It is likely, however, that from a 454,000 t/yr ethylene plant which is fed with an ethane or propane rich feed, it will be impossible to fill the demand for polypropylene or polystyrene. The yield of propylene is too low from both ethane and propane; however, in the event heavier feed stream became available, the demand for propylene could be met, provided the steam cracker had been designed to accept a heavier gas feed. The shortfall of polystyrene will come about due to inadequate domestic benzene supplies; this is readily corrected by increasing imports of benzene. There is a possibility that additional benzene will be available from one of the refineries, although except for North Sumatran crude: the Indonesian crude oils tend to be paraffinic rather than aromatic. Because of the uncertainty we assume that benzene will be imported (up to 126,000 t/yr.). There could also be a demand for 93,000 t/yr. chlorine, a major part of P.V.C. which also is assumed to be imported, although this demand could well serve to stimulate other industrial development.

10.35 The expansion of Case G to 1984 will result in the following before and after look.

CASE Q (1977) INDONESIAN PETROCHEMICAL PROJECT

| UNITS | SIZE TH.TONS/YR | COST,$MM |
|---|---|---|
| STEAM CRACKER | 411 | 28.425 |
| AROMATICS UNIT | | |
| LD POLYETHLENE UNIT | 300 | 87.000 |
| OXYCHLORONATION VICL UNIT | | |
| POLY VICL UNIT | | |
| ETHYL ALCOHOL HYDRATION UNIT | 13 | 6.065 |
| STYRENE UNIT | | |
| POLY STYRENE UNIT | | |
| POLY PROPYLENE UNIT | | |
| GAS SEPARATION | 486 | .576 |
| ETHYLENE | 313 | |
| BUTADIENE EXTRACTION UNIT(DMF) | | |
| SBR UNIT | | |
| TOTAL | | 122.066 ONSITES ONLY |

| PRODUCTS | DOMEST | EXPT | VALUE DOM.MM$/YR | VALUE EXP.MM$/YR |
|---|---|---|---|---|
| GAS TO FLARE | | | | |
| ETHYLENE POLYMER GRADE | | | | |
| POLYETHYLENE LD | 150 | 128 | 40.500 | 31.875 |
| PROPYLENE POLYMER GRADE | | | | |
| POLYPROPYLENE | | | | |
| MIXED BUTANES/UNSATS | 8 | | .275 | |
| GASOLINE 400EP | 11 | | .344 | |
| FUEL OIL 400PLUS | | | | |
| XYLENES MIXED | | | | |
| TOLUENE | | | | |
| BENZENE | | | | |
| ETHYL BENZENE | | | | |
| VINYL CHLORIDE | | | | |
| POLY VINYL CHLORIDE | | | | |
| ETHYL ALCOHOL | 5 | 15 | 1.000 | 3.750 |
| STYRENE | | | | |
| BUTADIENE | | | | |
| LOSS | 22 | | .000 | |
| BUTYLENE | | | | |
| PROCESS FUEL | 180 | | .002 | |
| SYNTHETIC RUBBER | | | | |
| POLYSTYRENE | | | | |
| TOTAL | | | 42.120 | 35.625 |

| | $MM/YR |
|---|---|
| GROSS REV | 78 |
| FEED COST | 9 |
| MARGIN | 69 |
| OPERATING COSTS | |
| LOCAL | 12 |
| FORGN | 13 |
| NET MARGIN | 44 |

INDONESIAN PETROCHEMICAL PROJECT

CASE B (1980)

| UNITS | SIZE TH.TONS/YR | COST,$MM |
|---|---|---|
| STEAM CRACKER | 419 | 28.764 |
| AROMATICS UNIT | | |
| LD POLYETHLENE UNIT | 300 | 87.000 |
| OXYCHLORONATION VICL UNIT | | |
| POLY VICL UNIT | | |
| ETHYL ALCOHOL HYDRATION UNIT | 19 | 7.142 |
| STYRENE UNIT | | |
| POLY STYRENE UNIT | | |
| POLY PROPYLENE UNIT | | |
| GAS SEPARATION | 498 | .590 |
| ETHYLENE | 319 | |
| BUTADIENE EXTRACTION UNIT(DMF) | | |
| SBR UNIT | | |
| TOTAL | | 123.496 ONSITES ONLY |

| PRODUCTS | DOMEST | EXPT | VALUE DOM.MM$/YR | VALUE EXP.MM$/YR |
|---|---|---|---|---|
| GAS TO FLARE | | | | |
| ETHYLENE POLYMER GRADE | | | | |
| POLYETHYLENE LD | 175 | 103 | 47.250 | 25.625 |
| PROPYLENE POLYMER GRADE | | | | |
| POLYPROPYLENE | | | | |
| MIXED BUTANES/UNSATS | 8 | | .280 | |
| GASOLINE 400EP | 12 | | .351 | |
| FUEL OIL 400PLUS | | | | |
| XYLENES MIXED | | | | |
| TOLUENE | | | | |
| BENZENE | | | | |
| ETHYL BENZENE | | | | |
| VINYL CHLORIDE | | | | |
| POLY VINYL CHLORIDE | | | | |
| ETHYL ALCOHOL | 10 | 20 | 2.000 | 5.000 |
| STYRENE | | | | |
| BUTADIENE | | | | |
| LOSS | 22 | | .000 | |
| BUTYLENE | | | | |
| PROCESS FUEL | 185 | | .002 | |
| SYNTHETIC RUBBER | | | | |
| POLYSTYRENE | | | | |
| TOTAL | | | 49.883 | 30.625 |

| | $MM/YR |
|---|---|
| GROSS REV | 81 |
| FEED COST | 9 |
| MARGIN | 71 |
| OPERATING COSTS | |
| LOCAL | 12 |
| FORGN | 13 |
| NET MARGIN | 47 |

N

INDONESIAN PETROCHEMICAL PROJECT

CASE S (1984)

| UNITS | SIZE TH.TONS/YR | COST,$MM |
|---|---|---|
| STEAM CRACKER | 428 | 29.103 |
| AROMATICS UNIT | | |
| LD POLYETHLENE UNIT | 300 | 87.000 |
| OXYCHLORONATION VICL UNIT | | |
| POLY VICL UNIT | | |
| ETHYL ALCOHOL HYDRATION UNIT | 26 | 8.220 |
| STYRENE UNIT | | |
| POLY STYRENE UNIT | | |
| POLY PROPYLENE UNIT | | |
| GAS SEPARATION | 510 | .604 |
| ETHYLENE | 326 | |
| BUTADIENE EXTRACTION UNIT(DMF) | | |
| SBR UNIT | | |
| TOTAL | | 124.926 ONSITES ONLY |

| PRODUCTS | DOMEST | EXPT | VALUE DOM.MM$/YR | VALUE EXP.MM$/YR |
|---|---|---|---|---|
| GAS TO FLARE | | | | |
| ETHYLENE POLYMER GRADE | | | | |
| POLYETHYLENE LD | 277 | | 74.925 | |
| PROPYLENE POLYMER GRADE | | | | |
| POLYPROPYLENE | | | | |
| MIXED BUTANES/UNSATS | 8 | | .286 | |
| GASOLINE 400EP | 12 | | .358 | |
| FUEL OIL 400PLUS | | | | |
| XYLENES MIXED | | | | |
| TOLUENE | | | | |
| BENZENE | | | | |
| ETHYL BENZENE | | | | |
| VINYL CHLORIDE | | | | |
| POLY VINYL CHLORIDE | | | | |
| ETHYL ALCOHOL | 15 | 25 | 3.000 | 6.250 |
| STYRENE | | | | |
| BUTADIENE | | | | |
| LOSS | 22 | | .000 | |
| BUTYLENE | | | | |
| PROCESS FUEL | 191 | | .002 | |
| SYNTHETIC RUBBER | | | | |
| POLYSTYRENE | | | | |
| TOTAL | | | 78.571 | 6.250 |

| | $MM/YR |
|---|---|
| GROSS REV | 85 |
| FEED COST | 9 |
| MARGIN | 75 |
| OPERATING COSTS | |
| LOCAL | 12 |
| FORGN | 13 |
| NET MARGIN | 51 |

N

Thousand Tons/Yr.

| | 1977 1/ | 1984 1/ | Short of Local Demand |
|---|---|---|---|
| Polyethylene | 278 | 278 2/ | |
| Polypropylene | - | 16 | 74 |
| Propylene | - | - | |
| Gasoline | 19 | 19 | |
| Fuel Oil | - | - | |
| Xylene | - | 2 | |
| Toluene | - | 2 | |
| VICL | - | - | |
| P.V.C. | - | 165 | 105 |
| Ethyl Alcohol | 12 | 34 | 19 |
| Styrene | - | - | |
| Polystyrene | - | 160 | 120 |
| Benzene | - | - | 126 |
| Chlorine | | - | 93 |

10.36 The schematic diagram, Figure 10.4, indicates the staging of new petrochemical units into Case G. The more profitable units are added first and the less profitable ones later until the total capacity of all petrochemical units consumes all the ethylene capacity. The additional costs, capital as well as operating, and the new income streams are presented in Table 10.2 and 10.3. The financial rate of return shows that the staged development represents an opportunity to improve from 14% where Case G is not expanded to 23% in the expanded 1984 petrochemical complex.

10.37 The total capital investment in onsite and offsite facilities amounts to $186,000,000 in Case G and another $134,800,000 for the staged expansion by 1984. The total estimated cost of $320,800,000 is too great a commitment for any private company to undertake in Indonesia. By the same token, Pertamina (in effect the government) probably could not commence such a venture alone because of the technical requirements for managing the project and operating it once it is built. Also Pertamina does not have the export marketing organization or background to develop the export market in competition with Japan or the U.S. Assuming Pertamina can negotiate for the managerial, technical and marketing skills that will insure successful project execution and efficient operation, then the door is open to financing and equity participation by private investors.

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1/ Assumed on ethane feed
2/ Considered equal to 310,000 t. demand

TABLE 10.2

STAGING OF CAPITAL ADDITIONS

| Year $MM | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ethylene Expansion | 5.0 | 16.5 | 10.0 | | | | | | | | | | | | |
| Ethyl Alcohol | 0.5 | 1.0 | 0.5 | | | | | | | | | | | | |
| P.V.C. | 13.0 | 28.0 | 5.0 | | | | | | | | | | | | |
| Acromatics | | | 0.6 | 1.3 | 0.5 | | | | | | | | | | |
| Polystyrene | | | 7.0 | 13.0 | 2.0 | | | | | | | | | | |
| Polypropylene | | | | | 2.0 | 3.9 | 0.6 | | | | | | | | |
| Onsites | 18.5 | 45.5 | 23.1 | 14.3 | 4.5 | 3.9 | 0.6 | | | | | | | | |
| Offsites | 4.1 | 10.0 | 5.1 | 3.2 | 1.0 | 1.0 | | | | | | | | | |
| Total Capital | 22.6 | 55.5 | 28.2 | 17.5 | 5.5 | 4.9 | 0.6 | | | | | | | | |
| New Operating Costs, $MM | | | | | | | | | | | | | | | |
| Ethylene, Alcohol, Oxychlorination, and Poly Vinyl Chloride | | | 27.5 | | | | | | | | | | | | |
| Aromatics | | | | .9 | | | | | | | | | | | |
| Polystyrene | | | | | 19.5 | | | | | | | | | | |
| Polypropylene | | | | | | 1.8 | | | | | | | | | |
| | | | 27.5 | .9 | 19.5 | 1.8 | | | | | | | | | |
| New Revenues | | | 39.7 | 39.8 | 64.1 | 88.0 | 88.0 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 |
| Depreciation | | | | | | | | 2.2 | 7.7 | 10.5 | 12.2 | 12.8 | 13.3 | 13.3 | 13.3 |
| Income Before Tax | | | | | | | | 86.1 | 80.6 | 77.8 | 76.1 | 75.5 | 75.0 | 75.0 | 75.0 |
| Income Tax 45% | | | | | | | | 38.7 | 36.3 | 35.0 | 34.2 | 33.9 | 33.7 | | |

TABLE 10.3

STAGING OF ADDITIONS TO CASE G

| | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Case G | - 18 | - 37 | - 113 | - 1 | 42.4 | 42.8 | 43.2 | 43.8 | 44.6 | 44.7 | 44.7 | 44.7 | 44.7 | 44.7 | 44.7 | 44.7 | 44.7 | 44.7 | 44.7 |
| Capital Additions, Onsite | | | | | - 18.5 | - 45.5 | - 23.1 | - 14.3 | - 4.5 | - 3.9 | - .6 | | | | | | | | |
| Capital Additions, Offsite | | | | | - 4.1 | - 10.0 | - 5.1 | - 3.2 | - 1.0 | - 1.0 | | | | | | | | | |
| New Operating Costs | | | | | | | - 27.5 | - .9 | - 19.9 | - 1.8 | | | | | | | | | |
| New Operating Revenues | | | | | | | 39.7 | 39.8 | 84.1 | 88.0 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 | 88.3 |
| Gross Revenue | - 18 | - 37 | - 113 | - 1 | 19.8 | - 12.7 | 27.2 | 65.2 | 103.3 | 126.0 | 132.4 | 133.0 | 133.0 | 133.0 | 133.0 | 133.0 | 133.0 | 133.0 | 133.0 |
| Depreciation 'G' | | | | | | | | | | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 18.0 | 23.0 |
| New Depreciation | | | | | | | | | | | | 2.2 | 7.7 | 10.5 | 12.2 | 12.8 | 13.3 | 13.3 | 13.3 |
| Income Before Tax | - 18 | - 37 | - 113 | - 1 | 19.8 | - 12.7 | 27.2 | 65.2 | 103.3 | 108.0 | 114.4 | 112.8 | 107.3 | 104.5 | 102.8 | 102.2 | 101.7 | 101.7 | 96.7 |
| Income Tax (old) | | | | | | | | | | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 10.0 |
| (new) | | | | | | | | | | | | 38.7 | 36.3 | 35.0 | 34.2 | 33.9 | 33.7 | 33.7 | 33.7 |
| Net Income | | | | | 19.8 | - 12.7 | 27.2 | 65.2 | 103.3 | 96.0 | 102.4 | 62.1 | 59.0 | 57.5 | 56.6 | 56.3 | 56.0 | 56.0 | 53.0 |
| Cash Flow | - 18 | - 37 | - 113 | - 1 | 19.8 | - 12.7 | 27.2 | 65.2 | 103.3 | 114.0 | 120.4 | 82.3 | 84.7 | 86.0 | 86.8 | 87.1 | 87.3 | 87.3 | 89.3 |

# CASE G AND 1984 SCHEMATIC

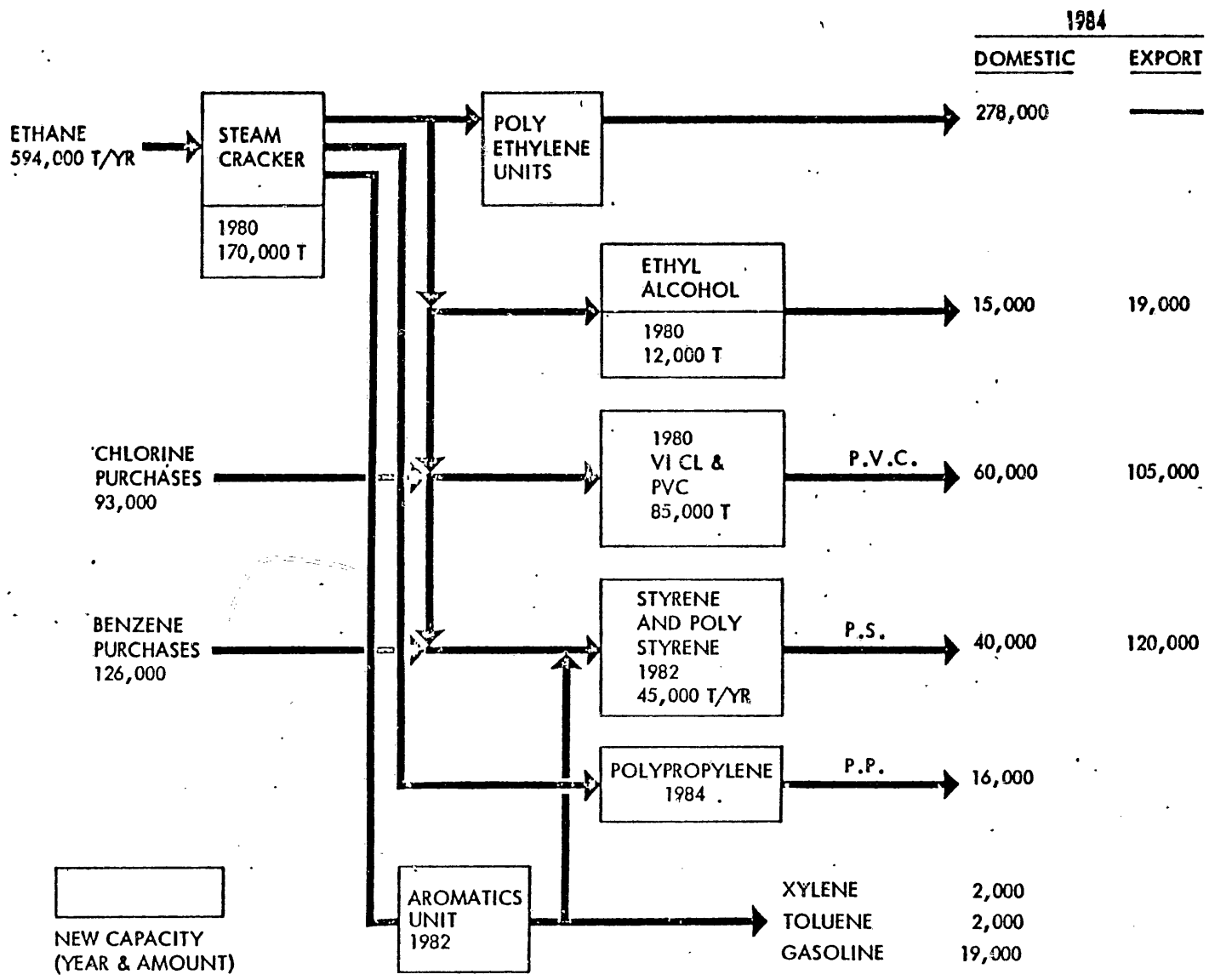


FIGURE 10.4

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## Summary and Recommendations

10.38 In conclusion, this report finds that the circumstances and the timing are propitious for commencing work toward developing a petrochemical complex in Indonesia. Such a project would be economically viable and would yield a 14-23% financial rate of return. The cost of the project would be about $186,000,000 to start and with a staged expansion the total capital cost would rise to $320,800,000 by 1984. The project is too large for private industry to undertake alone and the Indonesian government does not possess the technical resources to forego participation by a foreign party. Therefore, formal private and government collaboration is indicated.

10.39 By way of beginning the project it is recommended that the pre-feasibility study presented here be broadened to full feasibility and concurrently that discussions commence among all interested parties to stimulate interest in the project. Concerning a full feasibility study we suggest that the task be undertaken by a qualified firm in petrochemicals, a firm with recent demonstrated experience in market surveys, a knowledge of the areas around Indonesia, and a strong background in the technology and economics of petrochemicals. The major factors to be included in the scope of the study would be:

1. Detailed market analysis covering eight (possibly 10) countries tributary to Indonesia. It is estimated that this would take about eight months.

2. Site feasibility study. Three or four potential areas should be evaluated to determine if there are major advantages or disadvantages in location. This would include consideration of transporting products from the point of manufacture to consuming centers. Two months are needed and it could be done concurrently with the market survey.

3. Facilities planning and economic optimization of the entire complex. A more detailed linear programming model will be needed for this, including a transportation and distribution sector, and costs will need to be based on a specific location as well as preliminary contractor's estimates valid for Indonesia. This activity should commence when the market survey is completed, and it should take about four months.

10.40 Figure 10.5 shows the timing for the project. The reason for conducting discussions with interested foreign parties from the inception is that some company or consortium of companies might come

forward and be prepared to take a major equity position. If this were to happen the study work then in progress could be terminated or taken over by the foreign partner. We believe that any foreign group intent on taking a major equity position would insist on carrying out their own studies. It is estimated that the full feasibility study, embracing the first three steps on Figure 10.5 would cost between $500,000 - $750,000. In addition there may be expenses incidental to or in support of the feasibility study, probably amounting to $100,000 - $200,000. In total, therefore, a budget of about $1,000,000 should be considered as the probable upper limit to carry out the formal feasibility study.

# FEASIBILITY STUDY — INDONESIAN PETROCHEMICALS PROJECT

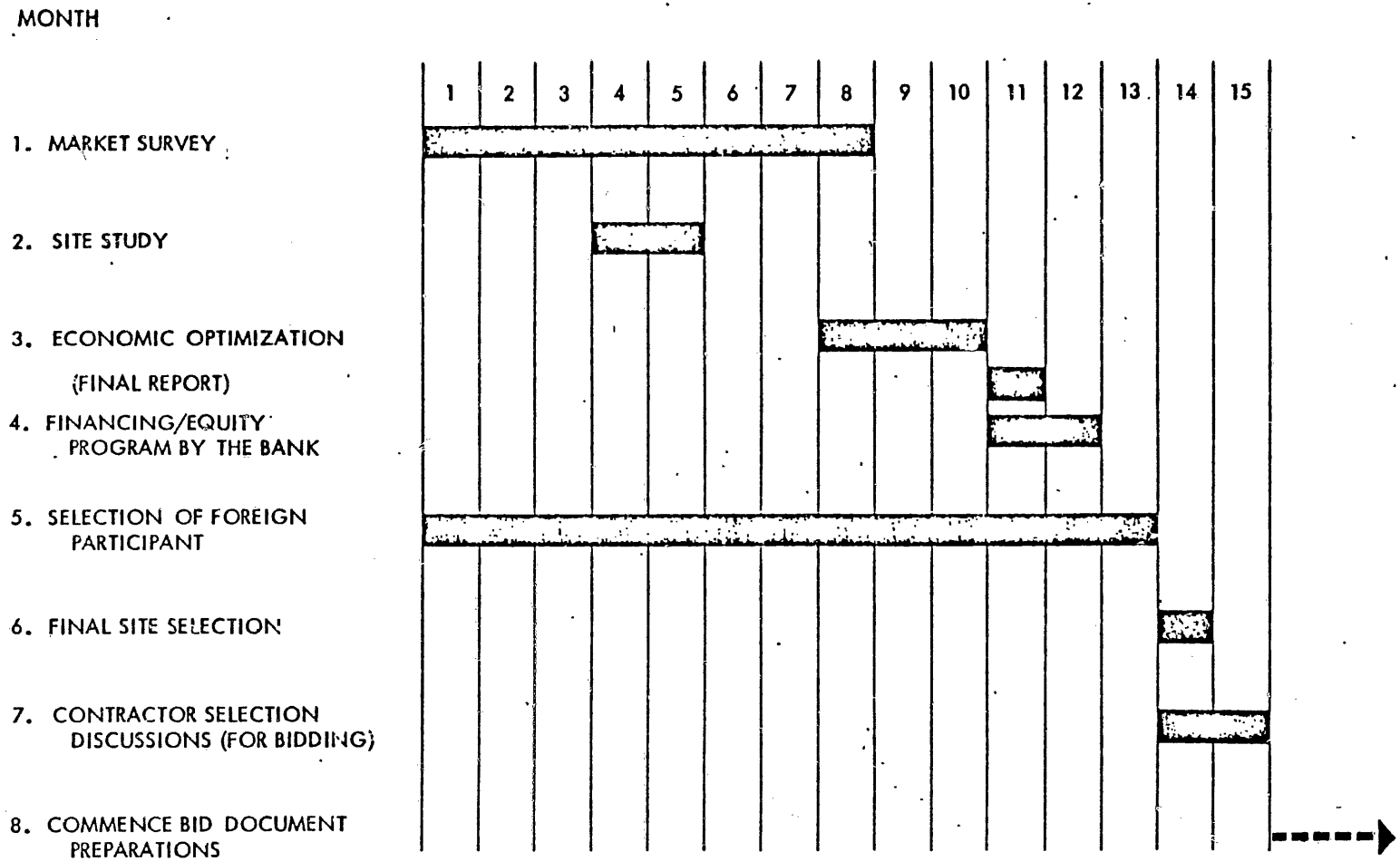


FIGURE 10.5

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# ANNEX A

## Basic Uses of Petrochemicals

Figure A 1 is a somewhat more detailed flow diagram of the major components of the steam cracker. This is included to provide a small indication of the relative complexity of these processes.

Figure A 2 shows the uses of the basic products as well as some future uses anticipated when the demand increases to permit building economically sized plants. There are of course many other potential combination and product end uses possible. A brief section of this report will show the major end uses of petrochemicals and provide suggestions for new uses in Indonesia.

The products available in significant quantity with appropriate separation are as follows: Ethylene, Propylene, Butadiene, Benzene, Toluene, and Xylene.

The major uses of these products are:

Ethylene:

Polyethylene and copolymers
Ethanol (Ethyl Alcohol)
Ethylene oxide
Styrene
Vinyl Chloride

Propylene:

Polypropylene
Isopropanol
Propylene oxide
Acrylonitrile (propylene and ammonia)
Ethylene propylene rubber
Acetone

Butadiene:

Styrene-butadiene rubber and foam
ABS plastics (styrene and butadiene and acrylonitrile)
Poly butadiene rubber
Nitrile rubber (butadiene and acrylonitrile)
Adeponitrile

Benzene:

Styrene
Cyclohexane
Detergents
Aniline
DDT
Phenol

Toluene:

Benzene
Cyclohexane
Phenol
TNT
Motor fuels

Xylenes ($O^-$, $m^-$, $p^-$)

Phthalic Anhytride (ortho)
Isophthalic Acid (meta)
Polyester fibers (para).

Many of the foregoing uses are only of minor importance in Indonesia and in South East Asia at this time; however, the availability of these beginning chemicals will serve to accelerate usage. Some of the more important engineering plastics are shown on Figure A 3. In addition a rough comparison is shown in Table A 1 to indicate the price relationships between materials that are substituteable in some instances.

The development of greater use of synthetic fibers is not part of this petrochemical project. However, the basis for such development on a sound economic footing probably will not be possible unless there is a large petrochemical project established. The basic building blocks will be available from primary or secondary petrochemical products.

Products such as ethylene glycol and DMT or TPA needed in polyester fibers manufacture could be derived secondarily from a petrochemical complex, as could acrylonitile and caprolactum. However, a full exposition of the fiber potential is beyond the current scope, although the market potential seems to be substantial. When the detailed feasibility study is made it should include a section on synthetic fibers as these will probably grow to considerable importance by 1984.

TABLE A 1

SUBSTITUTE MATERIALS

| | Tensile Strength ($T/IN^2$) | Density | Cost $/Ton | $/Tensile Unit |
|---|---|---|---|---|
| Steel | 40.0 | 7.8 | 220 | .00067 |
| P. E. | 1.0 | 0.9 | 270 | .0049 |
| P.V.C. | 4.0 | 1.4 | 230 | .00127 |
| Aluminum | 16.0 | 2.7 | 1032 | .0028 |
| Timber | .5 | .5 | 121 | .00013 |
| R. Concrete | 1 | 2.4 | 19 | .0007 |

Synthetic rubbers are an important consumer of the basic petrochemical monomers of butadiene, styrene, isoprene, and ethylene-propylene. However, the manufacture of SBR, cis-polylutodiene or cis-polyisoprene is not part of this study, even though some of the monomers will be available from the petrochemical complex. There is not likely to be any great pressure to delve deeply into synthetic rubbers for Indonesia or South East Asia, except for special uses, inasmuch as the country and the region are rich in natural rubber, at very little foreign exchange cost.

# ETHYLENE PLANT

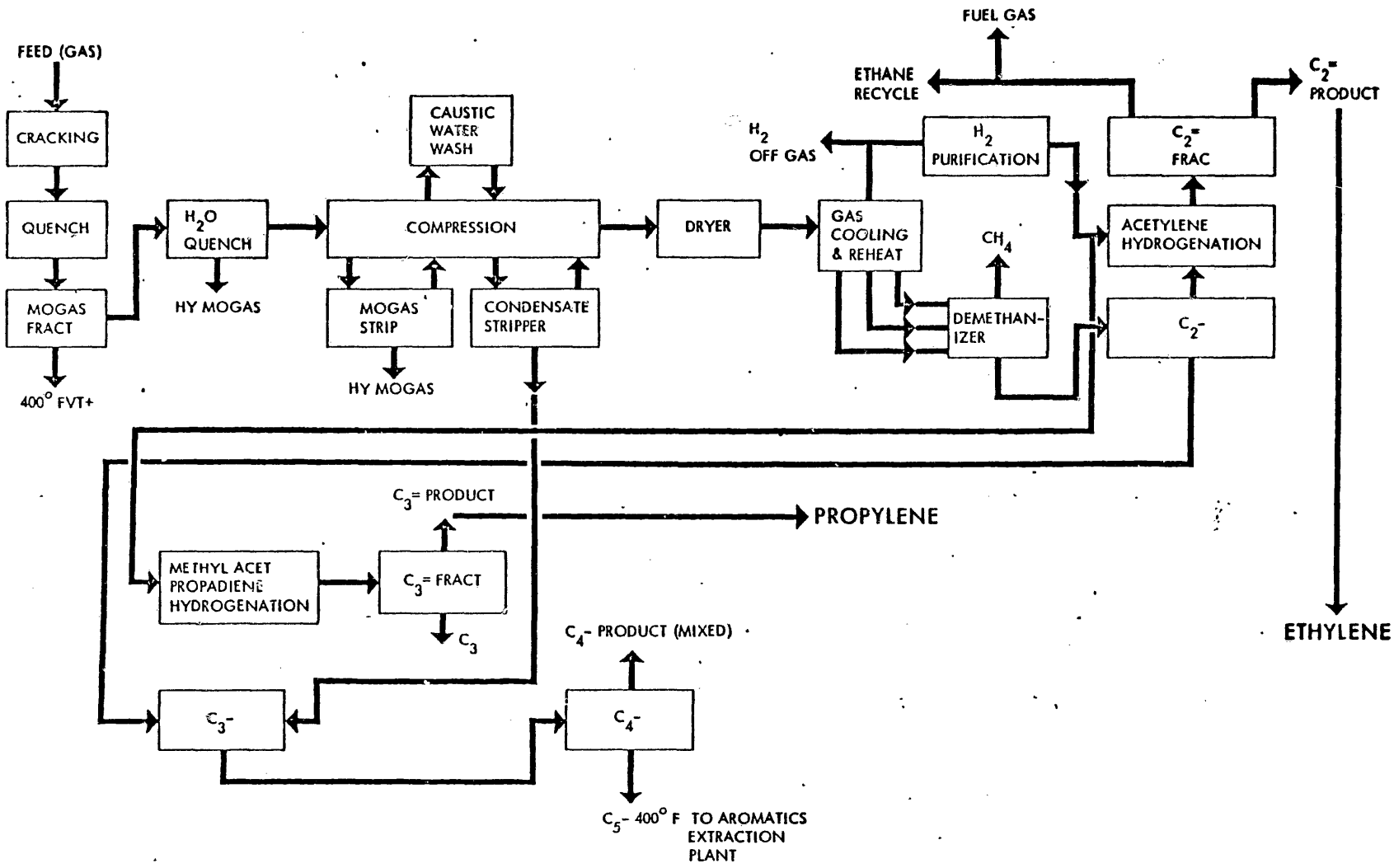
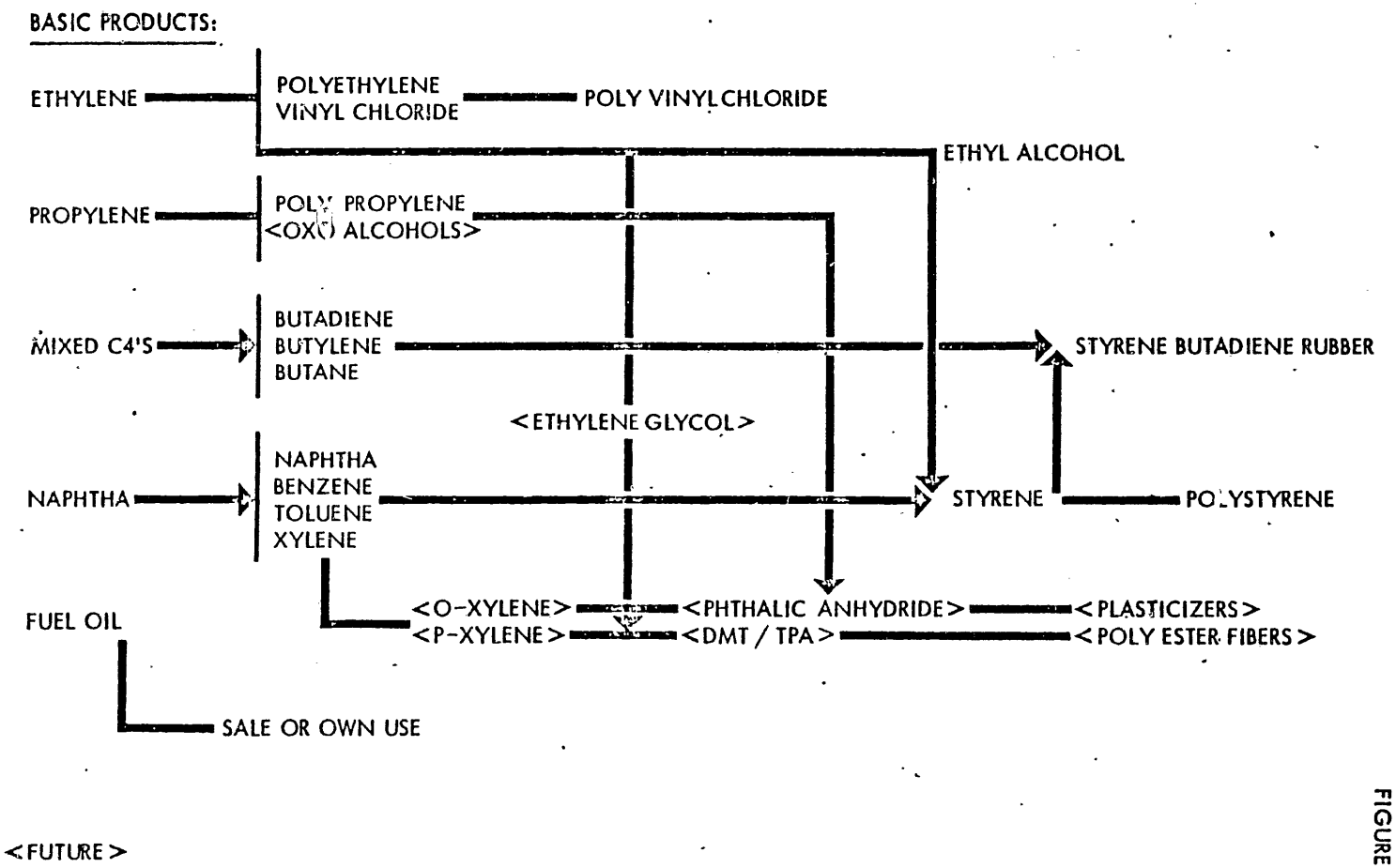



FIGURE A 1

IBRD-6098

# INDONESIAN PETROCHEMICAL COMPLEX SCHEMATIC




<FUTURE>

FIGURE A2

IBRD-6099

## SUBSTITUTE ENGINEERING PLASTICS

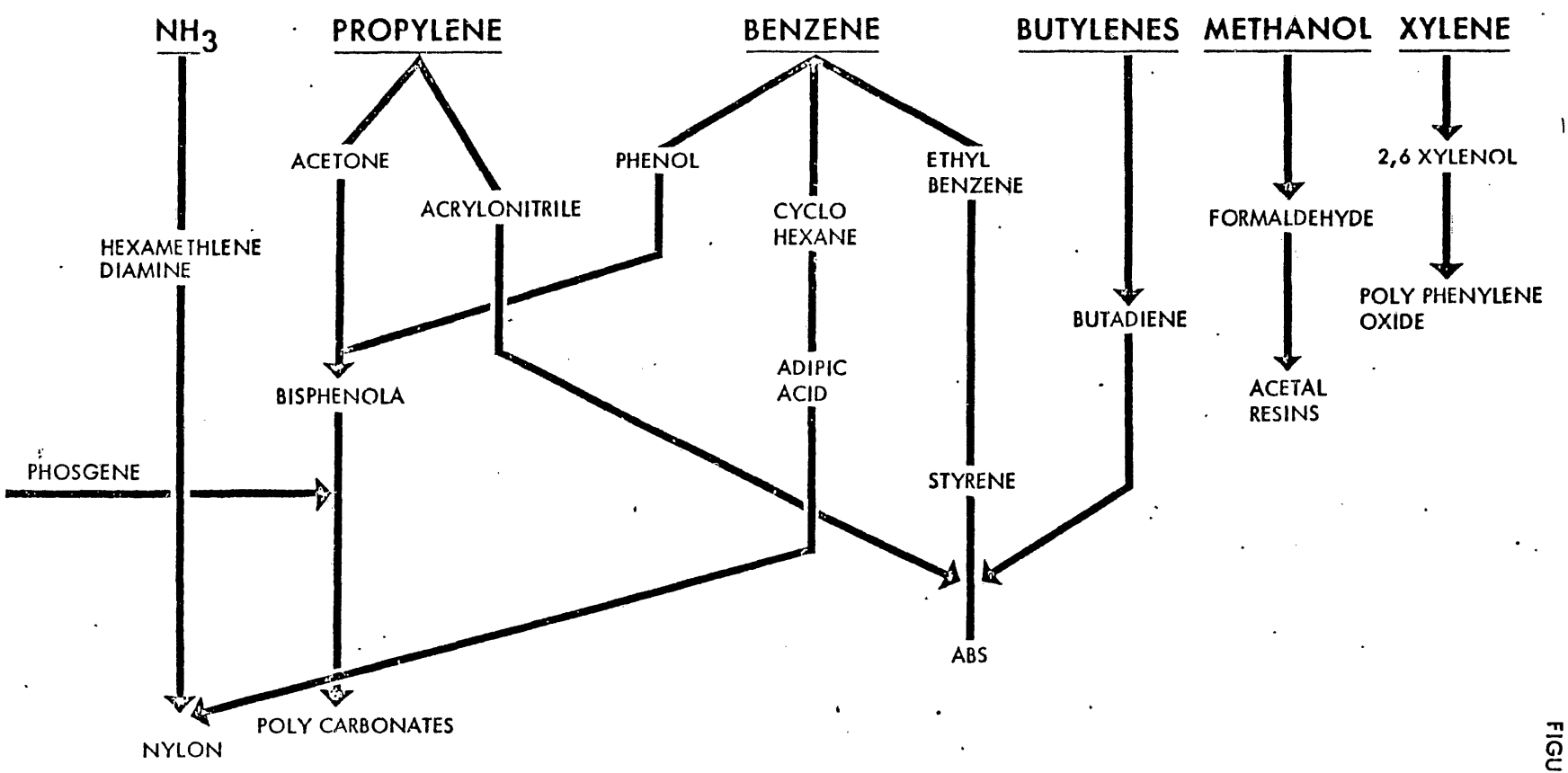



FIGURE A 3

IBRD - 6100

## ANNEX B INDEX

# ANNEX B

## The Petrochemicals Linear Programming Model

What follows is an explanation of the content of the linear programming model, including remarks on the format used; this is designed to explain the model and to present all the basic data used. The format adopted facilitates use of MAGEN (logic and language that causes the matrix to be assembled) and is simple to maintain and understand. This part should be read in conjunction with the computer print-out sheets that follow.

First, the basic definitions are created that will be needed to identify stream and keep track of costs. For simplicity, items are divided into classes. Thus Class PU includes all of the different petrochemical units that will be considered in the model. In Class PU you will note that we use 2 letters, for instance, SC means steam cracker. Similarly, under Class PR are shown the products that can be made, i.e. PP is polypropylene. Note that Class STR (stream) and Class COS (for costs) each has three letters, and that all members of the Class also have 3 letters. It is necessary not to exceed the number of letters shown in the Class. The advantage of identifying items in classes is that we can increase the members in the Class but still need only reference Class PU to refer to all the process units, regardless of how many members are in the Class.

Since the model is for use in a metric system country it has been designed to use weight units, namely metric tons, rather than volume units, such as barrels. Hence, in the Class COS where LAB stands for labor, supervision, overhead and indirect costs, the units connected with LAB are dollars per metric ton. The units of all costs are shown below:

KWH - Kilowatt hours per MT of feed
BFW - MT of water per MT of feed
STM - MT of steam
CWA - MT of cooling water per MT of feed
LAB - $ per MT of feed
MNT - $ per MT of feed based on a percentage of the investment cost.
CAT, ITX, RØY, EXA, UTL are all based on $ per MT of feed to the unit.
FUL - is in FOEMT per MT of feed. F.O.E. is an abbreviation for fuel oil equivalents and equals 39.07 $\frac{\text{MBTU}}{\text{FOE MT}}$, by definition.
CLØ - MT per MT. Chlorine is costed at 70$/MT.
INV - is the investment associated with installing one ton of annual capacity. More on this later.

With respect to Class FED, this class identifies the variety of feeds that are available to the petrochemical plant. Hence for study purposes, we have assumed that the plant could buy any of several feeds. In actual practice the choice would either be a gas mixture or naphtha or gas oil. It is not likely the steam cracker would be designed for multiple feeds, although in some places this is necessary. Benzene is included in this group for modeling convenience. It is not a feed to the steam cracker. All feeds are in metric tons. For instance, Table FD shows that ETH is 595 under column MX. This means that ethane in the amount of 595,000 metric tons is considered available for purchase at $18.0 per MT (under FE Cost). Thus for convenience we have rounded off by units of 1000 per year with respect to quantities of products, streams and feeds.

There are other classes shown but these are used in connection with carrying out the runs, or for ease in modeling. Consequently, we will not comment further on Class MF, R, MNF or CAP, O, YR, FOR or DRN.

The DATA section is organized in Tables where each table contains yield and cost information for a particular activity. Examine Table SC and you will note that stream CH2 (ethane from the gas separation plant) yields .196 tons of gas (which is consumed as fuel or is flared), .762 tons of C2X or ethylene, .0292 tons of propylene, .0191 of butanes and other C4's and .0279 tons of gasoline fractions. Looking down the column we see that local labor costs .25$/MT of ethane feed, and so forth. The rows CPM and CPN are used to place capacity limits when needed.

Exactly the same procedure is followed for all the other petrochemical units. There is a feed to each unit, streams are yielded from the unit and costs are incurred.

Table FD has already been explained and Table CAP is for the purpose of setting either minimum or maximum limits on the capacities of the process units. However, these limits apply only to continuous solutions and we are more interested in integer solutions, as will be discussed later.

Table PRD is used for blending streams produced on the various units to final products. To avoid too much complexity it was decided not to permit polymer blends or to set specific gravity quality constraints. However, when more accurate product demand and market use information is acquired, polymer blending, plasticizer additions, etc. will be evaluated. This table also converts weight units to heat units for gas and certain other streams that can be used as fuel in the plant.

Table COSTS represent an estimate of the local and foreign cost fractions for each cost function. However, this item does not influence

the solution nor does it have any real bearing on the foreign exchange costs. It is useful, however, in estimating what portion of the costs reside in Indonesia and what portion ultimately goes out again. Only operating costs are treated in this manner.

The next two tables labeled DEI and DEX represent, along with Table RHS, current estimates of product demands and prices, both domestic and export. This subject has already been discussed; this is the format used to introduce the data to the L.P. model.

Table INT shows the integer investment costs for various petrochemical units. For example, the steam cracker SC has a minimum size of 200,000 MT/year feed and a minimum cost of $20,000,000 (200,000 X 100 $/MT). Thus this is the minimum size permitted for any case. In the event the size selected exceeds 200,000 MT/yr. then the added cost is at a rate of 40 $/MT of annual capacity. In similar fashion the other units have integer minimums and maximum sizes. The maximum size permitted in this study is a 1 billion pound per year ethylene unit. Although larger units have been built, and by 1977 probably even larger plants than 1.5 billion pounds will exist, the 1 billion pound size is economical and by 1977 should be very reliable. Currently, reliability is still improving, but by then the problems will be resolved. One word of caution is appropriate concerning the sizes and costs. These costs are predicated on the onsite (battery limits) for plants built in other parts of the world over the last five years scaled either up or down from the sizes shown in parenthesis alongside each unit. Unfortunately, these units are not specifically for an Indonesian location and even though every effort was made to be conservative with the investment costs, there could be some surprises. However, based on some recent refinery work, which is similar but not as complex, these costs look reasonable. Certainly as a prefeasibility effort we have attempted to be on the conservative side.

Table COSCNV is a cost factor table that we will make more use of when a specific location is being evaluated. It places unit prices on the items listed. For example, a KWH costs 2¢ per unit.

Table PROF lists "investment pressure" factors and is used to require increasing rates of return and lower investment. Thus by increasing the numerical value of the number in the table we are in effect demanding that each unit invested earn a greater return, and this is done by decreasing the least profitable overall activity first, etc. This is a very useful shortcut for improving a project's rate of return within the framework of the L.P. Mathematically, it is a unique way to avoid the non-linearities of discounted cost flow calculations and also it points up that neither a maximum profit nor a minimum cost solution is necessarily a maximum discounted cash flow solution.

Table RHS is the table in which specific annual demands are included and these data override the data in Table DEI or DEX, except with respect

to price. We can also go from one solution year to the next sequentially and this makes it easier to do a group of case studies.

We are now into the logic and language of the matrix generator, a proprietary system known as MAGEN. Suffice it to say that on the next two pages are all of the necessary statements to construct the matrix. An explanation of MAGEN, or of matrix construction would not be appropriate in this report. However, reference will be supplied to anyone who wishes to go deeper into the subject.

Next follows the listing of all the vectors (activities) and the rows (constraints) that have been formed into the matrix. The listing starts with the work ROWS and contains 229 entries. The Rows are the constraints in the problem. Next come the columns and here each activity that intersects with a Row has a value which is indicated alongside. Thus these are the elements in the actual matrix. Using the listing and the matrix picture, it is easy to find any value of a vector, row, or RHS and to see how they fit with each other in the matrix. The listing and the matrix are included for the benefit of those who wish to go deeply into the details of linear programming, rather than for the casual reader.

The computer solution printout for Case G integer is attached for the record and to serve as a base point for further work. The Case G integer shown in Table 10.1 is not identical with the computer printout attached as part of this Annex. However, the only substantive difference as far as Case G is concerned is in the export price of ethyl alcohol which was reduced in the case shown in this Annex. The solution strategy is unchanged, hence the version which is attached is more up to date in matters of detail. The first six pages list the basic variables that make up this particular solution. On the first page inspection of the objective functions PROF 1 through PROF 6 shows that particular solution is PROF 5 numerically and has a sign change. This indicates that a solution with a somewhat better DCF lies between PROF 5 and PROF 6; since the improvement is probably around 2% and because this is a prefeasibility study we did not feel it worthwhile to explore the solutions between PROF 5 and PROF 6. It is relatively easy to understand the printout if you know what to look for. For instance, the last line on the first page reads.

| | | | |
|---|---|---|---|
| ETHMX | 191.13919 | 403.86081 | 595.000 |

This means that the amount of ethane is 403,860 tons per year out of a maximum availability of 595,000 tons per year, leaving 191,139 tons per year that isn't used. Thus the meaning is that the ethane activity is 191.139 units (value) below the maximum permitted (ETHMX). Look at Table FD and find out how this fits. The next line ETHEN indicates

that ethane activity is 403,860 units above the minimum permitted. Again look at Table FD and you will see that ETHEN is zero. Of course, there are no dual values because the basic variables are in the basis. The lower and upper bounds are constraint values which set limits which cannot be exceeded. For instance CHMDU upper bound is 454.000 and the constraint value is 307.741. In this case it means that the plant is not permitted to produce more than 454,000 t/year of ethylene (1 billion pounds). Now if the constraint value were at its limit then we would expect to see a dual value. DU is not one of the integer units.

On the fourth page the first 13 lines are all cost items in thousands of dollars. For instance, maintenance for the complex is expected to total 7,897,115 per year. However, INVTR is the total onsite investment, 121,281,447. The individual unit investments are like SCINVTR - literally "steam cracker investment transfer" - $28,154,432 and so on. The next group DEXETTR through DEIPSTR show the dollar values of sales of each product and its destination. The code is DEX for 'demand export', ET is the product identification for ethylene and TR is a symbol meaning the revenue has been transferred to the income account. Lines DEXTR and DEITR show the sums of all sales to export and domestically. From this point through the seventh page quantities are shown for various activities. For instance, METGS is 56,711 tons per year of methane gas feed to the gas plant. Since nothing is made from methane in this particular complex, it is clear that this is the amount of gas it is necessary to buy in order to meet the plants internal fuel needs. In similar fashion C2HEH 7.741 is that amount of ethylene going to the ethyl alcohol plant as feed from which alcohol is made. About two-thirds of the way down the sixth page and on through the seventh page the quantities of exports and domestic sales, in thousands of tons per year, are shown.

Beginning the eighth page (INDO/WBK #PROF5# #77# 09/09/71 are non basic variables and from this page through the thirteenth page we can learn certain economic facts about the solution. However, great care and skill is necessary in placing the proper interpretation on the Dual Value and on the DJ's. For instance, look at the dual value for ETHCOST and PROCOST, namely 1.0 and .66332. As we know, ethane is the optimum feed because it is being used. The price of ethane is 18$/MT. The price of propane is 18.3 $/MT (see Table FD), and it is not being used. The dual value for the first ton of propane as a feed is only worth about 66% as much as ethane. A crosscheck of this can be found under the DJ values on the tenth page where CH2BA is 18.36 and CH3BA is 12.5288 or 68%. The small discrepancy is due to the fact that the BA (balance row) value is for feed to the steam cracker whereas the cost of propane is as a feed to the gas plant. Thus, for the first ton of propane to be as attractive as

the last ton of ethane, its price would need to be 12.25 $/MT, approximately 6.05 $/MT less than it is. However, this is not for all the propane, and if we wished to determine the actual average difference we would force propane into the solution and determine the difference. Although most of the dual values and DJ's are important for purposes of understanding marginal value, shadow prices or costs, and so on, we will not discuss them all at this time, but rather will pick out selected ones. On the ninth page there are a series of items ending in BA, like C2HBA, etc. This is a particularly interesting item because it says that the cost of making ethylene in this solution is 56.35687 $/MT, or 2.557 ¢/lb. Thus the plant could sell marginal quantities at this price (or buy at this price) and not influence the economics.

On the eleventh page the Dual Value for EADMX (ethyl alcohol domestic demand maximum) is 188.573 and indicates that the profit would increase by that amount if we could find a market for one more ton. You could also imply that its break even value is 62 $/MT (its sale price of 250 $/MT - 188 $/MT). On the twelvth page near the bottom ETC2H shows a DJ of 12.356 which means that for the sale of ethylene to be economical its price would have to be increased that much. The export price of ethylene is 44.000 $/MT so it would have to be 56.356 $/MT in order to be attractive. From POC3H .30175 we can tell that this is the amount propylene is underpriced, i.e. at 18.30175 $/MT it would be profitable.

As explained in paragraph 10.34 and subsequently a staged expansion of Case G appeared viable and feasible. To confirm the end result of the staging a 1984 linear programming case was run and the continuous and integer solutions are attached, following the solutions of Case G, on pages ___ ____ in this Annex. You will note the L.P. has found a more profitable end-result for 1984 than shown in 10.37 or in Tables 10.2 and 10.3. The improved result only confirms the basic approach and it was not deemed necessary to try to show a revised set of economics for the indicated 23% rate of return.

In evaluating Case G it appeared that the unavailability of benzene was seriously limiting the core facilities ability to operate on a larger and more profitable scale. Consequently, we made benzene available to Case G at 94 $/MT for 1977 at the reduced demand for overall petrochemicals. The result is that it becomes attractive to expand the facility into styrene and polystyrene activity on a large scale. The result is a more economically attractive 1977 case than Case G. However, the firm availability of benzene is necessary to take this route. The solution for the "1977 benzene availability case" is attached on pages ____ to ____ , following the 1984 case.

```
GENERATE,MS,I
     DICTIONARY
          CLASS MF,R,MNF
                MX M MAX
                MN N MIN
                FX F FIX
          CLASS CAP
              CPM,CPN
          CLASS PR          PRODUCTS FOR REPORT WRITER
              FL     GAS TO FLARE
              ET     ETHYLENE POLYMER GRADE
              PE     POLYETHYLENE LD
              PO     PROPYLENE POLYMER GRADE
              PP     POLYPROPYLENE
              C4     MIXED BUTANES/UNSATS
              MG     GASOLINE 400EP
              FO     FUEL OIL 400PLUS
              XY     XYLENES MIXED
              TO     TOLUENE
              BZ     BENZENE
              EB     ETHYL BENZENE
              VC     VINYL CHLORIDE
              PV     POLY VINYL CHLORIDE
              EA     ETHYL ALCOHOL
              SY     STYRENE
              BT     BUTADIENE
              LS     LOSS
              BY     BUTYLENE
              PF     PROCESS FUEL
              SR     SYNTHETIC RUBBER
              PS     POLYSTYRENE
          CLASS STR
              GAS,C2H,C3H,C4M,MO1,MO2,MO3,FEO,RAF,XYL,BEZ,TOL,EBZ,
              NPA,GOA,PVC,EAL,STY,PST,PP1,MO4,MO5,PE1,LOS,VC1,BTY,BTA,
              SRR,HYD,CH2,CH3,CH4,C2X
          CLASS QU  QUALITIES
              GR
          CLASS PU  PETROCHEMICAL UNITS
              GS     GAS SEPARATION
              SC     STEAM CRACKER
              DU     DUMMY
              AR     AROMATICS UNIT
              LD     LD POLYETHLENE UNIT
              OX     OXYCHLORONATION VICL UNIT
              PC     POLY VICL UNIT
              EH     ETHYL ALCOHOL HYDRATION UNIT
              SE     STYRENE UNIT
              PY     POLY STYRENE UNIT
              PL     POLY PROPYLENE UNIT
              BU     BUTADIENE EXTRACTION UNIT(DMF)
              SB     SBR UNIT
          CLASS COS COSTS
              KWH    ELECTRICITY
              BFW    BOILER FEED WATER
              STM    STEAM
              CWA    COOLING WATER
              LAB    LABOR,SUPERVISION,OVERHEAD AND INDIRECT COSTS
              MNT    MAINTENANCE
              CAT    CATALYSTS AND CHEMICALS
              ITX    INSURANCE + LOCAL TAXES(NOT INCOME TAX)
              ROY    ROYALTY FOR PROCESS TECHNOLOGY
```

```
        ROY   ROYALTY FOR PROCESS TECHNOLOGY
        FUL   FUEL(OWN USE)
        BAG   BAGS FOR FINISHED PRODUCTS.
        EXA   FOREIGN EXPERTS
        UTL   UTILITIES
        INV   INVESTMENT,DOLLARS PER ANNUAL UNIT
        CLO   CHLORINE
    CLASS FED FEED TO CORE FACILITY
        MET   METHANE
        ETH   ETHANE
        PRO   PROPANE
        BUT   BUTANE
        NAP   NAPHTHA
        GAO   GAS OIL
        BEZ   BENZENE PURCHASES
    CLASS O   VARIOUS OBJECTIVE FUNCTION
        1,2,3,4,5,6
    CLASS YR  VARIOUS RHS NUMBERS
        77,78,79,80,81,82,83,84,85
    CLASS FOR FOREIGN EXCHANGE EARNINGS OR SAVINGS
        DOL
    CLASS DRN FOREIGN EXCHANGE OUTFLOW
        NEG
DATA
    TABLE GS  GAS SEPERATION
        MET     ETH     PRO     BUT     NAP     GAO
GAS     1.15                            .105
CH2             1.0
CH3                     1.0
CH4                             1.0
NPA                                     .9
GOA                                             1.0
INV     1.1     1.2     1.3     1.4     1.5     1.6
CPM     1.0     1.0     1.0     1.0     1.0     1.0
CPN     1.0     1.0     1.0     1.0     1.0     1.0
    TABLE SC  STEAM CRACKER (1 BILLION LBS ETHYLENE PER YR)
        CH2     CH3     CH4     NPA     GOA
GAS     .196    .363    .305    .351    .382
C2X     .7620   .422    .401    .340    .294
C3H     .0292   .171    .2085   .158    .116
C4M     .0191   .0456   .0982   .100    .040
MO1     .0279
MO2             .06
MO3                     .037
MO4                             .014
MO5                                     .115
FEO             .0123   .0049   .045    .232
LAB     .25     .139    .1325   .10     .086
MNT     4.5     1.5     1.55    1.44    1.70
CAT     .835    .46     .44     .51     .61
ITX     .9      .45     .465    .43     .52
ROY     .5      .4      .3      .2      .1
EXA     2.02    1.11    1.06    .82     .99
FUL     .43     .45     .48     .20     .24
INV     60.0    30.0    31.0    28.8    28.8
CPM     1.0     1.0     1.0     1.0     1.0
CPN     1.0     1.0     1.0     1.0     1.0
KWH     110     64      61      48      58
    TABLE DU    DUMMY.
        C2X
C2H     1
CPM     1
CPN     1
    TABLE AR  AROMATICS UNIT (20.000 T/YR BEZ)
        MO1     MO2     MO3     MO4     MO5
RAF     .40     .43     .368    .83     .80
```

| | | | | | |
|---|---|---|---|---|---|
| ATL | .10 | .09 | .10 | .03 | .03 |
| BEZ | .30 | .285 | .316 | .08 | .10 |
| TOL | .10 | .19 | .210 | .05 | .07 |
| EBZ | .10 | .005 | .006 | .001 | |
| LAB | 6.0 | 6.3 | 6.7 | 1.0 | .8 |
| MNT | 5.0 | 5.4 | 8.3 | 1.2 | 1.0 |
| CAT | 6.0 | 6.5 | 6.9 | 1.0 | .8 |
| UTL | 30.0 | 31.4 | 34.8 | 4.9 | 4.0 |
| ITX | 2.0 | 2.1 | 3.3 | .5 | .4 |
| ROY | .75 | .77 | 1.18 | .2 | .2 |
| FUL | .2 | .2 | .2 | .2 | .2 |
| INV | 100 | 108 | 166 | 24 | 20 |
| CPM | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| CPN | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |

TABLE BU BUTADIENE EXTRACTION(DMF)

| | C4M |
|---|---|
| BTY | .30 |
| BTA | .70 |
| LAB | 3.8 |
| MNT | 22.5 |
| CAT | 4.62 |
| ITX | 11.2 |
| ROY | .5 |
| EXA | 10.0 |
| FUL | .1 |
| INV | 450 |
| UTL | 18.5 |
| KWH | |
| CPM | 1.0 |
| CPN | 1.0 |

TABLE SB SYNTHETIC SBR (45400 T/YR)

| | BTA |
|---|---|
| SRR | 1.4 |
| STY | -.4 |
| LAB | 21.7 |
| CAT | 80.3 |
| MNT | 19.8 |
| UTL | 49.4 |
| INV | 396 |
| EXA | 90.0 |
| CPM | 1.0 |
| CPN | 1.0 |

TABLE LD LOW DENSITY POLYETYLENE (136.000T/YR)

| | C2H |
|---|---|
| PE1 | .925 |
| LOS | .075 |
| LAB | 2.2 |
| MNT | 20.0 |
| CAT | .90 |
| UTL | 30.0 |
| ROY | 11.0 |
| EXA | 8.84 |
| INV | 430 |
| CPM | 1.0 |
| CPN | 1.0 |

TABLE OX VICL OXYCHLORONATION (90800 T/YR)

| | C2H |
|---|---|
| VC1 | 2.05 |
| CLO | 1.10 |
| LAB | 3.30 |
| MNT | 9.13 |
| CAT | 1.80 |
| UTL | 5.30 |
| ROY | 6.10 |
| EXA | 9.90 |
| INV | 183 |

```
CPM     1.0
CPN     1.0
KWH     1305
   TABLE PL     POLY PROPYLENE PLANT
        C3H
PP1     .90
LOS     .10
LAB     2.5
MNT     31.0
CAT      1.0
UTL      35.0
ROY      20.0
EXA     10.0
INV     500
CPM      1.0
CPN      1.0
   TABLE PC  POLY VICL UNIT (45400T/YR)
        VCl
PVC     .95
LAB     2.65
MNT     10.7
CAT     18.2
UTL     10.5
ROY     1.15
EXA     10.6
INV     215
CPM     1.0
CPN     1.0
   TABLE EH  ETHYL ALCOHOL HYDRATION UNIT(90800T/YR)
        C2H
EAL     1.55
FUL     .34
LAB     2.05
MNT     10.3
CAT     5.16
UTL     1.36
ROY     1.0
EXA     6.85
INV     205
CPM     1.0
CPN     1.0
ITX     4.10
KWH     88.8
CWA     0.68
   TABLE SE  STYRENE UNIT (45400 T/YR)
        C2H        EBZ
STY     3.71       .87
BEZ    -2.78
LAB     2.75        1.0
MNT     6.60       3.0
CAT     1.00
UTL     35.2       27.8
ROY      1.0
EXA     11.1       7.5
INV     132        100
ITX      1.8
CPM      1.0       1.0
CPN      1.0       1.0
HYD     .071       .01
   TABLE PY  POLYSTYRENE UNIT(45400T/YR)
        STY
PST     .95
LAB     2.1
MNT     6.6
CAT     .42
UTL     6.2
ROY     1.0
```

```
ROI     1.0
EXA     20.1
INV     132
ITX     1.8
CPM     1.0
CPN     1.0
   TABLE FD  FEED TO COMPLEX(THOUSANDS OF TONS AND $/TON)
        MX      MN      FECOST   ! =/GAL     +/=
MET    300       0      21.0
ETH    595       0       18.0
PRO      1       0       18.3
BUT      1       0       19.5
NAP      1       0      25.0
GAO      1       0      30.0
   TABLE CAP UNIT CAPACITIES (THOUSAND TONS PER YEAR)
        CPM     CPN
GS     2000     0.1
SC     1500     0.1
DU      454      0
AR      100       0
LD      300       0
OX      200       0
PC      200       0
EH       90       0
SE      200       0
PY      200       0
PL      200       0
BU      200       0
SR       50       0
   TABLE PRD DECISION TABLE
    FL ET PE PO PP C4 MG FO XY TO BZ EB VC PV EA SY PS LS PF
GAS  1                                                    1.13
C2H  1  1                                                 1.149
C3H  1        1                                           1.115
C4M  1              1                                     1.114
MO1                    1
MO2                    1
MO3                    1
MO4                    1
MO5                    1
FEO                       1                                1
RAF                    1
XYL                          1
BEZ                             1
TOL                                1
EBZ                                   1
PE1        1
LOS                                                   1
VC1                                      1
PVC                                         1
EAL                                            1
STY                                               1
PST                                                  1
PP1              1
   TABLE PRDA
    BT BY SR
BTY     1
BTA  1
SRR        1
   TABLE COSTS
        LOCAL    FORGN
KWH      .5       .5
CWA      .8       .2
LAB     1.0
MNT      .3       .7
CAT      .2       .8
```

| | | |
|---|---|---|
| TIA | 1.0 | |
| ROY | | 1.0 |
| BAG | 1.0 | |
| EXA | | 1.0 |
| UTL | 1.0 | |
| CLO | 1.0 | |

TABLE DEI DOMESTIC INDONESIAN DEMAND (MT/YR) ($/MT EX PLT)

| | MX | MN | VALU |
|---|---|---|---|
| FL | | 0 | .01 |
| ET | | 0 | 0 |
| PE | 120 | 1 | 270 |
| PO | | 0 | 18 |
| PP | 32 | 0 | 230 |
| C4 | | 0 | 35 |
| MG | | 0 | 30 |
| FO | | 0 | 17 |
| XY | 5 | 0 | 49 |
| TO | 6 | 0 | 50 |
| BZ | 10 | 0 | 90 |
| EB | 1 | 0 | 88 |
| VC | 10 | 0 | 150 |
| PV | 23 | 0 | 230 |
| EA | 50 | 0 | 250 |
| SY | 5 | 0 | 200 |
| PS | 18 | 0 | 260 |
| BT | 3 | 0 | 150 |
| BY | 5 | 0 | 18 |
| SR | 5 | 0 | 265 |
| LS | | 0 | .01 |
| PF | | 0 | .01 |

TABLE DEX EXPORT DEMAND (FOB VALUE)

| | MX | MN | VALU |
|---|---|---|---|
| ET | 100 | 0 | 44 |
| PE | 16 | 0 | 250 |
| PP | 32 | 0 | 200 |
| XY | 10 | 0 | 22 |
| TO | 16 | 0 | 25 |
| VC | 25 | 0 | 125 |
| PV | 50 | 0 | 210 |
| EA | 50 | 0 | 200 |
| SY | 45 | 0 | 180 |
| PS | 70 | 0 | 235 |
| BT | 10 | 0 | 130 |
| SR | 20 | 0 | 250 |

TABLE INT INTEGER VARIABLES AND COST

| | SC | AR | LD | OX | PC | EH | SE | PY | PL |
|---|---|---|---|---|---|---|---|---|---|
| MINSIZE | 200 | 10 | 100 | 40 | 20 | 10 | 20 | 20 | 15 |
| MAXSIZE | 1500 | 200 | 300 | 200 | 200 | 100 | 200 | 200 | 99 |
| INTCOS | 100 | 166 | 500 | 250 | 290 | 558 | 180 | 180 | 400 |
| VARCOS | 40 | 108 | 185 | 160 | 156 | 167 | 85 | 85 | 200 |

TABLE COSCNV COST CONVERSION FACTORS

| | KWH | BAG | CWA | STM | BFW | CLO |
|---|---|---|---|---|---|---|
| CF | .02 | 1 | 1 | 1 | 1. | 70 |

TABLE PROF

| | FCT |
|---|---|
| 1 | .0001 |
| 2 | .0011 |
| 3 | .01 |
| 4 | .2 |
| 5 | .3 |
| 6 | .4 |

TABLE RHS

| | |
|---|---|
| | 84 |
| PEDMN | 270 |
| PEDMX | 310 |
| EADMN | 14 |
| EADMX | 15 |

```
        EAUMX        15
        EAEMN       17
        EAEMX        19
        PVDMN        54
        PVDMX        60
        PVEMN        90
        PVEMX        105
        PSDMN        36
        PSDMX        40
        PSEMN        108
        PSEMX        120
        PPDMN        14
        PPDMX        16
 *   ROWS                COLUMNS NEED 2 CHARACTER NANE(PA)
 *  (PR)E(MF)            ENTRIES HERE MUST HAVE AN ENTRY IN
 *    AND                TABLE DEI OR DEX IN ORDER TO
 *  (PR)D(MF)            GENERATE THE ROW IN FORM ROW ID
 *  (FED)(MF)
      FORM TABLE PRD ((XX),(YYY))= TABLE PRDA ((XX),(YYY))
              FOR XX=TABLE PRDA (=,)  FOR YYY=TABLE PRDA (,=)
MAGEN  COPY
 NAME          INDO/WBX
 ROWS
      FORM ROW ID
          PROF(O)          =OBJ
          (FED)COST        =MAX
          INV(PU)          =MAX
          (COS)            =MAX
          (REV)            =MAX  FOR REV=DEI,DEX
          LIM(PU)          =MAX    WHEN TABLE INT ((PU),INTCOS)
          (FED)(MF)        =(MNF/MF) WHEN TABLE FD((MF),(FED))
          CP(R)(PU)        =(MNF/R) WHEN TABLE CAP(CP(R),(PU))
                              EXCEPT TABLE INT ((PU),INTCOS)
          CPM(PU)          = MAX   WHEN TABLE INT ((PU),INTCOS)
          (PR)BA           =MAX
          (STR)BA          =MAX
          REV(PR)(REV)     =MAX  WHEN TABLE (REV)(VALU,(PR))
                            FOR REV=DEI,DEX
          (PR)(X/REV)(MF)=(MNF/MF)  WHEN TABLE (REV) ((MF),(PR))
                                    FOR X=D,E   FOR REV=DEI,DEX
          BEZMX            =MAX
      COPY
 COLUMNS
      FORM VECTOR BEZPUR
          BEZCOST          =94.0
          BEZBA            =-1
          BEZMX            =1
      FORM VECTOR (COS)TR EXCEPT COS=FUL
          PROF(O)          =1.0    EXCEPT COS=INV
          PROF(O)          =TABLE PROF(FCT,(O)) WHEN COS=INV
          (COS)            =-1.0  EXCEPT TABLE COSCNV((COS),CF)
          (COS)            =-1.0/TABLE COSCNV((COS),CF)
                            WHEN TABLE COSCNV((COS),CF)
      FORM VECTOR TR(FED)COS
          PROF(O)          =1.0
          (FED)COST        =-1.0
      FORM VECTOR (PU)INVTR
          INV(PU)          =-1.0
          INV              =1.0
      FORM SECTION (REV) FOR REV=DEX,DEI
      FORM VECTOR (REV)(PR)TR  WHEN TABLE (REV) (VALU,(PR))
          REV(PR)(REV)     = 1.0
          (REV)            =-1
      FORM SECTION,END
      FORM VECTOR (REV)TR  FOR REV=DEX,DEI
          (REV)            = 1
```

```
        PROF(U)          =-1
    FORM VECTOR (PU)INT   WHEN TABLE INT((PU),INTCOS)
        LIM(PU)          = TABLE INT ((PU),MINSIZE)-
                           TABLE INT ((PU),MAXSIZE)
        CPM(PU)          =-TABLE INT ((PU),MINSIZE)
        INV(PU)          = TABLE INT ((PU),INTCOS)*
                           TABLE INT ((PU),MINSIZE)
    FORM VECTOR (PU)VAR  WHEN TABLE INT ((PU),VARCOS)
        LIM(PU)          = 1
        CPM(PU)          =-1
        INV(PU)          = TABLE INT ((PU),VARCOS)
    FORM SECTION (PU)
    FORM VECTOR(FED)(PU)  FOR FED=TABLE(PU)(=,)
        (FED)COST        =TABLE FD(FECOST,(FED))
        (COS)            =TABLE (PU)((FED),(COS))EXCEPT COS=INV
        (FED)(MF)        =1.0 WHEN TABLE FD((MF),(FED))
                          WHEN PU=GS
        INV(PU)          =TABLE(PU)((FED),INV)*TABLE(PU)((FED),CPM)
                          EXCEPT TABLE INT((PU),INTCOS)
        (CAP)(PU)        =TABLE(PU)((FED),(CAP))
                          WHEN TABLE CAP((CAP),(PU))
                            EXCEPT TABLE INT ((PU),INTCOS)
        CPM(PU)          = TABLE (PU) ((FED),CPM)
                            WHEN TABLE INT ((PU),INTCOS)
        (STR)BA          =-TABLE(PU)((FED),(STR))
                          WHEN TABLE (PU)((FED),(STR))
        (FED)BA          =1.0 EXCEPT PU=GS
    FORM SECTION,END
    FORM VECTOR(PR)(STR) WHEN TABLE PRD((PR),(STR))
        (STR)BA          =1.0
        FUL              =-TABLE PRD(PF,(STR)) WHEN PR=PF
        (PR)BA           =-1.0
    FORM VECTOR EXP(PR) WHEN TABLE DEX (VALU,(PR))
        (PR)BA           = 1
        REV(PR)DEX       =-TABLE DEX(VALU,(PR))
        (PR)E(MF)        = 1  WHEN TABLE DEX ((MF),(PR))
    FORM VECTOR DOM(PR) WHEN TABLE DEI (VALU,(PR))
        (PR)BA           = 1
        REV(PR)DEI       =-TABLE DEI (VALU,(PR))
        (PR)D(MF)        = 1  WHEN TABLE DEI ((MF),(PR))
    COPY
RHS
    FORM VECTOR (PA)       FOR PA=TABLE RHS(=,)
        (FED)(MF)        =TABLE FD((MF),(FED))
                          EXCEPT TABLE RHS((FED),(PA))
        (FED)(MF)        =TABLE RHS ((PA),(FED)(MF))
        CP(R)(PU)        =TABLE CAP(CP(R),(PU))
                          EXCEPT TABLE INT((PU),INTCOS)
        (PR)E(MF)        = TABLE DEX ((MF),(PR))
                           EXCEPT TABLE RHS ((PA),(PR)E(MF))
        (PR)E(MF)        = TABLE RHS ((PA),(PR)E(MF))
        (PR)D(MF)        = TABLE DEI ((MF),(PR))
                           EXCEPT TABLE RHS ((PA),(PR)D(MF))
        (PR)D(MF)        = TABLE RHS ((PA),(PR)D(MF))
        BEZMX            =126.0
    COPY
BOUNDS
    FORM BOUNDS BND1
        (PU)INT,BV       = 1.0  WHEN TABLE INT ((PU),INTCOS)
    COPY
ENDATA
    SAVE
    END,L
NAME          INDO/WBK
ROWS
 N  PROF1
 N  PROF2
```

```
N  PROF2
N  PROF3
N  PROF4
N  PROF5
N  PROF6
L  METCOST
L  ETHCOST
L  PROCOST
L  BUTCOST
L  NAPCOST
L  GAOCOST
L  BEZCOST
L  INVGS
L  INVSC
L  INVDU
L  INVAR
L  INVLD
L  INVOX
L  INVPC
L  INVEH
L  INVSE
L  INVPY
L  INVPL
L  INVBU
L  INVSB
L  KWH
L  BFW
L  STM
L  CWA
L  LAB
L  MNT
L  CAT
L  ITX
L  ROY
L  FUL
L  BAG
L  EXA
L  UTL
L  INV
L  CLO
L  DEI
L  DEX
L  LIMSC
L  LIMAR
L  LIMLD
L  LIMOX
L  LIMPC
L  LIMEH
L  LIMSE
L  LIMPY
L  LIMPL
L  METMX
G  METMN
L  ETHMX
G  ETHMN
L  PROMX
G  PROMN
L  BUTMX
G  BUTMN
L  NAPMX
G  NAPMN
L  GAOMX
G  GAOMN
L  CPMGS
L  CPMDU
L  CPMBU
```

| | |
|---|---|
| G | CPNGS |
| G | CPNDU |
| G | CPNBU |
| L | CPMSC |
| L | CPMAR |
| L | CPMLD |
| L | CPMOX |
| L | CPMPC |
| L | CPMEH |
| L | CPMSE |
| L | CPMPY |
| L | CPMPL |
| L | FLBA |
| L | ETBA |
| L | PEBA |
| L | POBA |
| L | PPBA |
| L | C4BA |
| L | MGBA |
| L | FOBA |
| L | XYBA |
| L | TOBA |
| L | BZBA |
| L | EBBA |
| L | VCBA |
| L | PVBA |
| L | EABA |
| L | SYBA |
| L | BTBA |
| L | LSBA |
| L | BYBA |
| L | PFBA |
| L | SRBA |
| L | PSBA |
| L | GASBA |
| L | C2HBA |
| L | C3HBA |
| L | C4MBA |
| L | MO1BA |
| L | MO2BA |
| L | MO3BA |
| L | FEOBA |
| L | RAFBA |
| L | XYLBA |
| L | BEZBA |
| L | TOLBA |
| L | EBZBA |
| L | NPABA |
| L | GOABA |
| L | PVCBA |
| L | EALBA |
| L | STYBA |
| L | PSTBA |
| L | PP1BA |
| L | MO4BA |
| L | MO5BA |
| L | PE1BA |
| L | LOSBA |
| L | VC1BA |
| L | BTYBA |
| L | BTABA |
| L | SRRBA |
| L | HYDBA |
| L | CH2BA |
| L | CH3BA |
| L | CH4BA |

```
L  C2ABA
L  REVFLDEI
L  REVETDEI
L  REVETDEX
L  REVPEDEI
L  REVPEDEX
L  REVPODEI
L  REVPPDEI
L  REVPPDEX
L  REVC4DEI
L  REVMGDEI
L  REVFODEI
L  REVXYDEI
L  REVXYDEX
L  REVTODEI
L  REVTODEX
L  REVBZDEI
L  REVEBDEI
L  REVVCDEI
L  REVVCDEX
L  REVPVDEI
L  REVPVDEX
L  REVEADEI
L  REVEADEX
L  REVSYDEI
L  REVSYDEX
L  REVBTDEI
L  REVBTDEX
L  REVLSDEI
L  REVBYDEI
L  REVPFDEI
L  REVSRDEI
L  REVSRDEX
L  REVPSDEI
L  REVPSDEX
G  FLDMN
G  ETDMN
L  ETEMX
G  ETEMN
L  PEDMX
G  PEDMN
L  PEEMX
G  PEEMN
G  PODMN
L  PPDMX
G  PPDMN
L  PPEMX
G  PPEMN
G  C4DMN
G  MGDMN
G  FODMN
L  XYDMX
G  XYDMN
L  XYEMX
G  XYEMN
L  TODMX
G  TODMN
L  TOEMX
G  TOEMN
L  BZDMX
G  BZDMN
L  EBDMX
G  EBDMN
L  VCDMX
G  VCDMN
L  VCEMX
G  VCEMN
```

```
 G  VCEMN
 L  PVDMX
 G  PVDMN
 L  PVEMX
 G  PVEMN
 L  EADMX
 G  EADMN
 L  EAEMX
 G  EAEMN
 L  SYDMX
 G  SYDMN
 L  SYEMX
 G  SYEMN
 L  BTDMX
 G  BTDMN
 L  BTEMX
 G  BTEMN
 G  LSDMN
 L  BYDMX
 G  BYDMN
 G  PFDMN
 L  SRDMX
 G  SRDMN
 L  SREMX
 G  SREMN
 L  PSDMX
 G  PSDMN
 L  PSEMX
 G  PSEMN
 L  BEZMX
COLUMNS
    BEZPUR    BEZCOST      94.00000
    BEZPUR    BEZBA        -1.00000
    BEZPUR    BEZMX         1.00000
    KWHTR     PROF1         1.00000
    KWHTR     PROF2         1.00000
    KWHTR     PROF3         1.00000
    KWHTR     PROF4         1.00000
    KWHTR     PROF5         1.00000
    KWHTR     PROF6         1.00000
    KWHTR     KWH         -50.00000
    BFWTR     PROF1         1.00000
    BFWTR     PROF2         1.00000
    BFWTR     PROF3         1.00000
    BFWTR     PROF4         1.00000
    BFWTR     PROF5         1.00000
    BFWTR     PROF6         1.00000
    BFWTR     BFW          -1.00000
    STMTR     PROF1         1.00000
    STMTR     PROF2         1.00000
    STMTR     PROF3         1.00000
    STMTR     PROF4         1.00000
    STMTR     PROF5         1.00000
    STMTR     PROF6         1.00000
    STMTR     STM          -1.00000
    CWATR     PROF1         1.00000
    CWATR     PROF2         1.00000
    CWATR     PROF3         1.00000
    CWATR     PROF4         1.00000
    CWATR     PROF5         1.00000
    CWATR     PROF6         1.00000
    CWATR     CWA          -1.00000
    LABTR     PROF1         1.00000
    LABTR     PROF2         1.00000
    LABTR     PROF3         1.00000
    LABTR     PROF4         1.00000
    LABTR     PROF5         1.00000
```

| | | |
|---|---|---|
| LABTR | PROF5 | 1.00000 |
| LABTR | PROF6 | 1.00000 |
| LABTR | LAB | -1.00000 |
| MNTTR | PROF1 | 1.00000 |
| MNTTR | PROF2 | 1.00000 |
| MNTTR | PROF3 | 1.00000 |
| MNTTR | PROF4 | 1.00000 |
| MNTTR | PROF5 | 1.00000 |
| MNTTR | PROF6 | 1.00000 |
| MNTTR | MNT | -1.00000 |
| CATTR | PROF1 | 1.00000 |
| CATTR | PROF2 | 1.00000 |
| CATTR | PROF3 | 1.00000 |
| CATTR | PROF4 | 1.00000 |
| CATTR | PROF5 | 1.00000 |
| CATTR | PROF6 | 1.00000 |
| CATTR | CAT | -1.00000 |
| ITXTR | PROF1 | 1.00000 |
| ITXTR | PROF2 | 1.00000 |
| ITXTR | PROF3 | 1.00000 |
| ITXTR | PROF4 | 1.00000 |
| ITXTR | PROF5 | 1.00000 |
| ITXTR | PROF6 | 1.00000 |
| ITXTR | ITX | -1.00000 |
| ROYTR | PROF1 | 1.00000 |
| ROYTR | PROF2 | 1.00000 |
| ROYTR | PROF3 | 1.00000 |
| ROYTR | PROF4 | 1.00000 |
| ROYTR | PROF5 | 1.00000 |
| ROYTR | PROF6 | 1.00000 |
| ROYTR | ROY | -1.00000 |
| BAGTR | PROF1 | 1.00000 |
| BAGTR | PROF2 | 1.00000 |
| BAGTR | PROF3 | 1.00000 |
| BAGTR | PROF4 | 1.00000 |
| BAGTR | PROF5 | 1.00000 |
| BAGTR | PROF6 | 1.00000 |
| BAGTR | BAG | -1.00000 |
| EXATR | PROF1 | 1.00000 |
| EXATR | PROF2 | 1.00000 |
| EXATR | PROF3 | 1.00000 |
| EXATR | PROF4 | 1.00000 |
| EXATR | PROF5 | 1.00000 |
| EXATR | PROF6 | 1.00000 |
| EXATR | EXA | -1.00000 |
| UTLTR | PROF1 | 1.00000 |
| UTLTR | PROF2 | 1.00000 |
| UTLTR | PROF3 | 1.00000 |
| UTLTR | PROF4 | 1.00000 |
| UTLTR | PROF5 | 1.00000 |
| UTLTR | PROF6 | 1.00000 |
| UTLTR | UTL | -1.00000 |
| INVTR | PROF1 | .00010 |
| INVTR | PROF2 | .00110 |
| INVTR | PROF3 | .01000 |
| INVTR | PROF4 | .20000 |
| INVTR | PROF5 | .30000 |
| INVTR | PROF6 | .40000 |
| INVTR | INV | -1.00000 |
| CLOTR | PROF1 | 1.00000 |
| CLOTR | PROF2 | 1.00000 |
| CLOTR | PROF3 | 1.00000 |
| CLOTR | PROF4 | 1.00000 |
| CLOTR | PROF5 | 1.00000 |
| CLOTR | PROF6 | 1.00000 |
| CLOTR | CLO | -.01429 |
| TRMETCOS | PROF1 | 1.00000 |

| | | |
|---|---|---|
| TRMETCOS | PROF2 | 1.00000 |
| TRMETCOS | PROF3 | 1.00000 |
| TRMETCOS | PROF4 | 1.00000 |
| TRMETCOS | PROF5 | 1.00000 |
| TRMETCOS | PROF6 | 1.00000 |
| TRMETCOS | METCOST | -1.00000 |
| TRETHCOS | PROF1 | 1.00000 |
| TRETHCOS | PROF2 | 1.00000 |
| TRETHCOS | PROF3 | 1.00000 |
| TRETHCOS | PROF4 | 1.00000 |
| TRETHCOS | PROF5 | 1.00000 |
| TRETHCOS | PROF6 | 1.00000 |
| TRETHCOS | ETHCOST | -1.00000 |
| TRPROCOS | PROF1 | 1.00000 |
| TRPROCOS | PROF2 | 1.00000 |
| TRPROCOS | PROF3 | 1.00000 |
| TRPROCOS | PROF4 | 1.00000 |
| TRPROCOS | PROF5 | 1.00000 |
| TRPROCOS | PROF6 | 1.00000 |
| TRPROCOS | PROCOST | -1.00000 |
| TRBUTCOS | PROF1 | 1.00000 |
| TRBUTCOS | PROF2 | 1.00000 |
| TRBUTCOS | PROF3 | 1.00000 |
| TRBUTCOS | PROF4 | 1.00000 |
| TRBUTCOS | PROF5 | 1.00000 |
| TRBUTCOS | PROF6 | 1.00000 |
| TRBUTCOS | BUTCOST | -1.00000 |
| TRNAPCOS | PROF1 | 1.00000 |
| TRNAPCOS | PROF2 | 1.00000 |
| TRNAPCOS | PROF3 | 1.00000 |
| TRNAPCOS | PROF4 | 1.00000 |
| TRNAPCOS | PROF5 | 1.00000 |
| TRNAPCOS | PROF6 | 1.00000 |
| TRNAPCOS | NAPCOST | -1.00000 |
| TRGAOCOS | PROF1 | 1.00000 |
| TRGAOCOS | PROF2 | 1.00000 |
| TRGAOCOS | PROF3 | 1.00000 |
| TRGAOCOS | PROF4 | 1.00000 |
| TRGAOCOS | PROF5 | 1.00000 |
| TRGAOCOS | PROF6 | 1.00000 |
| TRGAOCOS | GAOCOST | -1.00000 |
| TRBEZCOS | PROF1 | 1.00000 |
| TRBEZCOS | PROF2 | 1.00000 |
| TRBEZCOS | PROF3 | 1.00000 |
| TRBEZCOS | PROF4 | 1.00000 |
| TRBEZCOS | PROF5 | 1.00000 |
| TRBEZCOS | PROF6 | 1.00000 |
| TRBEZCOS | BEZCOST | -1.00000 |
| GSINVTR | INVGS | -1.00000 |
| GSINVTR | INV | 1.00000 |
| SCINVTR | INVSC | -1.00000 |
| SCINVTR | INV | 1.00000 |
| DUINVTR | INVDU | -1.00000 |
| DUINVTR | INV | 1.00000 |
| ARINVTR | INVAR | -1.00000 |
| ARINVTR | INV | 1.00000 |
| LDINVTR | INVLD | -1.00000 |
| LDINVTR | INV | 1.00000 |
| OXINVTR | INVOX | -1.00000 |
| OXINVTR | INV | 1.00000 |
| PCINVTR | INVPC | -1.00000 |
| PCINVTR | INV | 1.00000 |
| EHINVTR | INVEH | -1.00000 |
| EHINVTR | INV | 1.00000 |
| SEINVTR | INVSE | -1.00000 |
| SEINVTR | INV | 1.00000 |

| | | |
|---|---|---|
| PYINVTR | INVPY | -1.00000 |
| PYINVTR | INV | 1.00000 |
| PLINVTR | INVPL | -1.00000 |
| PLINVTR | INV | 1.00000 |
| BUINVTR | INVBU | -1.00000 |
| BUINVTR | INV | 1.00000 |
| SBINVTR | INVSB | -1.00000 |
| SBINVTR | INV | 1.00000 |
| DEXETTR | REVETDEX | 1.00000 |
| DEXETTR | DEX | -1.00000 |
| DEXPETR | REVPEDEX | 1.00000 |
| DEXPETR | DEX | -1.00000 |
| DEXPPTR | REVPPDEX | 1.00000 |
| DEXPPTR | DEX | -1.00000 |
| DEXXYTR | REVXYDEX | 1.00000 |
| DEXXYTR | DEX | -1.00000 |
| DEXTOTR | REVTODEX | 1.00000 |
| DEXTOTR | DEX | -1.00000 |
| DEXVCTR | REVVCDEX | 1.00000 |
| DEXVCTR | DEX | -1.00000 |
| DEXPVTR | REVPVDEX | 1.00000 |
| DEXPVTR | DEX | -1.00000 |
| DEXEATR | REVEADEX | 1.00000 |
| DEXEATR | DEX | -1.00000 |
| DEXSYTR | REVSYDEX | 1.00000 |
| DEXSYTR | DEX | -1.00000 |
| DEXBTTR | REVBTDEX | 1.00000 |
| DEXBTTR | DEX | -1.00000 |
| DEXSRTR | REVSRDEX | 1.00000 |
| DEXSRTR | DEX | -1.00000 |
| DEXPSTR | REVPSDEX | 1.00000 |
| DEXPSTR | DEX | -1.00000 |
| DEIFLTR | REVFLDEI | 1.00000 |
| DEIFLTR | DEI | -1.00000 |
| DEIETTR | REVETDEI | 1.00000 |
| DEIETTR | DEI | -1.00000 |
| DEIPETR | REVPEDEI | 1.00000 |
| DEIPETR | DEI | -1.00000 |
| DEIPOTR | REVPODEI | 1.00000 |
| DEIPOTR | DEI | -1.00000 |
| DEIPPTR | REVPPDEI | 1.00000 |
| DEIPPTR | DEI | -1.00000 |
| DEIC4TR | REVC4DEI | 1.00000 |
| DEIC4TR | DEI | -1.00000 |
| DEIMGTR | REVMGDEI | 1.00000 |
| DEIMGTR | DEI | -1.00000 |
| DEIFOTR | REVFODEI | 1.00000 |
| DEIFOTR | DEI | -1.00000 |
| DEIXYTR | REVXYDEI | 1.00000 |
| DEIXYTR | DEI | -1.00000 |
| DEITOTR | REVTODEI | 1.00000 |
| DEITOTR | DEI | -1.00000 |
| DEIBZTR | REVBZDEI | 1.00000 |
| DEIBZTR | DEI | -1.00000 |
| DEIEBTR | REVEBDEI | 1.00000 |
| DEIEBTR | DEI | -1.00000 |
| DEIVCTR | REVVCDEI | 1.00000 |
| DEIVCTR | DEI | -1.00000 |
| DEIPVTR | REVPVDEI | 1.00000 |
| DEIPVTR | DEI | -1.00000 |
| DEIEATR | REVEADEI | 1.00000 |
| DEIEATR | DEI | -1.00000 |
| DEISYTR | REVSYDEI | 1.00000 |
| DEISYTR | DEI | -1.00000 |
| DEIBTTR | REVBTDEI | 1.00000 |
| DEIBTTR | DEI | -1.00000 |

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|---|---|---|
| DEILSTR | REVLSDEI | 1.00000 |
| DEILSTR | DEI | -1.00000 |
| DEIBYTR | REVBYDEI | 1.00000 |
| DEIBYTR | DEI | -1.00000 |
| DEIPFTR | REVPFDEI | 1.00000 |
| DEIPFTR | DEI | -1.00000 |
| DEISRTR | REVSRDEI | 1.00000 |
| DEISRTR | DEI | -1.00000 |
| DEIPSTR | REVPSDEI | 1.00000 |
| DEIPSTR | DEI | -1.00000 |
| DEXTR | DEX | 1.00000 |
| DEXTR | PROF1 | -1.00000 |
| DEXTR | PROF2 | -1.00000 |
| DEXTR | PROF3 | -1.00000 |
| DEXTR | PROF4 | -1.00000 |
| DEXTR | PROF5 | -1.00000 |
| DEXTR | PROF6 | -1.00000 |
| DEITR | DEI | 1.00000 |
| DEITR | PROF1 | -1.00000 |
| DEITR | PROF2 | -1.00000 |
| DEITR | PROF3 | -1.00000 |
| DEITR | PROF4 | -1.00000 |
| DEITR | PROF5 | -1.00000 |
| DEITR | PROF6 | -1.00000 |
| SCINT | LIMSC | -1300.00000 |
| SCINT | CPMSC | -200.00000 |
| SCINT | INVSC | 20000.00000 |
| ARINT | LIMAR | -190.00000 |
| ARINT | CPMAR | -10.00000 |
| ARINT | INVAR | 1660.00000 |
| LDINT | LIMLD | -200.00000 |
| LDINT | CPMLD | -100.00000 |
| LDINT | INVLD | 50000.00000 |
| OXINT | LIMOX | -160.00000 |
| OXINT | CPMOX | -40.00000 |
| OXINT | INVOX | 10000.00000 |
| PCINT | LIMPC | -180.00000 |
| PCINT | CPMPC | -20.00000 |
| PCINT | INVPC | 5800.00000 |
| EHINT | LIMEH | -90.00000 |
| EHINT | CPMEH | -10.00000 |
| EHINT | INVEH | 5580.00000 |
| SEINT | LIMSE | -180.00000 |
| SEINT | CPMSE | -20.00000 |
| SEINT | INVSE | 3600.00000 |
| PYINT | LIMPY | -180.00000 |
| PYINT | CPMPY | -20.00000 |
| PYINT | INVPY | 3600.00000 |
| PLINT | LIMPL | -84.00000 |
| PLINT | CPMPL | -15.00000 |
| PLINT | INVPL | 6000.00000 |
| SCVAR | LIMSC | 1.00000 |
| SCVAR | CPMSC | -1.00000 |
| SCVAR | INVSC | 40.00000 |
| ARVAR | LIMAR | 1.00000 |
| ARVAR | CPMAR | -1.00000 |
| ARVAR | INVAR | 108.00000 |
| LDVAR | LIMLD | 1.00000 |
| LDVAR | CPMLD | -1.00000 |
| LDVAR | INVLD | 185.00000 |
| OXVAR | LIMOX | 1.00000 |
| OXVAR | CPMOX | -1.00000 |
| OXVAR | INVOX | 160.00000 |
| PCVAR | LIMPC | 1.00000 |
| PCVAR | CPMPC | -1.00000 |
| PCVAR | INVPC | 156.00000 |

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|---|---|---|
| EHVAR | LIMEH | 1.00000 |
| EHVAR | CPMEH | -1.00000 |
| EHVAR | INVEH | 167.00000 |
| SEVAR | LIMSE | 1.00000 |
| SEVAR | CPMSE | -1.00000 |
| SEVAR | INVSE | 85.00000 |
| PYVAR | LIMPY | 1.00000 |
| PYVAR | CPMPY | -1.00000 |
| PYVAR | INVPY | 85.00000 |
| PLVAR | LIMPL | 1.00000 |
| PLVAR | CPMPL | -1.00000 |
| PLVAR | INVPL | 200.00000 |
| METGS | METCOST | 21.00000 |
| METGS | METMX | 1.00000 |
| METGS | METMN | 1.00000 |
| METGS | INVGS | 1.10000 |
| METGS | CPMGS | 1.00000 |
| METGS | CPNGS | 1.00000 |
| METGS | GASBA | -1.15000 |
| ETHGS | ETHCOST | 18.00000 |
| ETHGS | ETHMX | 1.00000 |
| ETHGS | ETHMN | 1.00000 |
| ETHGS | INVGS | 1.20000 |
| ETHGS | CPMGS | 1.00000 |
| ETHGS | CPNGS | 1.00000 |
| ETHGS | CH2BA | -1.00000 |
| PROGS | PROCOST | 18.30000 |
| PROGS | PROMX | 1.00000 |
| PROGS | PROMN | 1.00000 |
| PROGS | INVGS | 1.30000 |
| PROGS | CPMGS | 1.00000 |
| PROGS | CPNGS | 1.00000 |
| PROGS | CH3BA | -1.00000 |
| BUTGS | BUTCOST | 19.50000 |
| BUTGS | BUTMX | 1.00000 |
| BUTGS | BUTMN | 1.00000 |
| BUTGS | INVGS | 1.40000 |
| BUTGS | CPMGS | 1.00000 |
| BUTGS | CPNGS | 1.00000 |
| BUTGS | CH4BA | -1.00000 |
| NAPGS | NAPCOST | 25.00000 |
| NAPGS | NAPMX | 1.00000 |
| NAPGS | NAPMN | 1.00000 |
| NAPGS | INVGS | 1.50000 |
| NAPGS | CPMGS | 1.00000 |
| NAPGS | CPNGS | 1.00000 |
| NAPGS | GASBA | -.10500 |
| NAPGS | NPABA | -.90000 |
| GAOGS | GAOCOST | 30.00000 |
| GAOGS | GAOMX | 1.00000 |
| GAOGS | GAOMN | 1.00000 |
| GAOGS | INVGS | 1.60000 |
| GAOGS | CPMGS | 1.00000 |
| GAOGS | CPNGS | 1.00000 |
| GAOGS | GOABA | -1.00000 |
| CH2SC | KWH | 110.00000 |
| CH2SC | LAB | .25000 |
| CH2SC | MNT | 4.50000 |
| CH2SC | CAT | .83500 |
| CH2SC | ITX | .90000 |
| CH2SC | ROY | .50000 |
| CH2SC | FUL | .43000 |
| CH2SC | EXA | 2.02000 |
| CH2SC | CPMSC | 1.00000 |
| CH2SC | GASBA | -.19600 |
| CH2SC | C3HBA | -.02920 |

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|---|---|---|
| CH2SC | C4MBA | -.01910 |
| CH2SC | MO1BA | -.02790 |
| CH2SC | C2XBA | -.76200 |
| CH2SC | CH2BA | 1.00000 |
| CH3SC | KWH | 64.00000 |
| CH3SC | LAB | .13900 |
| CH3SC | MNT | 1.50000 |
| CH3SC | CAT | .46000 |
| CH3SC | ITX | .45000 |
| CH3SC | ROY | .40000 |
| CH3SC | FUL | .45000 |
| CH3SC | EXA | 1.11000 |
| CH3SC | CPMSC | 1.00000 |
| CH3SC | GASBA | -.36300 |
| CH3SC | C3HBA | -.17100 |
| CH3SC | C4MBA | -.04560 |
| CH3SC | MO2BA | -.06000 |
| CH3SC | FEOBA | -.01230 |
| CH3SC | C2XBA | -.42200 |
| CH3SC | CH3BA | 1.00000 |
| CH4SC | KWH | 61.00000 |
| CH4SC | LAB | .13250 |
| CH4SC | MNT | 1.55000 |
| CH4SC | CAT | .44000 |
| CH4SC | ITX | .46500 |
| CH4SC | ROY | .30000 |
| CH4SC | FUL | .48000 |
| CH4SC | EXA | 1.06000 |
| CH4SC | CPMSC | 1.00000 |
| CH4SC | GASBA | -.30500 |
| CH4SC | C3HBA | -.20850 |
| CH4SC | C4MBA | -.09820 |
| CH4SC | MO3BA | -.03700 |
| CH4SC | FEOBA | -.00490 |
| CH4SC | C2XBA | -.40100 |
| CH4SC | CH4BA | 1.00000 |
| NPASC | KWH | 48.00000 |
| NPASC | LAB | .10000 |
| NPASC | MNT | 1.44000 |
| NPASC | CAT | .51000 |
| NPASC | ITX | .43000 |
| NPASC | ROY | .20000 |
| NPASC | FUL | .20000 |
| NPASC | EXA | .82000 |
| NPASC | CPMSC | 1.00000 |
| NPASC | GASBA | -.35100 |
| NPASC | C3HBA | -.15800 |
| NPASC | C4MBA | -.10000 |
| NPASC | FEOBA | -.04500 |
| NPASC | MO4BA | -.01400 |
| NPASC | C2XBA | -.34000 |
| NPASC | NPABA | 1.00000 |
| GOASC | KWH | 58.00000 |
| GOASC | LAB | .08600 |
| GOASC | MNT | 1.70000 |
| GOASC | CAT | .61000 |
| GOASC | ITX | .52000 |
| GOASC | ROY | .10000 |
| GOASC | FUL | .24000 |
| GOASC | EXA | .99000 |
| GOASC | CPMSC | 1.00000 |
| GOASC | GASBA | -.38200 |
| GOASC | C3HBA | -.11600 |
| GOASC | C4MBA | -.04000 |
| GOASC | FEOBA | -.23200 |
| GOASC | MO5BA | -.11500 |

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|---|---|---|
| GOASC | C2XBA | -.29400 |
| GOASC | GOABA | 1.00000 |
| C2XDU | CPMDU | 1.00000 |
| C2XDU | CPNDU | 1.00000 |
| C2XDU | C2HBA | -1.00000 |
| C2XDU | C2XBA | 1.00000 |
| MO1AR | LAB | 6.00000 |
| MO1AR | MNT | 5.00000 |
| MO1AR | CAT | 6.00000 |
| MO1AR | ITX | 2.00000 |
| MO1AR | ROY | .75000 |
| MO1AR | FUL | .20000 |
| MO1AR | UTL | 30.00000 |
| MO1AR | CPMAR | 1.00000 |
| MO1AR | RAFBA | -.40000 |
| MO1AR | XYLBA | -.10000 |
| MO1AR | BEZBA | -.30000 |
| MO1AR | TOLBA | -.10000 |
| MO1AR | EBZBA | -.10000 |
| MO1AR | MO1BA | 1.00000 |
| MO2AR | LAB | 6.30000 |
| MO2AR | MNT | 5.40000 |
| MO2AR | CAT | 6.50000 |
| MO2AR | ITX | 2.10000 |
| MO2AR | ROY | .77000 |
| MO2AR | FUL | .20000 |
| MO2AR | UTL | 31.40000 |
| MO2AR | CPMAR | 1.00000 |
| MO2AR | RAFBA | -.43000 |
| MO2AR | XYLBA | -.09000 |
| MO2AR | BEZBA | -.28500 |
| MO2AR | TOLBA | -.19000 |
| MO2AR | EBZBA | -.00500 |
| MO2AR | MO2BA | 1.00000 |
| MO3AR | LAB | 6.70000 |
| MO3AR | MNT | 8.30000 |
| MO3AR | CAT | 6.90000 |
| MO3AR | ITX | 3.30000 |
| MO3AR | ROY | 1.18000 |
| MO3AR | FUL | .20000 |
| MO3AR | UTL | 34.80000 |
| MO3AR | CPMAR | 1.00000 |
| MO3AR | RAFBA | -.36800 |
| MO3AR | XYLBA | -.10000 |
| MO3AR | BEZBA | -.31600 |
| MO3AR | TOLBA | -.21000 |
| MO3AR | EBZBA | -.00600 |
| MO3AR | MO3BA | 1.00000 |
| MO4AR | LAB | 1.00000 |
| MO4AR | MNT | 1.20000 |
| MO4AR | CAT | 1.00000 |
| MO4AR | ITX | .50000 |
| MO4AR | ROY | .20000 |
| MO4AR | FUL | .20000 |
| MO4AR | UTL | 4.90000 |
| MO4AR | CPMAR | 1.00000 |
| MO4AR | RAFBA | -.83000 |
| MO4AR | XYLBA | -.03000 |
| MO4AR | BEZBA | -.08000 |
| MO4AR | TOLBA | -.05000 |
| MO4AR | EBZBA | -.00100 |
| MO4AR | MO4BA | 1.00000 |
| MO5AR | LAB | .80000 |
| MO5AR | MNT | 1.00000 |
| MO5AR | CAT | .80000 |
| MO5AR | ITX | .40000 |

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|---|---|---|
| MOSAR | ROY | .20000 |
| MOSAR | FUL | .20000 |
| MOSAR | UTL | 4.00000 |
| MOSAR | CPMAR | 1.00000 |
| MOSAR | RAFBA | -.80000 |
| MOSAR | XYLBA | -.03000 |
| MOSAR | BEZBA | -.10000 |
| MOSAR | TOLBA | -.07000 |
| MOSAR | MOSBA | 1.00000 |
| C2HLD | LAB | 2.20000 |
| C2HLD | MNT | 20.00000 |
| C2HLD | CAT | .90000 |
| C2HLD | ROY | 11.00000 |
| C2HLD | EXA | 8.84000 |
| C2HLD | UTL | 30.00000 |
| C2HLD | CPMLD | 1.00000 |
| C2HLD | PE1BA | -.92500 |
| C2HLD | LOSBA | -.07500 |
| C2HLD | C2HBA | 1.00000 |
| C2HOX | KWH | 1305.00000 |
| C2HOX | LAB | 3.30000 |
| C2HOX | MNT | 9.13000 |
| C2HOX | CAT | 1.80000 |
| C2HOX | ROY | 6.10000 |
| C2HOX | EXA | 9.90000 |
| C2HOX | UTL | 5.30000 |
| C2HOX | CLO | 1.10000 |
| C2HOX | CPMOX | 1.00000 |
| C2HOX | VC1BA | -2.05000 |
| C2HOX | C2HBA | 1.00000 |
| VC1PC | LAB | 2.65000 |
| VC1PC | MNT | 10.70000 |
| VC1PC | CAT | 18.20000 |
| VC1PC | ROY | 1.15000 |
| VC1PC | EXA | 10.60000 |
| VC1PC | UTL | 10.50000 |
| VC1PC | CPMPC | 1.00000 |
| VC1PC | PVCBA | -.95000 |
| VC1PC | VC1BA | 1.00000 |
| C2HEH | KWH | 88.80000 |
| C2HEH | CWA | .68000 |
| C2HEH | LAB | 2.05000 |
| C2HEH | MNT | 10.30000 |
| C2HEH | CAT | 5.16000 |
| C2HEH | ITX | 4.10000 |
| C2HEH | ROY | 1.00000 |
| C2HEH | FUL | .34000 |
| C2HEH | EXA | 6.85000 |
| C2HEH | UTL | 1.36000 |
| C2HEH | CPMEH | 1.00000 |
| C2HEH | EALBA | -1.55000 |
| C2HEH | C2HBA | 1.00000 |
| C2HSE | LAB | 2.75000 |
| C2HSE | MNT | 6.60000 |
| C2HSE | CAT | 1.00000 |
| C2HSE | ITX | 1.80000 |
| C2HSE | ROY | 1.00000 |
| C2HSE | EXA | 11.10000 |
| C2HSE | UTL | 35.20000 |
| C2HSE | CPMSE | 1.00000 |
| C2HSE | BEZBA | 2.78000 |
| C2HSE | STYBA | -3.71000 |
| C2HSE | HYDBA | -.07100 |
| C2HSE | C2HBA | 1.00000 |
| EBZSE | LAB | 1.00000 |
| EBZSE | MNT | 3.00000 |

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|---|---|---|
| EBZSE | EXA | 7.50000 |
| EBZSE | UTL | 27.80000 |
| EBZSE | CPMSE | 1.00000 |
| EBZSE | STYBA | -.87000 |
| EBZSE | HYDBA | -.01000 |
| EBZSE | EBZBA | 1.00000 |
| STYPY | LAB | 2.10000 |
| STYPY | MNT | 6.60000 |
| STYPY | CAT | .42000 |
| STYPY | ITX | 1.80000 |
| STYPY | ROY | 1.00000 |
| STYPY | EXA | 20.10000 |
| STYPY | UTL | 6.20000 |
| STYPY | CPMPY | 1.00000 |
| STYPY | PSTBA | -.95000 |
| STYPY | STYBA | 1.00000 |
| C3HPL | LAB | 2.50000 |
| C3HPL | MNT | 31.00000 |
| C3HPL | CAT | 1.00000 |
| C3HPL | ROY | 20.00000 |
| C3HPL | EXA | 10.00000 |
| C3HPL | UTL | 35.00000 |
| C3HPL | CPMPL | 1.00000 |
| C3HPL | PP1BA | -.90000 |
| C3HPL | LOSBA | -.10000 |
| C3HPL | C3HBA | 1.00000 |
| C4MBU | LAB | 3.80000 |
| C4MBU | MNT | 22.50000 |
| C4MBU | CAT | 4.62000 |
| C4MBU | ITX | 11.20000 |
| C4MBU | ROY | .50000 |
| C4MBU | FUL | .10000 |
| C4MBU | EXA | 10.00000 |
| C4MBU | UTL | 18.50000 |
| C4MBU | INVBU | 450.00000 |
| C4MBU | CPMBU | 1.00000 |
| C4MBU | CPNBU | 1.00000 |
| C4MBU | BTYBA | -.30000 |
| C4MBU | BTABA | -.70000 |
| C4MBU | C4MBA | 1.00000 |
| BTASB | LAB | 21.70000 |
| BTASB | MNT | 19.80000 |
| BTASB | CAT | 80.30000 |
| BTASB | EXA | 90.00000 |
| BTASB | UTL | 49.40000 |
| BTASB | INVSB | 396.00000 |
| BTASB | STYBA | .40000 |
| BTASB | SRRBA | -1.40000 |
| BTASB | BTABA | 1.00000 |
| FLGAS | GASBA | 1.00000 |
| FLGAS | FLBA | -1.00000 |
| FLC2H | C2HBA | 1.00000 |
| FLC2H | FLBA | -1.00000 |
| FLC3H | C3HBA | 1.00000 |
| FLC3H | FLBA | -1.00000 |
| FLC4M | C4MBA | 1.00000 |
| FLC4M | FLBA | -1.00000 |
| ETC2H | C2HBA | 1.00000 |
| ETC2H | ETBA | -1.00000 |
| PEPE1 | PE1BA | 1.00000 |
| PEPE1 | PEBA | -1.00000 |
| POC3H | C3HBA | 1.00000 |
| POC3H | POBA | -1.00000 |
| PPPP1 | PP1BA | 1.00000 |
| PPPP1 | PPBA | -1.00000 |
| C4C4M | C4MBA | 1.00000 |

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|---|---|---|
| C4C4M | C4BA | -1.00000 |
| MGMO1 | MO1BA | 1.00000 |
| MGMO1 | MGBA | -1.00000 |
| MGMO2 | MO2BA | 1.00000 |
| MGMO2 | MGBA | -1.00000 |
| MGMO3 | MO3BA | 1.00000 |
| MGMO3 | MGBA | -1.00000 |
| MGRAF | RAFBA | 1.00000 |
| MGRAF | MGBA | -1.00000 |
| MGMO4 | MO4BA | 1.00000 |
| MGMO4 | MGBA | -1.00000 |
| MGMO5 | MO5BA | 1.00000 |
| MGMO5 | MGBA | -1.00000 |
| FOFEO | FEOBA | 1.00000 |
| FOFEO | FOBA | -1.00000 |
| XYXYL | XYLBA | 1.00000 |
| XYXYL | XYBA | -1.00000 |
| TOTOL | TOLBA | 1.00000 |
| TOTOL | TOBA | -1.00000 |
| BZBEZ | BEZBA | 1.00000 |
| BZBEZ | BZBA | -1.00000 |
| EBEBZ | EBZBA | 1.00000 |
| EBEBZ | EBBA | -1.00000 |
| VCVC1 | VC1BA | 1.00000 |
| VCVC1 | VCBA | -1.00000 |
| PVPVC | PVCBA | 1.00000 |
| PVPVC | PVBA | -1.00000 |
| EAEAL | EALBA | 1.00000 |
| EAEAL | EABA | -1.00000 |
| SYSTY | STYBA | 1.00000 |
| SYSTY | SYBA | -1.00000 |
| BTBTA | BTABA | 1.00000 |
| BTBTA | BTBA | -1.00000 |
| LSLOS | LOSBA | 1.00000 |
| LSLOS | LSBA | -1.00000 |
| BYBTY | BTYBA | 1.00000 |
| BYBTY | BYBA | -1.00000 |
| PFGAS | GASBA | 1.00000 |
| PFGAS | FUL | -1.13000 |
| PFGAS | PFBA | -1.00000 |
| PFC2H | C2HBA | 1.00000 |
| PFC2H | FUL | -1.14900 |
| PFC2H | PFBA | -1.00000 |
| PFC3H | C3HBA | 1.00000 |
| PFC3H | FUL | -1.11500 |
| PFC3H | PFBA | -1.00000 |
| PFC4M | C4MBA | 1.00000 |
| PFC4M | FUL | -1.11400 |
| PFC4M | PFBA | -1.00000 |
| PFFEO | FEOBA | 1.00000 |
| PFFEO | FUL | -1.00000 |
| PFFEO | PFBA | -1.00000 |
| SRSRR | SRRBA | 1.00000 |
| SRSRR | SRBA | -1.00000 |
| PSPST | PSTBA | 1.00000 |
| PSPST | PSBA | -1.00000 |
| EXPET | ETBA | 1.00000 |
| EXPET | REVETDEX | -44.00000 |
| EXPET | ETEMX | 1.00000 |
| EXPET | ETEMN | 1.00000 |
| EXPPE | PEBA | 1.00000 |
| EXPPE | REVPEDEX | -250.00000 |
| EXPPE | PEEMX | 1.00000 |
| EXPPE | PEEMN | 1.00000 |
| EXPPP | PPBA | 1.00000 |
| EXPPP | REVPPDEX | -200.00000 |

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|---|---|---|
| EXPPP | PPEMX | 1.00000 |
| EXPPP | PPEMN | 1.00000 |
| EXPXY | XYBA | 1.00000 |
| EXPXY | REVXYDEX | -22.00000 |
| EXPXY | XYEMX | 1.00000 |
| EXPXY | XYEMN | 1.00000 |
| EXPTO | TOBA | 1.00000 |
| EXPTO | REVTODEX | -25.00000 |
| EXPTO | TOEMX | 1.00000 |
| EXPTO | TOEMN | 1.00000 |
| EXPVC | VCBA | 1.00000 |
| EXPVC | REVVCDEX | -125.00000 |
| EXPVC | VCEMX | 1.00000 |
| EXPVC | VCEMN | 1.00000 |
| EXPPV | PVBA | 1.00000 |
| EXPPV | REVPVDEX | -210.00000 |
| EXPPV | PVEMX | 1.00000 |
| EXPPV | PVEMN | 1.00000 |
| EXPEA | EABA | 1.00000 |
| EXPEA | REVEADEX | -200.00000 |
| EXPEA | EAEMX | 1.00000 |
| EXPEA | EAEMN | 1.00000 |
| EXPSY | SYBA | 1.00000 |
| EXPSY | REVSYDEX | -180.00000 |
| EXPSY | SYEMX | 1.00000 |
| EXPSY | SYEMN | 1.00000 |
| EXPBT | BTBA | 1.00000 |
| EXPBT | REVBTDEX | -130.00000 |
| EXPBT | BTEMX | 1.00000 |
| EXPBT | BTEMN | 1.00000 |
| EXPSR | SRBA | 1.00000 |
| EXPSR | REVSRDEX | -250.00000 |
| EXPSR | SREMX | 1.00000 |
| EXPSR | SREMN | 1.00000 |
| EXPPS | PSBA | 1.00000 |
| EXPPS | REVPSDEX | -235.00000 |
| EXPPS | PSEMX | 1.00000 |
| EXPPS | PSEMN | 1.00000 |
| DOMFL | FLBA | 1.00000 |
| DOMFL | REVFLDEI | -.01000 |
| DOMFL | FLDMN | 1.00000 |
| DOMET | ETBA | 1.00000 |
| DOMET | REVETDEI | 0.00000 |
| DOMET | ETDMN | 1.00000 |
| DOMPE | PEBA | 1.00000 |
| DOMPE | REVPEDEI | -270.00000 |
| DOMPE | PEDMX | 1.00000 |
| DOMPE | PEDMN | 1.00000 |
| DOMPO | POBA | 1.00000 |
| DOMPO | REVPODEI | -18.00000 |
| DOMPO | PODMN | 1.00000 |
| DOMPP | PPBA | 1.00000 |
| DOMPP | REVPPDEI | -230.00000 |
| DOMPP | PPDMX | 1.00000 |
| DOMPP | PPDMN | 1.00000 |
| DOMC4 | C4BA | 1.00000 |
| DOMC4 | REVC4DEI | -35.00000 |
| DOMC4 | C4DMN | 1.00000 |
| DOMMG | MGBA | 1.00000 |
| DOMMG | REVMGDEI | -30.00000 |
| DOMMG | MGDMN | 1.00000 |
| DOMFO | FOBA | 1.00000 |
| DOMFO | REVFODEI | -17.00000 |
| DOMFO | FODMN | 1.00000 |
| DOMXY | XYBA | 1.00000 |
| DOMXY | REVXYDEI | -49.00000 |

| | | | |
|---|---|---|---|
| | DOMXY | XYDMX | 1.00000 |
| | DOMXY | XYDMN | 1.00000 |
| | DOMTO | TOBA | 1.00000 |
| | DOMTO | REVTODEI | -50.00000 |
| | DOMTO | TODMX | 1.00000 |
| | DOMTO | TODMN | 1.00000 |
| | DOMBZ | BZBA | 1.00000 |
| | DOMBZ | REVBZDEI | -90.00000 |
| | DOMBZ | BZDMX | 1.00000 |
| | DOMBZ | BZDMN | 1.00000 |
| | DOMEB | EBBA | 1.00000 |
| | DOMEB | REVEBDEI | -88.00000 |
| | DOMEB | EBDMX | 1.00000 |
| | DOMEB | EBDMN | 1.00000 |
| | DOMVC | VCBA | 1.00000 |
| | DOMVC | REVVCDEI | -150.00000 |
| | DOMVC | VCDMX | 1.00000 |
| | DOMVC | VCDMN | 1.00000 |
| | DOMPV | PVBA | 1.00000 |
| | DOMPV | REVPVDEI | -230.00000 |
| | DOMPV | PVDMX | 1.00000 |
| | DOMPV | PVDMN | 1.00000 |
| | DOMEA | EABA | 1.00000 |
| | DOMEA | REVEADEI | -250.00000 |
| | DOMEA | EADMX | 1.00000 |
| | DOMEA | EADMN | 1.00000 |
| | DOMSY | SYBA | 1.00000 |
| | DOMSY | REVSYDEI | -200.00000 |
| | DOMSY | SYDMX | 1.00000 |
| | DOMSY | SYDMN | 1.00000 |
| | DOMBT | BTBA | 1.00000 |
| | DOMBT | REVBTDEI | -150.00000 |
| | DOMBT | BTDMX | 1.00000 |
| | DOMBT | BTDMN | 1.00000 |
| | DOMLS | LSBA | 1.00000 |
| | DOMLS | REVLSDEI | -.01000 |
| | DOMLS | LSDMN | 1.00000 |
| | DOMBY | BYBA | 1.00000 |
| | DOMBY | REVBYDEI | -18.00000 |
| | DOMBY | BYDMX | 1.00000 |
| | DOMBY | BYDMN | 1.00000 |
| | DOMPF | PFBA | 1.00000 |
| | DOMPF | REVPFDEI | -.01000 |
| | DOMPF | PFDMN | 1.00000 |
| | DOMSR | SRBA | 1.00000 |
| | DOMSR | REVSRDEI | -265.00000 |
| | DOMSR | SRDMX | 1.00000 |
| | DOMSR | SRDMN | 1.00000 |
| | DOMPS | PSBA | 1.00000 |
| | DOMPS | REVPSDEI | -260.00000 |
| | DOMPS | PSDMX | 1.00000 |
| | DOMPS | PSDMN | 1.00000 |
| RHS | | | |
| | 84 | METMX | 300.00000 |
| | 84 | METMN | 0.00000 |
| | 84 | ETHMX | 595.00000 |
| | 84 | ETHMN | 0.00000 |
| | 84 | PROMX | 1.00000 |
| | 84 | PROMN | 0.00000 |
| | 84 | BUTMX | 1.00000 |
| | 84 | BUTMN | 0.00000 |
| | 84 | NAPMX | 1.00000 |
| | 84 | NAPMN | 0.00000 |
| | 84 | GAOMX | 1.00000 |
| | 84 | GAOMN | 0.00000 |
| | 84 | CPMGS | 2000.00000 |

| | | |
|---|---|---|
| 84 | CPMDU | 454.00000 |
| 84 | CPMBU | 200.00000 |
| 84 | CPNGS | .10000 |
| 84 | CPNDU | 0.00000 |
| 84 | CPNBU | 0.00000 |
| 84 | ETEMX | 100.00000 |
| 84 | ETEMN | 0.00000 |
| 84 | PEEMX | 16.00000 |
| 84 | PEEMN | 0.00000 |
| 84 | PPEMX | 32.00000 |
| 84 | PPEMN | 0.00000 |
| 84 | XYEMX | 10.00000 |
| 84 | XYEMN | 0.00000 |
| 84 | TOEMX | 16.00000 |
| 84 | TOEMN | 0.00000 |
| 84 | VCEMX | 25.00000 |
| 84 | VCEMN | 0.00000 |
| 84 | SYEMX | 45.00000 |
| 84 | SYEMN | 0.00000 |
| 84 | BTEMX | 10.00000 |
| 84 | BTEMN | 0.00000 |
| 84 | SREMX | 20.00000 |
| 84 | SREMN | 0.00000 |
| 84 | PVEMX | 105.00000 |
| 84 | PVEMN | 90.00000 |
| 84 | EAEMX | 19.00000 |
| 84 | EAEMN | 17.00000 |
| 84 | PSEMX | 120.00000 |
| 84 | PSEMN | 108.00000 |
| 84 | FLDMN | 0.00000 |
| 84 | ETDMN | 0.00000 |
| 84 | PODMN | 0.00000 |
| 84 | C4DMN | 0.00000 |
| 84 | MGDMN | 0.00000 |
| 84 | FODMN | 0.00000 |
| 84 | XYDMX | 5.00000 |
| 84 | XYDMN | 0.00000 |
| 84 | TODMX | 6.00000 |
| 84 | TODMN | 0.00000 |
| 84 | BZDMX | 10.00000 |
| 84 | BZDMN | 0.00000 |
| 84 | EBDMX | 1.00000 |
| 84 | EBDMN | 0.00000 |
| 84 | VCDMX | 10.00000 |
| 84 | VCDMN | 0.00000 |
| 84 | SYDMX | 5.00000 |
| 84 | SYDMN | 0.00000 |
| 84 | BTDMX | 3.00000 |
| 84 | BTDMN | 0.00000 |
| 84 | LSDMN | 0.00000 |
| 84 | BYDMX | 5.00000 |
| 84 | BYDMN | 0.00000 |
| 84 | PFDMN | 0.00000 |
| 84 | SRDMX | 5.00000 |
| 84 | SRDMN | 0.00000 |
| 84 | PEDMX | 310.00000 |
| 84 | PEDMN | 270.00000 |
| 84 | PPDMX | 16.00000 |
| 84 | PPDMN | 14.00000 |
| 84 | PVDMX | 60.00000 |
| 84 | PVDMN | 54.00000 |
| 84 | EADMX | 15.00000 |
| 84 | EADMN | 14.00000 |
| 84 | PSDMX | 40.00000 |
| 84 | PSDMN | 36.00000 |
| 84 | BEZMX | 126.00000 |

```
BOUNDS
 BV BND1      SCINT
 BV BND1      ARINT
 BV BND1      LDINT
 BV BND1      OXINT
 BV BND1      PCINT
 BV BND1      EHINT
 BV BND1      SEINT
 BV BND1      PYINT
 BV BND1      PLINT
ENDATA
```

| ROW NAME | BEZPUR | KWHTTTTTTR | BFWRRRRRRR | SHTRRRRRRR | CWATWAABTT | LMCNATTTTT | INTXTTTTTT | IRTOYTTTTT | BEAXGTTTTT | EUTALTTTTT | ICNLVTTTTT | CTLRTTTTTT | TTRHETTTTT | TTRPTHTTTT | TTRBOTTTTT | TTRNPTTTTT | TTRAGTTTTT | TTRGAZTTTT | TGBEZCTTTT | SSINVCTTTT | CUIINVTTTT | DRIINVTTTT | DAIINVTTTT | DXIINVTTTT | OCIINVTTTT | PCIINVTTTT | EHIINVTTTT | SEIINVTTTT | PYIINVTTTT | PLIINVTTTT | BUIINVTTTT | SBIINVTTTT | DBEINVTTTT | DEEXPTTTTT | DEEXPTTTTT | DEEXPTTTTT | DEEXYTTTTT | DEEXOTTTTT | DEEXCTTTTT | DEEXVTTTTT | DEEXPTTTTT | DEEXETTTTT | DEEXSTTTTT | DEEXBTTTTT | DEEXTTTTTT | DEEXRTTTTT | DEEXSTTTTT | DEEXPTTTTT | DEEXFTTTTT | DEEXLTTTTT | DEEXTTTTTT | DEEXEPTTTT | DEEXOPTTTT | DEEXPTTTTT | DEEXP4TTTT | DEEXTTTTTT | DEEXCTTTTT | DEEXMTTTTT | DEEXGTTTTT | DEEXOTTTTT | DEEXFTTTTT | DEEXTTTTTT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROF1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROF2 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROF3 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROF4 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROF5 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROF6 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | A | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| METCOST | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETHCOST | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROCOST | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BUTCOST | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NAPCOST | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GAOCOST | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BEZCOST | C | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVGS | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVSC | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVDU | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVAR | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVLD | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVOX | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVPC | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVEH | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVSE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVPY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVPL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVBU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| INVSB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | |
| KWH | | -C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BFW | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| STM | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CWA | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LAB | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MNT | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CAT | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ITX | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ROY | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FUL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BAG | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EXA | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| UTL | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| INV | | | | | | | | | | | | | | -1 | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CLO | | | | | | | | | | | | | | | -A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DEI | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DEX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | | | | | | | | | | | | | |
| LIMSC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIMAR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIMLD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIMOX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIMPC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIMEH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIMSE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| ROW NAME \ COLUMN NAME | BEZPUR | KWHTTR | BFWTTR | STWMTR | CWAABR | LANTTR | MNTTTR | CATTTR | IRTXTR | RBOYTR | BEAGTR | EXTALR | UTNLTR | ICVOTR | CLRMETHCOS | TRRPTRCOS | TRRBNOCOS | TRRNGAPCOS | TRRGBAOCOS | TGSBIEZCOR | SCUIINVTR | DURINNVTR | ALDINNVTR | OXIINVTR | PCIINVTR | ESHINNVTR | SEYINNVTR | PPLINNVTR | BLUINNVTR | SBIINNVTR | DEXNEPTR | DEXPEPTR | DEXPYXTR | DEXTOCTR | DEXVPCTR | DEXPEVTR | DEXSAYTR | DEXBTRTR | DEXSRSTR | DEXPSLTR | DEXIFLTR | DEXIETTR | DEXIEPTR | DEXIEPTR | DEXIEPTR | DEXICPTR | DEXIMGTR | DEXIFOTR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LIMPY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIMPL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| METMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| METMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETHMX | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| ETHMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BUTMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BUTMN | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| NAPMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NAPMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GAOMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GAOMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMGS | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| CPMDU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMBU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPNGS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPNDU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPNBU | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| CPMSC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMAR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMLD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMOX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMPC | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| CPMEH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMSE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMPY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMPL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FLBA | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| ETBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PEBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| POBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PPBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C4BA | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| MGBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FOBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| XYBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BZBA | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| CBBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VCBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PVBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EABA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SYBA | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |
| BTBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LSBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BYBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PFBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SRBA | • | | | | • | | | | • | | | | | • | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • | | | | | • |

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   INDO/WBK A-MATRIX PICTURE     SEP 02, 1971                                                             PAGE NUMBER   3
ROW NAME      COLUMN NAME
              B K B S C L M C I R B E U I C T T T T T T T G S D A L O P E S P P B S D D D D D D D D D D D D D D D D D D D D
              E W F T W A N A T O A X T N L R R R R R R R S C U R D X C H E Y L U B E E E E E E E E E E E E E E E E E E E E
              Z H W M A B T T X Y G A L V O M E P B N G B I I I I I I I I I I I I I X X X X X X X X X X X X I I I I I I I I
              P T T T T T T T T T T T T T T E T R U A A E N N N N N N N N N N N N N E P P X T V P E S B S P F E P P P C M F
              U R R R R R R R R R R R R R R T H O T P O Z V V V V V V V V V V V V V T E P Y O C V A Y T R S L T E O P 4 G O
              R                             C C C C C C C T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T
                                            O O O O O O O R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R
                                            S S S S S S S

   PSBA
   GASBA
   C2HBA
   C3HBA
   C4MBA      .         .         .         .         .         .         .         .         .         .         .
   MO1BA
   MO2BA
   MO3BA
   FEOBA
   RAFBA      .         .         .         .         .         .         .         .         .         .         .
   XYLBA
   BEZBA     -1
   TOLBA
   EBZBA
   NPABA      .         .         .         .         .         .         .         .         .         .         .
   GOABA
   PVCBA
   EALBA
   STYBA
   PSTBA      .         .         .         .         .         .         .         .         .         .         .
   PP1BA
   MO4BA
   MO5BA
   PE1BA
   LOSBA      .         .         .         .         .         .         .         .         .         .         .
   VC1BA
   BTYBA
   BTABA
   SRRBA
   HYDBA      .         .         .         .         .         .         .         .         .         .         .
   CH2BA
   CH3BA
   CH4BA
   C2XBA
   REVFLDEI   .         .         .         .         .         .         .         .         .         .   1     .
   REVETDEI                                                                                                   1
   REVETDEX                                                                         1
   REVPEDEI                                                                                                     1
   REVPEDEX                                                                           1
   REVPODEI   .         .         .         .         .         .         .         .         .         .         1
   REVPPDEI                                                                                                         1
   REVPPDEX                                                                             1
   REVC4DEI                                                                                                           1
   REVMGDEI                                                                                                             1
   REVFODEI   .         .         .         .         .         .         .         .         .         .         .       1
   REVXYDEI
   REVXYDEX                                                                               1
   REVTODEI
   REVTODEX                                                                                 1
   REVBZDEI   .         .         .         .         .         .         .         .         .         .         .
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ROW NAME      COLUMN NAME
              B K B S C L N C I R B E U I C T T T T T T T G S D A L O P E S P P B S D D D D D D D D D D D D D D D D D D D D
              E W F T W A N A T O A X T N L R R R R R R R S C U R D X C H E Y L U B E E E E E E E E E E E E E E E E E E E E
              Z H W M A B T T X Y G A L V O H E P B N G B I I I I I I I I I I I I I X X X X X X X X X X X X I I I I I I I I
              P T Y T T T T T T T T T T T T E T R U A A E N N N N N N N N N N N N N E P P X T V P E S B S P F E P P P C M F
              U R R R R R R R R R R R R R R T H O T P O Z V V V V V V V V V V V V V T E P Y O C V A Y T R S L T E O P 4 G O
              R                             C C C C C C C T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T
                                            O O O O O O O R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R
                                            S S S S S S S


  REVEBDEI
  REVVCDEI
  REVVCDEX                                                                                    1
  REVPVDEI
  REVPVDEX    .         .         .         .         .         .         .         .         . 1       .         .
  REVEADEI
  REVEADEX                                                                                        1
  REVSYDEI
  REVSYDEX                                                                                          1
  REVBTDEI    .         .         .         .         .         .         .         .         .         .         .
  REVBTDEX                                                                                            1
  REVLSDEI
  REVBYDEI
  REVPFDEI
  REVSRDEI    .         .         .         .         .         .         .         .         .         .         .
  REVSRDEX                                                                                              1
  REVPSDEI
  REVPSDEX                                                                                                1
  FLDMN
  ETDMN       .         .         .         .         .         .         .         .         .         .         .
  ETEMX
  ETEMN
  PEDMX
  PEDMN
  PEEMX       .         .         .         .         .         .         .         .         .         .         .
  PEEMN
  PODMN
  PPDMX
  PPDMN
  PPEMX       .         .         .         .         .         .         .         .         .         .         .
  PPEMN
  C4DMN
  MGDMN
  FODMN
  XYDMX       .         .         .         .         .         .         .         .         .         .         .
  XYDMN
  XYEMX
  XYEMN
  TODMX
  TODMN       .         .         .         .         .         .         .         .         .         .         .
  TOEMX
  TOEMN
  BZDMX
  BZDMN
  EBDMX       .         .         .         .         .         .         .         .         .         .         .
  EBDMN
  VCDMX
  VCDMN
  VCEMX
  VCEMN       .         .         .         .         .         .         .         .         .         .         .
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ROW NAME      COLUMN NAME
              B K B S C L M C I R B E U I C T T T T T T T G S D A L O P E S P P B S D D D D D D D D D D D D D D D D D D D D
              E W F T W A N A T O A X T N L R R R R R R R S C U R D X C H E Y L U B E E E E E E E E E E E E E E E E E E E E
              Z H W M A B T T X Y G A L V O M E P B N G B I I I I I I I I I I I I I X X X X X X X X X X X X I I I I I I I I
              P T T T T T T T T T T T T T T E T R U A A E N N N N N N N N N N N N N E P P X T V P E S B S P F E P P P C M F
              U R R R R R R R R R R R R R R T H O T P O Z V V V V V V V V V V V V V T E P Y O C V A Y T R S L T E O P 4 G O
              R                             C C C C C C C T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T T
                                            O O O O O O O R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R R
                                            S S S S S S S

 PVDMX
 PVDMN
 PVEMX
 PVEMN
 EADMX        .         .         .         .         .         .         .         .         .         .         .
 EADMN
 EAEMX
 EAEMN
 SYDMX
 SYDMN        .         .         .         .         .         .         .         .         .         .         .
 SYEMX
 SYEMN
 BTDMX
 BTDMN
 BTEMX        .         .         .         .         .         .         .         .         .         .         .
 BTEMN
 LSDMN
 BYDMX
 BYDMN
 PFDMN        .         .         .         .         .         .         .         .         .         .         .
 SRDMX
 SRDMN
 SREMX
 SREMN
 PSDMX        .         .         .         .         .         .         .         .         .         .         .
 PSDMN
 PSEMX
 PSEMN
 BEZMX        1
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ROW NAME            COLUMN NAME
                     D D D D D D D D D D D D D D D D S A L O P E S P P S A L O P E S P P M E P B N G C C C N G C M M M M M C C V C
                     E E E E E E E E E E E E E E E E C R D X C H E Y L C R D X C H E Y L E T R U A A H H H P O 2 O O O O O 2 2 C 2
                     I I I I I I I I I I I I I I X I I I I I I I I I I V V V V V V V V V T H O T P O 2 3 4 A A X 1 2 3 4 5 H H 1 H
                     X T B E V P E S B L B P S P T T N N N N N N N N N A A A A A A A A A G G G G G G S S S S S D A A A A A L O P E
                     Y O Z B C V A Y T S Y F R S R R T T T T T T T T T R R R R R R R R R S S S S S S C C C C C U R R R R R D X C H
                     T T T T T T T T T T T T T T
                     R R R R R R R R R R R R R R


    PROF1                                           -1-1
    PROF2                                           -1-1
    PROF3                                           -1-1
    PROF4                                           -1-1
    PROF5            .         .         .      -1-1         .         .         .         .         .         .         .
    PROF6                                           -1-1
    METCOST                                                                                  C
    ETHCOST                                                                                    C
    PROCOST                                                                                      C
    BUTCOST          .         .         .         .         .         .         .         .   C     .         .         .
    NAPCOST                                                                                          C
    GAOCOST                                                                                            C
    BEZCOST
    INVGS                                                                                    J J J J J J
    INVSC            .         .         .         . F       .         C         .         .         .         .         .
    INVDU
    INVAR                                          E                 D
    INVLD                                            F                 D
    INVOX                                              F                 D
    INVPC            .         .         .         .         E         .       D .         .         .         .         .
    INVEH                                                  E                 D
    INVSE                                                    E                 C
    INVPY                                                      E                 C
    INVPL                                                        E                 D
    INVBU            .         .         .         .         .         .         .         .         .         .         .
    INVSB
    KWH                                                                                              D C C C C               E   C
    BFW
    STM
    CWA              .         .         .         .         .         .         .         .         .         .         .       B
    LAB                                                                                              A A A A A   6 6 6 1 8 2 3 2 2
    MNT                                                                                              4 J J J J   5 5 8 J 1 C 9 C C
    CAT                                                                                              B A A B B   6 6 6 1 8 B J C 5
    ITX                                                                                              B A A A B   2 2 3 B A       4
    ROY              .         .         .         .         .         .         .         .         B A A A A . B B J A A C 6 J 1
    FUL                                                                                              A A A A A   A A A A A       A
    BAG
    EXA                                                                                              2 J J B B             8 9 C 6
    UTL                                                                                                          C C C 4 4 C 5 C J
    INV              .         .         .         .         .         .         .         .         .         .         .
    CLO                                                                                                                      J
    DEI             -1-1-1-1-1-1-1-1-1-1-1-1-1-1   1
    DEX                                          1
    LIMSC                                          -E                 1
    LIMAR            .         .         .         .  -D     .         . 1       .         .         .         .         .
    LIMLD                                              -D                 1
    LIMOX                                                -D                 1
    LIMPC                                                  -D                 1
    LIMEH                                                    -C                 1
    LIMSE            .         .         .         .         .  -D     .         . 1       .         .         .         .
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ROW NAME      COLUMN NAME
              D D D D D D D D D D D D D D D D S A L O P E S P P S A L O P E S P P M E P B N G C C C N G C M M M M M C C V C
              E E E E E E E E E E E E E E E E C R D X C H E Y L C R D X C H E Y L E T R U A A H H H P O 2 0 0 0 0 0 2 2 C 2
              I I I I I I I I I I I I I I X I I I I I I I I I I V V V V V V V V V T H O T P O 2 3 4 A A X 1 2 3 4 S H H I H
              X T B E V P E S B L B P S P T T N N N N N N N N N A A A A A A A A A G G G G G G S S S S S D A A A A A L O P E
              Y O Z B C V A Y T S Y F R S R R T T T T T T T T T R R R R R R R R R S S S S S S C C C C C U R R R R R D X C H
              T T T T T T T T T T T T T T
              R R R R R R R R R R R H R R


   LIMPY                                                   -D                 1
   LIMPL                                                     -C                 1
   METMX                                                                      1
   METMN                                                                      1
   ETHMX      .         .         .         .         .         .         .         1         .         .         .
   ETHMN                                                                        1
   PROMX                                                                          1
   PROMN                                                                          1
   BUTMX                                                                            1
   BUTMN      .         .         .         .         .         .         .         .   1     .         .         .
   NAPMX                                                                              1
   NAPMN                                                                              1
   GAOMX                                                                                1
   GAOMN                                                                                1
   CPMGS      .         .         .         .         .         .         .       1 1 1 1 1 1 .         .         .
   CPMDU                                                                                                1
   CPMBU
   CPNGS                                                                      1 1 1 1 1 1
   CPNDU                                                                                                1
   CPNBU      .         .         .         .         .         .         .         .         .         .         .
   CPMSC                                     -D                -1                             1 1 1 1 1
   CPMAR                                       -C                -1                                       1 1 1 1 1
   CPMLD                                         -D                -1                                               1
   CPMOX                                           -C                -1                                               1
   CPMPC      .         .         .         .        -C         .      -1 .         .         .         .         .     1
   CPMEH                                               -C                -1                                               1
   CPMSE                                                 -C                -1
   CPMPY                                                   -C                -1
   CPMPL                                                     -C                -1
   FLBA       .         .         .         .         .         .         .         .         .         .         .
   ETBA
   PEBA
   POBA
   PPBA
   C4BA       .         .         .         .         .         .         .         .         .         .         .
   MGBA
   FOBA
   XYBA
   TOBA
   BZBA       .         .         .         .         .         .         .         .         .         .         .
   EBBA
   VCBA
   PVBA
   EABA
   SYBA       .         .         .         .         .         .         .         .         .         .         .
   BTBA
   LSBA
   BYBA
   PFBA
   SHBA       .         .         .         .         .         .         .         .         .         .         .
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ROW NAME      COLUMN NAME
              D D D D D D D D D D D D D D D D S A L O P E S P P S A L O P E S P P M E P B N G C C C N G C M M M M M C C V C
              E E E E E E E E E E E E E E E E C R D X C H E Y L C R D X C H E Y L E T R U A A H H H P O 2 O O O O O 2 2 C 2
              I I I I I I I I I I I I I I X I I I I I I I I I I V V V V V V V V V T H O T P O 2 3 4 A A X 1 2 3 4 5 H H 1 H
              X T B E V P E S B L B P S P T T N N N N N N N N N A A A A A A A A A G G G G G G S S S S S D A A A A A L O P E
              Y O Z B C V A Y T S Y F R S R R T T T T T T T T T R R R R R R R R R S S S S S S C C C C C U R R R R R D X C H
              T T T T T T T T T T T T T T
              R R R R R R R R R R R R R R


   PSBA
   GASBA                                                                         -J      -A  -A-A-A-A-A
   C2HBA                                                                                                 -1           1 1   1
   C3HBA                                                                                     -A-A-A-A-A
   C4MBA      .         .         .         .         .         .         .         .        -A-A-A-A-A .         .
   MO1BA                                                                                     -A           1
   MO2BA                                                                                       -A           1
   MO3BA                                                                                         -A           1
   FEOBA                                                                                       -A-A-A-A
   RAFBA      .         .         .         .         .         .         .         .         .         .-A-A-A-B-B
   XYLBA                                                                                                 -A-A-A-A-A
   BEZBA                                                                                                 -A-A-A-A-A
   TOLBA                                                                                                 -A-A-A-A-A
   EBZBA                                                                                                 -A-A-A-A
   NPABA      .         .         .         .         .         .         .         .    -B   .     1   .         .
   GOABA                                                                                 -1         1
   PVCBA                                                                                                                 -B
   EALBA                                                                                                                   -J
   STYBA
   PSTBA      .         .         .         .         .         .         .         .         .         .         .
   PP1BA
   MO4BA                                                                                               -A           1
   MO5BA                                                                                                 -A           1
   PE1BA                                                                                                           -B
   LOSBA      .         .         .         .         .         .         .         .         .         .         .-A
   VC1BA                                                                                                             -2 1
   BTYBA
   BTABA
   SRRBA
   HYDBA      .         .         .         .         .         .         .         .         .         .         .
   CH2BA                                                                   -1         1
   CH3BA                                                                     -1         1
   CH4BA                                                                       -1         1
   C2XBA                                                                             -B-A-A-A-A 1
   REVFLDEI   .         .         .         .         .         .         .         .         .         .         .
   REVETDEI
   REVETDEX
   REVPEDEI
   REVPEDEX
   REVPODEI   .         .         .         .         .         .         .         .         .         .         .
   REVPPDEI
   REVPPDEX
   REVC4DEI
   REVMGDEI
   REVFODEI   .         .         .         .         .         .         .         .         .         .         .
   REVXYDEI   1
   REVXYDEX
   REVTODEI     1
   REVTODEX
   REVBZDEI   .   1     .         .         .         .         .         .         .         .         .         .
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| ROW NAME | COLUMN NAME | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DEIXTTRR | DEIYTTRR | DEIZTTRR | DEIBTTRR | DEIVTTRR | DEIPTTRR | DEISTTRR | DEIBTTRR | DEILTTRR | DEIBTTRR | DEIPTTRR | DEISTTRR | DEIFTTRR | DEIRTTRR | DEISTTRR | DSCRTTRR | ALDXNNTT | ALDXNNTT | OPCHNNTT | OPCHNNTT | ESEYNNTT | ESEYNNTT | PPLCNNTT | PPLCNNTT | SALVRRRR | SALVRRRR | OPDXAARR | OPDXAARR | ESCHAARR | ESCHAARR | ESEYAARR | ESEYAARR | PPLEAARR | PPLEAARR | METRGGSS | MEPRGGSS | BNUAGGSS | BNAAGGSS | NGHMSSCC | NGHMSSCC | CHPSSSCC | CHPSSSCC |
| REVEBDEI | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVVCDEI | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVVCDEX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVPVDEI | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVPVDEX | | | | • | | | | | | • | | | | | | • | | | | | | • | | | | | | • | | | | | | • | | | | | | • | | |
| REVEADEI | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVEADEX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVSYDEI | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVSYDEX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVBTDEI | | | | • | | | 1 | | | • | | | | | | • | | | | | | • | | | | | | • | | | | | | • | | | | | | • | | |
| REVBTDEX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVLSDEI | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVBYDEI | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| REVPFDEI | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| FLDMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| PEDMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| C4DMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MGDMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FODMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| XYEMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| XYEMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TODMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TODMN | | | | • | | | | | | • | | | | | | • | | | | | | • | | | | | | • | | | | | | • | | | | | | • | | |
| TOEMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| BZDMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BZDMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| VCDMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VCDMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VCEMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| ROW NAME | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DEIXYTRR | DECRTTRR | SAIXTTRR | ALDNTTRR | OPCNTTRR | ESHNTTRR | SPEYTTRR | PPLCNTTR | SALVNTTR | ORDVNTTR | PEXVNTTR | ESCVNTTR | PPHVNTTR | MELVNTTR | EPETNTTR | BRTGGGGG | NUOGSSSS | GAPGSSSS | CAAGSSSS | CHHGSSSS | CHPGSSSS | NPHGSSSS | GOAGSSSS | CO2DUUUU | HO0AUUUU | HO0AUUUU | HO0AUUUU | HO0AUUUU | CO2HUUUU | C2HLUUUU | VC1DUUUU | C2HXUUUU |
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| PVDMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PVDMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PVEMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PVEMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| EADMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EAEMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EAEMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| SYEMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BTDMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| LSDMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BYDMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| PFDMN | • | | | | | | | | • | | | | | | | | • | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SRDMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SRDMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| PSDMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PSEMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| BEZMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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   INDO/WBK A-MATRIX PICTURE     SEP 02, 1971                                          PAGE NUMBER  11

ROW NAME      COLUMN NAME
               C E S C C B F F F F E P P P C M M M M M M F X T B E V P E S B L B P P P P P S P E E E E E E E E E E E E D D D
               2 B T 3 4 T L L L L T E O P 4 G G G G G G O Y O Z B C V A Y T S Y F F F F F R S X X X X X X X X X X X X O O O
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               S S P P B S A 2 3 4 2 E 3 P 4 0 0 0 A 0 0 E Y 0 E B C V A T T O T A 2 3 4 E R S E P P X T V P E S B S P F E P
               E E Y L U B S H H H H 1 H 1 M 1 2 3 F 4 5 0 L L Z Z 1 C L Y A S Y S H H M O R T T E P Y O C V A Y T R S L T E


   PROF1
   PROF2
   PROF3
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   PROF5       .         .         .         .         .         .         .         .         .         .         .
   PROF6
   METCOST
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   BUTCOST     .         .         .         .         .         .         .         .         .         .         .
   NAPCOST
   GAOCOST
   BEZCOST
   INVGS
   INVSC       .         .         .         .         .         .         .         .         .         .         .
   INVDU
   INVAR
   INVLD
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   INVPC       .         .         .         .         .         .         .         .         .         .         .
   INVEH
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   INVBU       .       D .         .         .         .         .         .         .         .         .         .
   INVSB                 D
   KWH
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   LAB         2 1 2 2 3 C
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   CAT         1   A 1 4 C
   ITX         J   J   C
   ROY         1   1 C B .         .         .         .         .         .         .         .         .         .
                                                                            -J-J-J-J-1
   FUL                 A
   BAG
   EXA         C 7 C C C C
   UTL         C C 6 C C C
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   LIMLD
   LIMOX
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   LIMSE       .         .         .         .         .         .         .         .         .         .         .
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| ROW NAME | CH2HZSSE | ESBTYSE | CCYHPL | CH3HPB | BHMUBS | FLAGSA | FLCCH2 | FLCCH3 | FLCCH4 | ETPEH1 | PCPOH | PCPPH1 | CH4MM1 | HGHMM2 | HGHMM3 | HGHMFA | HGHMO4 | FOEYSO | XYOYOL | TBOZLZ | EBZBZ1 | VPCVCL | PEVAPE | SYATLY | BLTSAS | BLYFSY | PPFFSH | PPFFCH | PPFFC2 | PPFFC3 | PSFSC4 | SPRSER | EPXPPT | EPXPPE | EPXPPP | EPXPPX | EPXPPY | EPXPTO | EPXPVC | EPXPVA | EPXPYT | EPXPRS | EPXPSL | DOMPFT | DOMMET | DOMPTE |
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| LIMPY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIMPL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| METMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| METMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ETHMX | • | | | • | | | | | • | | | | • | | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | |
| ETHMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BUTMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BUTMN | • | | | • | | | | | • | | | | • | | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | |
| NAPMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NAPMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GAOMX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GAOMN | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMGS | • | | | • | | | | | • | | | | • | | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | |
| CPMDU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMBU | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPNGS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPNDU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPNBU | • | | 1 | • | | | | | • | | | | • | | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | |
| CPMSC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMAR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMLD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMOX | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMPC | • | | | • | | | | | • | | | | • | | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | |
| CPMEH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMSE | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMPY | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CPMPL | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FLBA | • | | | | | -1 | -1 | -1 | -1 | • | | | • | | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | 1 | | |
| ETBA | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 | | |
| PEBA | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | 1 | |
| POBA | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | |
| PPBA | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | |
| C4BA | • | | | • | | | | | • | | | | | -1 | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | • | | | |
| MGBA | | | | | | | | | | | | | | | -1 | -1 | -1 | -1 | -1 | -1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| FOBA | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | | | | |
| XYBA | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | 1 | | | | | | | | |
| TOBA | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | 1 | | | | | | | |
| BZBA | • | | | • | | | | | • | | | | • | | | | • | | | • | | | | -1 | | | | | | | | | | | | | | | • | | | • | | | |
| EBBA | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | | |
| VCBA | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | 1 | | | | | | | |
| PVBA | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | 1 | | | | | | |
| EABA | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | 1 | | | | | |
| SYBA | • | | | • | | | | | • | | | | • | | | | • | | | • | | | | | -1 | | | | | | | | | | | | | | | | 1 | | • | | |
| BTBA | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | | |
| LSBA | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | | |
| BYBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | | | | | | | | | | | | | | | | | | |
| PFBA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | -1 | -1 | -1 | -1 | -1 | | | | | | | | | | | | | |
| SRBA | • | | | • | | | | | • | | | | • | | | | • | | | • | | | • | | | | | | | | | | -1 | | | • | | | • | | | 1 | | | |

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      INDO/WBK A-MATRIX PICTURE     SEP 02, 1971      -373-                                              PAGE NUMBER  13

ROW NAME            COLUMN NAME
                    C E S C C B F F F F E P P P C M M M M M M F X T B E V P E S B L B P P P P P S P E E E E E E E E E E E E D O O
                    2 B T 3 4 T L L L L T E O P 4 G G G G G G O Y O Z B C V A Y T S Y F F F F F R S X X X X X X X X X X X X O O O
                    H Z Y H H A G C C C C P C P C M M M R M M F X T B E V P E S B L B G C C C F S P P P P P P P P P P P P P M M M
                    S S P P B S A 2 3 4 2 E 3 P 4 0 0 0 A 0 0 E Y O E B C V A T T O T A 2 3 4 E R S E P P X T V P E S B S P F E P
                    E E Y L U B S H H M H 1 H 1 H 1 2 3 F 4 5 O L L Z Z 1 C L Y A S Y S H H M O R T T E P Y O C V A Y T R S L T E


   PSBA                                                                                             -1                       1
   GASBA                            1                                                     1
   C2HBA            1             1     1                                               1
   C3HBA                  1         1       1                                             1
   C4MBA            .       1 .       1 .       1 .         .         .         .         . 1       .         .         .
   MO1BA                                          1
   MO2BA                                            1
   MO3BA                                              1
   FEOBA                                                      1                               1
   RAFBA            .         .         .         .     1   .         .         .         .         .         .         .
   XYLBA                                                        1
   BEZBA            2                                               1
   TOLBA                                                          1
   EBZBA              1                                               1
   NPABA            .         .         .         .         .         .         .         .         .         .         .
   GOABA
   PVCBA                                                                  1
   EALBA                                                                    1
   STYBA           -3-B 1     A                                               1
   PSTBA            .  -B     .         .         .         .         .         .         .       1 .         .         .
   PP1BA                 -B                   1
   MO4BA                                                  1
   MO5BA                                                    1
   PE1BA                                      1
   LOSBA            .    -A   .         .         .         .         .         . 1       .         .         .         .
   VC1BA                                                                    1
   BTYBA                   -A                                                       1
   BTABA                   -B 1                                                 1
   SRRBA                     -J                                                                 1
   HYDBA           -A-A       .         .         .         .         .         .         .         .         .         .
   CH2BA
   CH3BA
   CH4BA
   C2XBA
   REVFLDEI         .         .         .         .         .         .         .         .         .         .         .  -A
   REVETDEI
   REVETDEX                                                                                        -C
   REVPEDEI                                                                                                                   -D
   REVPEDEX                                                                                          -D
   REVPODEI         .         .         .         .         .         .         .         .         .         .         .
   REVPPDEI
   REVPPDEX                                                                                            -D
   REVC4DEI
   REVMGDEI
   REVFODEI         .         .         .         .         .         .         .         .         .         .         .
   REVXYDEI
   REVXYDEX                                                                                              -C
   REVTODEI
   REVTODEX                                                                                                -C
   REVBZDEI         .         .         .         .         .         .         .         .         .         .         .
```

```
ROW NAME        COLUMN NAME
                C E S C C B F F F F E P P P C M M M M M M F X T B E V P E S B L B P P P P P S P E E E E E E E E E E E E D D D
                2 B T 3 4 T L L L L T E O P 4 G G G G G G O Y O Z B C V A Y T S Y F F F F F R S X X X X X X X X X X X X O O O
                H Z Y H M A G C C C C P C P C M M M R M M F X T B E V P E S B L B G C C C F S P P P P P P P P P P P P P M M M
                S S P P B S A 2 3 4 2 E 3 P 4 0 0 0 A 0 0 E Y G E B C V A T T O T A 2 3 4 E R S E P P X T V P E S B S P F E P
                E E Y L U B S H H M H 1 H 1 M 1 2 3 F 4 5 O L L Z Z 1 C L Y A S Y S H H M O R T T E P Y O C V A Y T R S L T E



REVEBDEI
REVVCDEI
REVVCDEX                                                                                                 -D
REVPVDEI
REVPVDEX        .         .         .         .         .         .         .         .         .         .-D       .
REVEADEI
REVEADEX                                                                                                     -D
REVSYDEI
REVSYDEX                                                                                                       -D
REVBTDEI        .         .         .         .         .         .         .         .         .         .         .
REVBTDEX                                                                                                         -D
REVLSDEI
REVBYDEI
REVPFDEI
REVSRDEI        .         .         .         .         .         .         .         .         .         .         .
REVSRDEX                                                                                                           -D
REVPSDEI
REVPSDEX                                                                                                             -D
FLDMN                                                                                                                   1
ETDMN           .         .         .         .         .         .         .         .         .         .         .     1
ETEMX                                                                                           1
ETEMN                                                                                           1
PEDMX                                                                                                                       1
PEDMN                                                                                                                       1
PEEMX           .         .         .         .         .         .         .         .         . 1       .         .
PEEMN                                                                                             1
PODMN
PPDMX
PPDMN
PPEMX           .         .         .         .         .         .         .         .         .   1     .         .
PPEMN                                                                                               1
C4DMN
MGDMN
FODMN
XYDMX           .         .         .         .         .         .         .         .         .         .         .
XYDMN
XYEMX                                                                                                 1
XYEMN                                                                                                 1
TODMX
TODMN           .         .         .         .         .         .         .         .         .         .         .
TOEMX                                                                                                   1
TOEMN                                                                                                   1
BZDMX
BZDMN
EBDMX           .         .         .         .         .         .         .         .         .         .         .
EBDMN
VCDMX
VCDMN
VCEMX                                                                                                     1
VCEMN           .         .         .         .         .         .         .         .         .         1         .
```

```
ROW NAME       COLUMN NAME
               C E S C C B F F F F E P P P C M M M M M M F X T B E V P E S B L B P P P P P S P E E E E E E E E E E E E D D D
               2 B T 3 4 T L L L L T E O P 4 G G G G G G O Y O Z B C V A Y T S Y F F F F F R S X X X X X X X X X X X X O O O
               M Z Y M M A G C C C C P C P C M M M R M M F X T B E V P E S B L B G C C C F S P P P P P P P P P P P P P M M M
               S S P P B S A 2 3 4 2 E 3 P 4 O O O A O O E Y O E B C V A T T O T A 2 3 4 E R S E P P X T V P E S B S P F E P
               E E Y L U B S M M M M 1 M 1 M 1 2 3 F 4 5 O L L Z Z 1 C L Y A S Y S M M M O R T T E P Y O C V A Y T R S L T E



  PVDMX
  PVDMN
  PVEMX                                                                                                          1
  PVEMN                                                                                                          1
  EADMX        .         .         .         .         .         .         .         .         .         .         .
  EADMN
  EAEMX                                                                                                            1
  EAEMN                                                                                                            1
  SYDMX
  SYDMN        .         .         .         .         .         .         .         .         .         .         .
  SYEMX                                                                                                              1
  SYEMN                                                                                                              1
  BTDMX
  BTDMN
  BTEMX        .         .         .         .         .         .         .         .         .         .       1 .
  BTEMN                                                                                                                1
  LSDMN
  BYDMX
  BYDMN
  PFDMN        .         .         .         .         .         .         .         .         .         .         .
  SRDMX
  SRDMN
  SREMX                                                                                                                  1
  SREMN                                                                                                                  1
  PSDMX        .         .         .         .         .         .         .         .         .         .         .
  PSDMN
  PSEMX                                                                                                                    1
  PSEMN                                                                                                                    1
  BEZMX
```

| ROW NAME | COLUMN NAME DOMPG | DOMP4 | DOMCG | DOMFO | DOMXY | DOMTO | DOMBZ | DOMEB | DOMVC | DOMPV | DOMEA | DOMSY | DOMBT | DOMLS | DOMBY | DOMPF | DOMSR | DOMPS | 84 | ROWTYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROF1 | | | | | | | | | | | | | | | | | | | | N |
| PROF2 | | | | | | | | | | | | | | | | | | | | N |
| PROF3 | | | | | | | | | | | | | | | | | | | | N |
| PROF4 | | | | | | | | | | | | | | | | | | | | N |
| PROF5 | • | | | | • | | | | | • | | | | | • | | | | | N |
| PROF6 | | | | | | | | | | | | | | | | | | | | N |
| METCOST | | | | | | | | | | | | | | | | | | | | L |
| ETHCOST | | | | | | | | | | | | | | | | | | | | L |
| PROCOST | | | | | | | | | | | | | | | | | | | | L |
| BUTCOST | • | | | | • | | | | | • | | | | | • | | | | | L |
| NAPCOST | | | | | | | | | | | | | | | | | | | | L |
| GADCOST | | | | | | | | | | | | | | | | | | | | L |
| BEZCOST | | | | | | | | | | | | | | | | | | | | L |
| INVGS | | | | | | | | | | | | | | | | | | | | L |
| INVSC | • | | | | • | | | | | • | | | | | • | | | | | L |
| INVDU | | | | | | | | | | | | | | | | | | | | L |
| INVAR | | | | | | | | | | | | | | | | | | | | L |
| INVLD | | | | | | | | | | | | | | | | | | | | L |
| INVOX | | | | | | | | | | | | | | | | | | | | L |
| INVPC | • | | | | • | | | | | • | | | | | • | | | | | L |
| INVEH | | | | | | | | | | | | | | | | | | | | L |
| INVSE | | | | | | | | | | | | | | | | | | | | L |
| INVPY | | | | | | | | | | | | | | | | | | | | L |
| INVPL | | | | | | | | | | | | | | | | | | | | L |
| INVBU | • | | | | • | | | | | • | | | | | • | | | | | L |
| INVSB | | | | | | | | | | | | | | | | | | | | L |
| KWH | | | | | | | | | | | | | | | | | | | | L |
| BFW | | | | | | | | | | | | | | | | | | | | L |
| STM | | | | | | | | | | | | | | | | | | | | L |
| CWA | • | | | | • | | | | | • | | | | | • | | | | | L |
| LAB | | | | | | | | | | | | | | | | | | | | L |
| MNT | | | | | | | | | | | | | | | | | | | | L |
| CAT | | | | | | | | | | | | | | | | | | | | L |
| ITX | | | | | | | | | | | | | | | | | | | | L |
| ROY | • | | | | • | | | | | • | | | | | • | | | | | L |
| FUL | | | | | | | | | | | | | | | | | | | | L |
| BAG | | | | | | | | | | | | | | | | | | | | L |
| EXA | | | | | | | | | | | | | | | | | | | | L |
| UTL | | | | | | | | | | | | | | | | | | | | L |
| INV | • | | | | • | | | | | • | | | | | • | | | | | L |
| CLO | | | | | | | | | | | | | | | | | | | | L |
| DEI | | | | | | | | | | | | | | | | | | | | L |
| DEX | | | | | | | | | | | | | | | | | | | | L |
| LIMSC | | | | | | | | | | | | | | | | | | | | L |
| LIMAR | • | | | | • | | | | | • | | | | | • | | | | | L |
| LIMLD | | | | | | | | | | | | | | | | | | | | L |
| LIMOX | | | | | | | | | | | | | | | | | | | | L |
| LIMPC | | | | | | | | | | | | | | | | | | | | L |
| LIMEH | | | | | | | | | | | | | | | | | | | | L |
| LIMSE | • | | | | • | | | | | • | | | | | • | | | | | L |

| ROW NAME | COLUMN NAME DOMPO | DOMPP | DOMC4 | DOMMG | DOMFO | DOMXY | DOMTO | DOMBZ | DOMEB | DOMVC | DOMPV | DOMEA | DOMSY | DOMBT | DOMLS | DOMBY | DOMPF | DOMRS | DOMPS | 84DA | ROTYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LIMPY | | | | | | | | | | | | | | | | | | | | | LLG |
| LIMPL | | | | | | | | | | | | | | | | | | | | | LLG |
| METMX | | | | | | | | | | | | | | | | | | | | D | LLG |
| METMN | | | | | | | | | | | | | | | | | | | | | LLG |
| ETHMX | • | | | | | • | | | | | • | | | | | | • | | | D | LLG |
| ETHMN | | | | | | | | | | | | | | | | | | | | | LLG |
| PROMX | | | | | | | | | | | | | | | | | | | | 1 | LLG |
| PROMN | | | | | | | | | | | | | | | | | | | | | LLG |
| BUTMX | | | | | | | | | | | | | | | | | | | | 1 | LLG |
| BUTMN | • | | | | | • | | | | | • | | | | | | • | | | | LLG |
| NAPMX | | | | | | | | | | | | | | | | | | | | 1 | LLG |
| NAPMN | | | | | | | | | | | | | | | | | | | | | LLG |
| GAOMX | | | | | | | | | | | | | | | | | | | | 1 | LLG |
| GAOMN | | | | | | | | | | | | | | | | | | | | | LLG |
| CPMGS | • | | | | | • | | | | | • | | | | | | • | | | E | LLG |
| CPMDU | | | | | | | | | | | | | | | | | | | | D | LLG |
| CPMBU | | | | | | | | | | | | | | | | | | | | D | LLG |
| CPNGS | | | | | | | | | | | | | | | | | | | | A | LLG |
| CPNDU | | | | | | | | | | | | | | | | | | | | | LLG |
| CPNBU | • | | | | | • | | | | | • | | | | | | • | | | | LLG |
| CPMSC | | | | | | | | | | | | | | | | | | | | | LLG |
| CPMAR | | | | | | | | | | | | | | | | | | | | | LLG |
| CPMLD | | | | | | | | | | | | | | | | | | | | | LLG |
| CPMOX | | | | | | | | | | | | | | | | | | | | | LLG |
| CPMPC | • | | | | | • | | | | | • | | | | | | • | | | | LLG |
| CPMEH | | | | | | | | | | | | | | | | | | | | | LLG |
| CPMSE | | | | | | | | | | | | | | | | | | | | | LLG |
| CPMPY | | | | | | | | | | | | | | | | | | | | | LLG |
| CPMPL | | | | | | | | | | | | | | | | | | | | | LLG |
| FLBA | • | | | | | • | | | | | • | | | | | | • | | | | LLG |
| ETBA | | | | | | | | | | | | | | | | | | | | | LLG |
| PEBA | | | | | | | | | | | | | | | | | | | | | LLG |
| POBA | 1 | | | | | | | | | | | | | | | | | | | | LLG |
| PPBA | | 1 | | | | | | | | | | | | | | | | | | | LLG |
| C4BA | • | | 1 | | | • | | | | | • | | | | | | • | | | | LLG |
| MGBA | | | | 1 | | | | | | | | | | | | | | | | | LLG |
| FOBA | | | | | 1 | | | | | | | | | | | | | | | | LLG |
| XYBA | | | | | | 1 | | | | | | | | | | | | | | | LLG |
| TOBA | | | | | | | 1 | | | | | | | | | | | | | | LLG |
| BZBA | • | | | | | • | | 1 | | | • | | | | | | • | | | | LLG |
| EBBA | | | | | | | | | 1 | | | | | | | | | | | | LLG |
| VCBA | | | | | | | | | | 1 | | | | | | | | | | | LLG |
| PVBA | | | | | | | | | | | 1 | | | | | | | | | | LLG |
| EABA | | | | | | | | | | | | 1 | | | | | | | | | LLG |
| SYBA | • | | | | | • | | | | | • | | 1 | | | | • | | | | LLG |
| BTBA | | | | | | | | | | | | | | 1 | | | | | | | LLG |
| LSBA | | | | | | | | | | | | | | | 1 | | | | | | LLG |
| BYBA | | | | | | | | | | | | | | | | 1 | | | | | LLG |
| PFBA | | | | | | | | | | | | | | | | | 1 | | | | LLG |
| SRBA | • | | | | | • | | | | | • | | | | | | • | 1 | | | LLG |

| ROW NAME | COLUMN NAME DOMPO | DOMPP | DOMC4 | DOMMG | DOMFO | DOMXY | DOMTO | DOMBZ | DOMEB | DOMVC | DOMPV | DOMEA | DOMSY | DOMBT | DOMLS | DOMBY | DOMPF | DOMSR | DOMPS | B4 | ROTYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PSBA | | | | | | | | | | | | | | | | | | | | 1 | L |
| GASBA | | | | | | | | | | | | | | | | | | | | | L |
| C2HBA | | | | | | | | | | | | | | | | | | | | | L |
| C3HBA | | | | | | | | | | | | | | | | | | | | | L |
| C4HBA | • | | | | | • | | | | | • | | | | | • | | | | | L |
| HO1BA | | | | | | | | | | | | | | | | | | | | | L |
| HO2BA | | | | | | | | | | | | | | | | | | | | | L |
| HO3BA | | | | | | | | | | | | | | | | | | | | | L |
| FEOBA | | | | | | | | | | | | | | | | | | | | | L |
| RAFBA | • | | | | | • | | | | | • | | | | | • | | | | | L |
| XYLBA | | | | | | | | | | | | | | | | | | | | | L |
| BEZBA | | | | | | | | | | | | | | | | | | | | | L |
| TOLBA | | | | | | | | | | | | | | | | | | | | | L |
| EBZBA | | | | | | | | | | | | | | | | | | | | | L |
| NPABA | • | | | | | • | | | | | • | | | | | • | | | | | L |
| GOABA | | | | | | | | | | | | | | | | | | | | | L |
| PVCBA | | | | | | | | | | | | | | | | | | | | | L |
| EALBA | | | | | | | | | | | | | | | | | | | | | L |
| STYBA | | | | | | | | | | | | | | | | | | | | | L |
| PSTBA | • | | | | | • | | | | | • | | | | | • | | | | | L |
| PP1BA | | | | | | | | | | | | | | | | | | | | | L |
| HO4BA | | | | | | | | | | | | | | | | | | | | | L |
| HO5BA | | | | | | | | | | | | | | | | | | | | | L |
| PE1BA | | | | | | | | | | | | | | | | | | | | | L |
| LOSBA | • | | | | | • | | | | | • | | | | | • | | | | | L |
| VC1BA | | | | | | | | | | | | | | | | | | | | | L |
| BTYBA | | | | | | | | | | | | | | | | | | | | | L |
| BTABA | | | | | | | | | | | | | | | | | | | | | L |
| SRRBA | | | | | | | | | | | | | | | | | | | | | L |
| HYDBA | • | | | | | • | | | | | • | | | | | • | | | | | L |
| CH2BA | | | | | | | | | | | | | | | | | | | | | L |
| CH3BA | | | | | | | | | | | | | | | | | | | | | L |
| CH4BA | | | | | | | | | | | | | | | | | | | | | L |
| C2XBA | | | | | | | | | | | | | | | | | | | | | L |
| REVFLDEI | • | | | | | • | | | | | • | | | | | • | | | | | L |
| REVETDEI | | | | | | | | | | | | | | | | | | | | | L |
| REVETDEX | | | | | | | | | | | | | | | | | | | | | L |
| REVPEDEI | | | | | | | | | | | | | | | | | | | | | L |
| REVPEDEX | | | | | | | | | | | | | | | | | | | | | L |
| REVPODEI | -C | | | | | • | | | | | • | | | | | • | | | | | L |
| REVPPDEI | | -D | | | | | | | | | | | | | | | | | | | L |
| REVPPDEX | | | | | | | | | | | | | | | | | | | | | L |
| REVC4DEI | | | -C | | | | | | | | | | | | | | | | | | L |
| REVMGDEI | | | | -C | | | | | | | | | | | | | | | | | L |
| REVFODEI | • | | | | -C | • | | | | | • | | | | | • | | | | | L |
| REVXYDEI | | | | | | -C | | | | | | | | | | | | | | | L |
| REVXYDEX | | | | | | | | | | | | | | | | | | | | | L |
| REVTODEI | | | | | | | -C | | | | | | | | | | | | | | L |
| REVTODEX | | | | | | | | | | | | | | | | | | | | | L |
| REVBZDEI | • | | | | | • | | -C | | | • | | | | | • | | | | | L |

| ROW NAME | COLUMN NAME DOMPO | DOMPC4 | DOMMG | DOMFO | DOMXY | DOMTO | DOMBZ | DOMEB | DOMVC | DOMPV | DOMEA | DOMSY | DOMBT | DOMLS | DOMBY | DOMPF | DOMRS | DOMPS | 84 | ROTYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| REVEBDEI | | | | | | | | -C | | | | | | | | | | | | L |
| REVVCDEI | | | | | | | | | -D | | | | | | | | | | | L |
| REVVCDEX | | | | | | | | | | | | | | | | | | | | L |
| REVPVDEI | | | | | | | | | | -D | | | | | | | | | | L |
| REVPVDEX | • | | | | • | | | | | • | | | | | • | | | | | L |
| REVEADEI | | | | | | | | | | | -D | | | | | | | | | L |
| REVEADEX | | | | | | | | | | | | | | | | | | | | L |
| REVSYDEI | | | | | | | | | | | | -D | | | | | | | | L |
| REVSYDEX | | | | | | | | | | | | | | | | | | | | L |
| REVBTDEI | • | | | | • | | | | | • | | | -D | | • | | | | | L |
| REVBTDEX | | | | | | | | | | | | | | | | | | | | L |
| REVLSDEI | | | | | | | | | | | | | | -A | | | | | | L |
| REVBYDEI | | | | | | | | | | | | | | | -C | | | | | L |
| REVPFDEI | | | | | | | | | | | | | | | | -A | | | | L |
| REVSRDEI | • | | | | • | | | | | • | | | | | • | | -D | | | L |
| REVSRDEX | | | | | | | | | | | | | | | | | | | | L |
| REVPSDEI | | | | | | | | | | | | | | | | | | -D | | L |
| REVPSDEX | | | | | | | | | | | | | | | | | | | | L |
| FLDMN | | | | | | | | | | | | | | | | | | | | G |
| ETDMN | • | | | | • | | | | | • | | | | | • | | | | | G |
| ETEMX | | | | | | | | | | | | | | | | | | | D | L |
| ETEMN | | | | | | | | | | | | | | | | | | | | G |
| PEDMX | | | | | | | | | | | | | | | | | | | D | L |
| PEDMN | | | | | | | | | | | | | | | | | | | D | G |
| PEEMX | • | | | | • | | | | | • | | | | | • | | | | C | L |
| PEEMN | | | | | | | | | | | | | | | | | | | | G |
| PODMN | 1 | | | | | | | | | | | | | | | | | | | G |
| PPDMX | | 1 | | | | | | | | | | | | | | | | | C | L |
| PPDMN | | 1 | | | | | | | | | | | | | | | | | C | G |
| PPEMX | • | | | | • | | | | | • | | | | | • | | | | C | L |
| PPEMN | | | | | | | | | | | | | | | | | | | | G |
| C4DMN | | | 1 | | | | | | | | | | | | | | | | | G |
| MGDMN | | | | 1 | | | | | | | | | | | | | | | | G |
| FODMN | | | | | 1 | | | | | | | | | | | | | | | G |
| XYDMX | • | | | | | 1 | | | | • | | | | | • | | | | 5 | L |
| XYDMN | | | | | | 1 | | | | | | | | | | | | | | G |
| XYEMX | | | | | | | | | | | | | | | | | | | C | L |
| XYEMN | | | | | | | | | | | | | | | | | | | | G |
| TODMX | | | | | | | 1 | | | | | | | | | | | | 6 | L |
| TODMN | • | | | | | • | 1 | | | • | | | | | • | | | | | G |
| TOEMX | | | | | | | | | | | | | | | | | | | C | L |
| TOEMN | | | | | | | | | | | | | | | | | | | | G |
| BZDMX | | | | | | | | 1 | | | | | | | | | | | C | L |
| BZDMN | | | | | | | | 1 | | | | | | | | | | | | G |
| EBDMX | • | | | | | • | | | 1 | • | | | | | • | | | | 1 | L |
| EBDMN | | | | | | | | | 1 | | | | | | | | | | | G |
| VCDMX | | | | | | | | | | 1 | | | | | | | | | C | L |
| VCDMN | | | | | | | | | | 1 | | | | | | | | | | G |
| VCEMX | | | | | | | | | | | | | | | | | | | C | L |
| VCEMN | • | | | | | • | | | | • | | | | | • | | | | | G |

| ROW NAME | COLUMN NAME DOMPO | DOMPP | DOMC4 | DOMHG | DOMFO | DOMXY | DOMTO | DOMBZ | DOMEB | DOMVC | DOMPV | DOMEA | DOMSY | DOMBT | DOMLS | DOMBY | DOMPF | DOMSR | DOMPS | 84 | ROTYPE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PVDMX | | | | | | | | | | | 1 | | | | | | | | | C | L |
| PVDMN | | | | | | | | | | | 1 | | | | | | | | | C | G |
| PVEMX | | | | | | | | | | | | | | | | | | | | D | L |
| PVEMN | | | | | | | | | | | | | | | | | | | | C | G |
| EADMX | • | | | | | • | | | | | • | 1 | | | | • | | | | C | L |
| EADMN | | | | | | | | | | | | 1 | | | | | | | | C | G |
| EAEMX | | | | | | | | | | | | | | | | | | | | C | L |
| EAEMN | | | | | | | | | | | | | | | | | | | | C | G |
| SYDMX | | | | | | | | | | | | | 1 | | | | | | | 5 | L |
| SYDMN | • | | | | | • | | | | | • | | 1 | | | • | | | | | G |
| SYEMX | | | | | | | | | | | | | | | | | | | | C | L |
| SYEMN | | | | | | | | | | | | | | | | | | | | | G |
| BTDMX | | | | | | | | | | | | | | 1 | | | | | | 3 | L |
| BTDMN | | | | | | | | | | | | | | 1 | | | | | | | G |
| BTEMX | • | | | | | • | | | | | • | | | | | • | | | | C | L |
| BTEMN | | | | | | | | | | | | | | | | | | | | | G |
| LSDMN | | | | | | | | | | | | | | | 1 | | | | | | G |
| BYDMX | | | | | | | | | | | | | | | | 1 | | | | 5 | L |
| BYDMN | | | | | | | | | | | | | | | | 1 | | | | | G |
| PFDMN | • | | | | | • | | | | | • | | | | | • | 1 | | | | G |
| SRDMX | | | | | | | | | | | | | | | | | | 1 | | 5 | L |
| SRDMN | | | | | | | | | | | | | | | | | | 1 | | | G |
| SREMX | | | | | | | | | | | | | | | | | | | | C | L |
| SREMN | | | | | | | | | | | | | | | | | | | | | G |
| PSDMX | • | | | | | • | | | | | • | | | | | • | | | 1 | C | L |
| PSDMN | | | | | | | | | | | | | | | | | | | 1 | C | G |
| PSEMX | | | | | | | | | | | | | | | | | | | | D | L |
| PSEMN | | | | | | | | | | | | | | | | | | | | D | G |
| BEZMX | | | | | | | | | | | | | | | | | | | | D | L |

TABLE OF CODED MATRIX COEFFICIENTS

| CODE | RANGE OF ABSOLUTE VALUES |
|---|---|
| . | N = 0.0 |
| A | 0.0 < N < 0.5 |
| B | 0.5 ≤ N < 1.0 |
| 1 | N = 1.0 |
| J | 1.0 < N < 2.0 |
| 2 | 2.0 ≤ N < 3.0 |
| 3 | 3.0 ≤ N < 4.0 |
| 4 | 4.0 ≤ N < 5.0 |
| 5 | 5.0 ≤ N < 6.0 |
| 6 | 6.0 ≤ N < 7.0 |
| 7 | 7.0 ≤ N < 8.0 |
| 8 | 8.0 ≤ N < 9.0 |
| 9 | 9.0 ≤ N < 10.0 |
| C | 10.0 ≤ N < 100.0 |
| D | 100.0 ≤ N < 1000.0 |
| E | 1000.0 ≤ N < 10000.0 |
| G | 10000.0 ≤ N < 100000.0 |
| G | 100000.0 ≤ N |

1 ROW/ 6

SOLUTION TYPE = PHASE 2 - OPTIMUM

NUMBER OF BASIS CHANGES
SINCE THE START OF THE PROBLEM = 188
NAME OF THE OBJECTIVE FUNCTION = #PROFS#
NAME OF SELECTED ISET = ##
NAME OF SELECTED RHS = #7/#
NAME OF SELECTED RANGES SET = ##
NAME OF SELECTED BOUNDS SET = #BND1#
VALUE OF THE OBJECTIVE FUNCTION = -7352.45455

BASIC VARIABLES
**********

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| F | #PROF1 | #1 | 42024.33513 | -42024.33513 | NONE | NONE | 0.00000 | |
| F | #PROF2 | #2 | 41908.72370 | -41908.72370 | NONE | NONE | 0.00000 | |
| F | #PROF3 | #3 | 40879.78150 | -40879.78150 | NONE | NONE | 0.00000 | |
| F | #PROF4 | #4 | 10913.60150 | -10913.60150 | NONE | NONE | 0.00000 | |
| F | #PROF5 | #5 | 7352.45455 | -7352.45455 | NONE | NONE | 1.00000 | |
| F | #PROF6 | #6 | -4208.69272 | 4208.69272 | NONE | NONE | 0.00000 | |
| F | #INVDO | #F | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| F | #INVSB | #F | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| F | #FV | #F | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| F | #STM | #F | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| F | #EAG | #F | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| F | #ETMX | #F | 229.49920 | 73.50000 | | 309.00000 | 0.00000 | |
| F | #STMD | #F | 74.50000 | 74.50000 | -0.00000 | | 0.00000 | |
| F | #ETRAX | #F | 158.26130 | 425.73861 | | 595.00000 | 0.00000 | |
| F | #ETRAM | #F | 425.73861 | 425.73861 | -0.00000 | | 0.00000 | |
| F | #PROMX | #F | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |

1500/[illegible] *PROFS* ** *774

| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| *F | *PROMN | 0.[illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *OUT-X | 1.[illegible] | 0.00000 | | 1.00000 | 0.00000 | |
| *F | *OUT-N | 0.[illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *NAP-X | 1.[illegible] | 0.00000 | | 1.00000 | 0.00000 | |
| *F | *NAP-N | 0.[illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *GAS-X | 1.[illegible] | 0.00000 | | 1.00000 | 0.00000 | |
| *F | *GAS-N | 0.[illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *CP-GS | 1502.76954 | 497.23941 | | 2000.00000 | 0.00000 | |
| *F | *CP-OU | 129.62518 | 325.17482 | | 454.00000 | 0.00000 | |
| *F | *CP-OU | [illegible] | [illegible] | | 200.00000 | 0.00000 | |
| *F | *CP-GS | 497.13941 | 497.23941 | .10000 | | 0.00000 | |
| *F | *CP-OU | 325.17482 | 325.17482 | -0.00000 | | 0.00000 | |
| *F | *CP-PU | 0.[illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *HYDRA | .32354 | -.32354 | | 0.00000 | 0.00000 | |
| *F | *FLD-U | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *ETD-N | 0.[illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *ETE-X | 100.[illegible] | 0.00000 | | 100.00000 | 0.00000 | |
| *F | *ETE-N | 0.[illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *EED-N | [illegible] | 91.00000 | 1.00000 | | 0.00000 | |
| *F | *EEE-X | 136.[illegible] | 187.50000 | | 324.00000 | 0.00000 | |
| *F | *EEE-N | 187.[illegible] | 187.50000 | -0.00000 | | 0.00000 | |
| *F | *PD-N | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *PDD-X | 6.73531 | 11.21469 | | 18.00000 | 0.00000 | |
| *F | *PDD-N | 11.21469 | 11.21469 | -0.00000 | | 0.00000 | |
| *F | *PE-X | 1.2.[illegible] | 0.00000 | | 102.00000 | 0.00000 | |
| *F | *PE-N | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *CSD-N | 8.15071 | 8.15071 | -0.00000 | | 0.00000 | |
| *F | *GD-N | 11.[illegible] | 11.[illegible] | -0.00000 | | 0.00000 | |
| *F | *FGD-N | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *XYD-X | 5.[illegible] | 0.00000 | | 5.00000 | 0.00000 | |
| *F | *XYD-N | 0.[illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *XYE-X | 10.[illegible] | 0.00000 | | 10.00000 | 0.00000 | |
| *F | *XYE-N | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *TOD-X | 6.[illegible] | 0.00000 | | 6.00000 | 0.00000 | |
| *F | *TOD-N | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *TOE-X | 16.[illegible] | 0.00000 | | 16.00000 | 0.00000 | |
| *F | *TOE-N | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *ZD-X | 10.[illegible] | 0.00000 | | 10.00000 | 0.00000 | |
| *F | *ZD-N | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *F | *ERD-X | 1.[illegible] | 0.00000 | | 1.00000 | 0.00000 | |

IEOO/[illegible] *PROF[illegible]* ** *77*

| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | VCOMM | 10.00000 | 10.00000 | -0.00000 | | 0.00000 | |
| [illegible] | VCEIN | 25.00000 | 25.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PVOMX | 24.00000 | 0.00000 | | 24.00000 | 0.00000 | |
| [illegible] | PVOMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PVEMX | 120.00000 | 0.00000 | | 120.00000 | 0.00000 | |
| [illegible] | PVEMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PAOMX | 3.00000 | 3.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PAEMX | 9.00000 | 9.00000 | -0.00000 | | 0.00000 | |
| [illegible] | SYOMX | 3.66547 | 1.33453 | | 5.00000 | 0.00000 | |
| [illegible] | SYOMN | 1.33453 | 1.33453 | -0.00000 | | 0.00000 | |
| [illegible] | SYEMX | 45.00000 | 0.00000 | | 45.00000 | 0.00000 | |
| [illegible] | SYEMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | STOMX | 3.00000 | 0.00000 | | 3.00000 | 0.00000 | |
| [illegible] | STOMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | STEMX | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| [illegible] | STEMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | LSOMN | 23.74608 | 23.74608 | -0.00000 | | 0.00000 | |
| [illegible] | YOMX | 5.00000 | 0.00000 | | 5.00000 | 0.00000 | |
| [illegible] | YOMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | FOMN | 164.71669 | 164.71669 | -0.00000 | | 0.00000 | |
| [illegible] | SOMX | 5.00000 | 0.00000 | | 5.00000 | 0.00000 | |
| [illegible] | SOMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | SREMX | 20.00000 | 0.00000 | | 20.00000 | 0.00000 | |
| [illegible] | SREMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PSOMX | 15.00000 | 0.00000 | | 15.00000 | 0.00000 | |
| [illegible] | PSOMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PSEMX | 108.00000 | 0.00000 | | 108.00000 | 0.00000 | |
| [illegible] | PSEMN | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |

I 0/3R( *PPUF5* ** *77*

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| *F | *EZPUR | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *KOHTR | 1398.18437 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *CIATR | 5.26452 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *LAHTO | 871.13521 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *NUTTR | 8544.50156 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *CATTR | 709.42731 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *ITATR | 416.45416 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DOYTR | 3874.83254 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *EXATR | 3864.66911 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *UTLTR | 9549.81957 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *INVTR | 115611.47264 | .30000 | 0.00000 | NONE | 0.00000 | |
| *F | *CLOTR | 1314.23987 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *TRETCOS | 1489.51633 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *TRETRCOS | 7541.29491 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *TRETZCOS | [illegible] | 1.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *GSIAVTR | 599.53721 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *SCIAVTR | 25443.45316 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *LDIAVTR | 86949.99993 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *OXIAVTR | 3039.12436 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *EHIAVTR | 1595.81297 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *SEIAVTR | 33.99221 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *PLIAVTR | 2869.75247 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEAEITR | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEAHETR | 46875.00932 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEAVCTR | 3125.00001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEAEATR | 1[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIELTR | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIETTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIHFTR | 2430[illegible].00005 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIHOTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIHPTR | 2579.37885 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIOATR | 235.27476 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIOGTR | 357.15921 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIFDTR | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIAYTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIICTR | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIZETR | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIEPTR | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIVCTR | 1500.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F | *DEIPVTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

INDO/A PROFS# #* #77#

| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | DEIBATR | BF | 759.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISYTR | BF | 266.97648 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEICTTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEILSTR | BF | .23746 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISYTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPFTR | BF | 1.54717 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISRTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPSTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEETR | BF | 51800.00037 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEITR | BF | 30040.62500 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| I | SCINT | B | .28449 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | ARINT | B | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | OXINT | B | .08537 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | PCINT | B | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | EHINT | B | .07742 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | SEINT | B | .01186 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | PYINT | B | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | PLINT | B | .12587 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| P | SCVAR | BF | 369.84013 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ARVAR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LDVAR | BF | 200.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | OXVAR | BF | 13.65854 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PCVAR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EHVAR | BF | 0.96774 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SEVAR | BF | .32374 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PYVAR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PLVAR | BF | 10.57277 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ETGS | BF | 70.50030 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ETHGS | BF | 426.73861 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PAOGS | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | OUTGS | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | OAPGS | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GAOGS | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH2SC | BF | 426.73861 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH3SC | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH4SC | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | NPASC | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GOASC | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2XDU | BF | 325.17482 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | HOIAR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

I000/WPK #PROFS# ## #77#

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| F | [illegible] | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | C2HLO | 300.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | C2HOX | 17.[illegible]317 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | VC1PC | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | C2HFH | 7.74194 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | C2HSE | .35971 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EHZSE | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | STYPY | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | C3HPL | 12.46977 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | C4[illegible] | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | PEPL1 | 277.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | PPPPI | 11.21465 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | C4C4P | [illegible].15071 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | HG[illegible]01 | 11.9[illegible]21 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | HGM02 | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | HGM03 | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | HGMF | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | HGM04 | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | HGM05 | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | FOFCO | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | XYAYL | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | TOTOL | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | VCVCI | 35.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | PVPVC | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EAEAL | 12.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | SYSTY | 1.33453 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | [illegible] | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | LSLOS | 23.74623 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | HYETY | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | PFGAS | 164.71669 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | SPSPR | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | PSPST | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EXPPI | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EXPPE | 187.5[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EXPPP | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EXPAY | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EXPTO | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EXPVC | 25.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EXPPV | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| F | EXPEA | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |

[illegible] #PROF# ## #77#

| TYPE | VARIABLE | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | EXPSY | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPT | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPSE | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAFE | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAPE | 90.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | [illegible] | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAPP | 11.21469 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAC4 | 8.15071 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAFG | 11.95001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAFG | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAAY | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOA[illegible] | 0.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOA[illegible] | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAVC | 10.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOA[illegible] | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAEA | 3.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAST | 1.33453 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAIT | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOALS | 23.74608 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAAY | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOAPF | 164.71659 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOA[illegible] | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | [illegible] | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

IEOJ/WGA #PROFS# ## #77#

NON BASIC VARIABLES
**********

| TYPE | VARIABLE | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | ETCOST | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ETHCOST | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | PROCOST | 0.00000 | 0.00000 | | 0.00000 | .77494 | |
| P | AUTCOST | 0.00000 | 0.00000 | | 0.00000 | .71728 | |
| P | APCOST | 0.00000 | 0.00000 | | 0.00000 | .60326 | |
| P | GSOCOST | 0.00000 | 0.00000 | | 0.00000 | .45400 | |
| P | HEZCOST | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | INVBS | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVBC | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVED | 0.00000 | 0.00000 | | 0.00000 | .23443 | |
| P | INVEL | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVGA | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVPC | 0.00000 | 0.00000 | | 0.00000 | .25022 | |
| P | INVEH | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVSE | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVPY | 0.00000 | 0.00000 | | 0.00000 | .09291 | |
| P | INVPL | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVHO | 0.00000 | 0.00000 | | 0.00000 | .00587 | |
| P | AMH | 0.00000 | 0.00000 | | 0.00000 | .02000 | |
| P | CMA | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | LAB | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | CMT | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | CAT | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | TTX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | SOY | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | FUL | 0.00000 | 0.00000 | | 0.00000 | 16.40516 | |
| P | EXA | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | UTL | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | INV | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | CLO | 0.00000 | 0.00000 | | 0.00000 | 69.97901 | |
| P | CEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | LIMSC | 0.00000 | 0.00000 | | 0.00000 | 2.40000 | |
| P | LIMAR | 0.00000 | 0.00000 | | 0.00000 | .67986 | |
| P | LIMLD | 0.00000 | 0.00000 | | 0.00000 | 44.07484 | |
| P | LIMDX | 0.00000 | 0.00000 | | 0.00000 | 5.40000 | |
| P | LIMFC | 0.00000 | 0.00000 | | 0.00000 | 3.35288 | |
| P | LIMEH | 0.00000 | 0.00000 | | 0.00000 | 11.73000 | |
| P | LIMSE | 0.00000 | 0.00000 | | 0.00000 | 2.65000 | |
| P | LIMPY | 0.00000 | 0.00000 | | 0.00000 | .88265 | |

I-00/-'8 #PROF-# ## #77#

| T | VARIABLE NAME | S A T | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | LIIPL | NF | 0.00000 | 0.00000 | | 0.00000 | 9.09091 | |
| P | CPMSC | NF | 0.00000 | 0.00000 | | 0.00000 | 14.40000 | |
| P | CPIAK | NF | 0.00000 | 0.00000 | | 0.00000 | 25.99284 | |
| P | CPALO | NF | 0.00000 | 0.00000 | | 0.00000 | 99.57484 | |
| P | CPSGX | NF | 0.00000 | 0.00000 | | 0.00000 | 53.40000 | |
| P | CPAPC | NF | 0.00000 | 0.00000 | | 0.00000 | 42.38643 | |
| P | CPAEH | NF | 0.00000 | 0.00000 | | 0.00000 | 61.53000 | |
| P | CPMSE | NF | 0.00000 | 0.00000 | | 0.00000 | 28.35000 | |
| P | CPSPY | NF | 0.00000 | 0.00000 | | 0.00000 | 8.78000 | |
| P | CPMPL | NF | 0.00000 | 0.00000 | | 0.00000 | 69.09091 | |
| P | ELHA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | ETHA | NF | 0.00000 | 0.00000 | | 0.00000 | 44.00000 | |
| P | PERA | NF | 0.00000 | 0.00000 | | 0.00000 | 250.00000 | |
| P | ODBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PPBA | NF | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | C4BA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| P | IGBA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | FOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |
| P | AYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 49.00000 | |
| P | TOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 172.36153 | |
| P | ZBA | NF | 0.00000 | 0.00000 | | 0.00000 | 90.00000 | |
| P | FBBA | NF | 0.00000 | 0.00000 | | 0.00000 | 98.00000 | |
| P | VCBA | NF | 0.00000 | 0.00000 | | 0.00000 | 122.31357 | |
| P | PVBA | NF | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | EABA | NF | 0.00000 | 0.00000 | | 0.00000 | 102.85140 | |
| P | SYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 200.00000 | |
| P | BTBA | NF | 0.00000 | 0.00000 | | 0.00000 | 150.00000 | |
| P | LSBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | BYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PFBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | SRBA | NF | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | PSBA | NF | 0.00000 | 0.00000 | | 0.00000 | 260.00000 | |
| P | GASOA | NF | 0.00000 | 0.00000 | | 0.00000 | 16.54763 | |
| P | C2HBA | NF | 0.00000 | 0.00000 | | 0.00000 | 58.73592 | |
| P | C3HBA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.41009 | |
| P | C4HBA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| P | IO1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | IO2BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | IO3BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | FFOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |

INDO/#BK #PROFS# ## #77#

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | RAF4A | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | XYL8A | NF | 0.00000 | 0.00000 | | 0.00000 | 49.00000 | |
| P | BEZ8A | NF | 0.00000 | 0.00000 | | 0.00000 | 214.19571 | |
| P | TOL8A | NF | 0.00000 | 0.00000 | | 0.00000 | 172.36153 | |
| P | EBZ8A | NF | 0.00000 | 0.00000 | | 0.00000 | 106.35000 | |
| P | NPA04 | NF | 0.00000 | 0.00000 | | 0.00000 | 15.09326 | |
| P | 60A8A | NF | 0.00000 | 0.00000 | | 0.00000 | 14.09996 | |
| P | PVC4A | NF | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | PAL2A | NF | 0.00000 | 0.00000 | | 0.00000 | 102.85140 | |
| P | STY4A | NF | 0.00000 | 0.00000 | | 0.00000 | 200.00000 | |
| P | PSF8A | NF | 0.00000 | 0.00000 | | 0.00000 | 260.00000 | |
| P | PPI8A | NF | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | 80A8A | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | 60S8A | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | PE18A | NF | 0.00000 | 0.00000 | | 0.00000 | 250.00000 | |
| P | LOS8A | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | VC18A | NF | 0.00000 | 0.00000 | | 0.00000 | 122.31357 | |
| P | BTY8A | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | BTA8A | NF | 0.00000 | 0.00000 | | 0.00000 | 150.00000 | |
| P | SRR8A | NF | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | CH28A | NF | 0.00000 | 0.00000 | | 0.00000 | 18.36000 | |
| P | CH38A | NF | 0.00000 | 0.00000 | | 0.00000 | 14.57132 | |
| P | CH48A | NF | 0.00000 | 0.00000 | | 0.00000 | 14.40702 | |
| P | C2X8A | NF | 0.00000 | 0.00000 | | 0.00000 | 58.73592 | |
| P | REVFLDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSTDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVETDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPEDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPEDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPGDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPPDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPPDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.15000 | |
| P | REVC4DEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVIGDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVFODEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVAYDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVAYDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 2.22727 | |
| P | REVTODEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVTODEX | NF | 0.00000 | 0.00000 | | 0.00000 | 6.89446 | |
| P | REVBZDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |

I900/W-F *PROF=* ** *77*

| T | S | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| Y | VARIABLE NAME | | | | | | |
| P | A | | | | | | |
| E | T | | | | | | |
| P | *FVEYDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *FEVVCDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVVCDEX* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *RFVPVLCEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVPVOTX* | 0.00000 | 0.00000 | | 0.00000 | 1.09524 | |
| P | *FEVEYDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVEADEX* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *FEVSYDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *FEVSYDEX* | 0.00000 | 0.00000 | | 0.00000 | 1.11111 | |
| P | *REVSTDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVSTDEX* | 0.77000 | 0.00000 | | 0.00000 | 1.15385 | |
| P | *REVLSDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVSYDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVPFDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVSRDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVSRDEX* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *REVSSDEI* | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | *TEVSSDEX* | 0.00000 | 0.00000 | | 0.00000 | 1.10638 | |
| P | *PSDMX* | 0.00000 | 90.00000 | | 90.00000 | 20.00000 | |
| P | *VCDMX* | 0.00000 | 10.00000 | | 10.00000 | 27.68643 | |
| P | *VCEMX* | 0.00000 | 25.00000 | | 25.00000 | 2.68643 | |
| P | *EADMX* | 0.00000 | 3.00000 | | 3.00000 | 147.14860 | |
| P | *EAEMX* | 0.00000 | 9.00000 | | 9.00000 | 97.14860 | |
| P | *DEZMX* | 0.00000 | 1.00000 | | 1.00000 | 120.19572 | |

INDO/WRK *PROFS* ** *77*

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | *FWTR | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | *STWTR | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | *SAGTR | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | *TRPPCOS | 0.00000 | 1.00000 | 0.00000 | NONE | .22506 | |
| P | *TRNSTCOS | 0.00000 | 1.00000 | 0.00000 | NONE | .28272 | |
| P | *TRNSPCOS | 0.00000 | 1.00000 | 0.00000 | NONE | .39674 | |
| P | *TRPDUCOS | 0.00000 | 1.00000 | 0.00000 | NONE | .54600 | |
| P | *DUIDVTR | 0.00000 | 0.00000 | 0.00000 | NONE | .30000 | |
| P | *API NVTR | 0.00000 | 0.00000 | 0.00000 | NONE | .06557 | |
| P | *PCIDVTR | 0.00000 | 0.00000 | 0.00000 | NONE | .04978 | |
| P | *PYIDVTR | 0.00000 | 0.00000 | 0.00000 | NONE | .20769 | |
| P | *SUIDVTR | 0.00000 | 0.00000 | 0.00000 | NONE | .29413 | |
| P | *SCIDVTR | 0.00000 | 0.00000 | 0.00000 | NONE | .30000 | |
| P | *DEXPPTR | 0.00000 | 0.00000 | 0.00000 | NONE | .15000 | |
| P | *DEXXYTR | 0.00000 | 0.00000 | 0.00000 | NONE | 1.22727 | |
| P | *DEXTOTR | 0.00000 | 0.00000 | 0.00000 | NONE | 5.89446 | |
| P | *DEXPVTR | 0.00000 | 0.00000 | 0.00000 | NONE | .09524 | |
| P | *DEXSYTR | 0.00000 | 0.00000 | 0.00000 | NONE | .11111 | |
| P | *DEXSTTR | 0.00000 | 0.00000 | 0.00000 | NONE | .15385 | |
| P | *DEXSWTR | 0.00000 | 0.00000 | 0.00000 | NONE | .06000 | |
| P | *DEXPSTR | 0.00000 | 0.00000 | 0.00000 | NONE | .10638 | |
| T | *LDINT | 1.00000 | 0.00000 | 0.00000 | 1.00000 | -3772.45062 | |
| P | *CO2AR | 0.00000 | 0.00000 | 0.00000 | NONE | .11365 | |
| P | *CO4AR | 0.00000 | 0.00000 | 0.00000 | NONE | 15.84978 | |
| P | *SO2AR | 0.00000 | 0.00000 | 0.00000 | NONE | 7.52499 | |
| P | *BTASH | 0.00000 | 0.00000 | 0.00000 | NONE | 120.20000 | |
| P | *FLG1S | 0.00000 | 0.00000 | 0.00000 | NONE | 18.53783 | |
| P | *FLC2H | 0.00000 | 0.00000 | 0.00000 | NONE | 58.72592 | |
| P | *FLC3H | 0.00000 | 0.00000 | 0.00000 | NONE | 38.40009 | |
| P | *FLC4H | 0.00000 | 0.00000 | 0.00000 | NONE | 34.59900 | |
| P | *FTC2H | 0.00000 | 0.00000 | 0.00000 | NONE | 14.73592 | |
| P | *FTC3H | 0.00000 | 0.00000 | 0.00000 | NONE | 20.41009 | |
| P | *ZHEZ | 0.00000 | 0.00000 | 0.00000 | NONE | 124.19571 | |
| P | *EHEHZ | 0.00000 | 0.00000 | 0.00000 | NONE | 18.35000 | |
| P | *PFC2H | 0.00000 | 0.00000 | 0.00000 | NONE | 39.87639 | |
| P | *PFC3H | 0.00000 | 0.00000 | 0.00000 | NONE | 20.10834 | |
| P | *PFC4H | 0.00000 | 0.00000 | 0.00000 | NONE | 16.71466 | |
| P | *PFFEO | 0.00000 | 0.00000 | 0.00000 | NONE | .58484 | |
| P | *DMET | 0.00000 | 0.00000 | 0.00000 | NONE | 44.00000 | |
| P | *DMTO | 0.00000 | 0.00000 | 0.00000 | NONE | 122.36153 | |

IN007.36

SOLUTION TYPE = PHASE 2 - MEDIARY SOLUTION

NUMBER OF BASIS CHANGES
SINCE THE START OF THE PROBLEM = 236
NAME OF THE OBJECTIVE FUNCTION = ≠PROFS≠
NAME OF SELECTED ISET = ≠≠
NAME OF SELECTED RHS = ≠77≠
NAME OF SELECTED RANGES SET = ≠≠
NAME OF SELECTED BOUNDS SET = ≠BND1≠
VALUE OF THE OBJECTIVE FUNCTION = -2825.05128

BASIC VARIABLES
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| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| F | PROF1 | 39197.35736 | -39197.35736 | NONE | NONE | 0.00000 | |
| F | PROF2 | 39076.07592 | -39076.07592 | NONE | NONE | 0.00000 | |
| F | PROF3 | 37996.67104 | -37996.67104 | NONE | NONE | 0.00000 | |
| F | PROF4 | 14953.19611 | -14953.19611 | NONE | NONE | 0.00000 | |
| F | PROF5 | 2825.05128 | -2825.05128 | NONE | NONE | 1.00000 | |
| F | PROF6 | -9303.09348 | 9303.09348 | NONE | NONE | 0.00000 | |
| P | INVDU | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | INVSE | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | BFL | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | STG | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | BAG | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | LIMSC | 1096.13919 | -1096.13919 | | 0.00000 | 0.00000 | |
| P | LIMEH | 90.00000 | -90.00000 | | 0.00000 | 0.00000 | |
| P | METGX | 243.28364 | 56.71136 | | 300.00000 | 0.00000 | |
| M | METMN | 56.71136 | 56.71136 | -0.00000 | | 0.00000 | |
| P | ETHMX | 191.13919 | 403.86081 | | 595.00000 | 0.00000 | |

[illegible] APROF-A #* #77*

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 4 | ETHMN | BF | 403.86081 | 403.86081 | -0.00000 | | 0.00000 | |
| 5 | PROMX | UP | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| 6 | PROMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 7 | OUTMX | UP | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| 8 | OUTMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 9 | LAPMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| 10 | LAPMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 11 | COSMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| 12 | COSMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 13 | CPMGS | BF | 1539.42783 | 460.57217 | | 2000.00000 | 0.00000 | |
| 14 | CPMDU | BF | 145.25806 | 307.74194 | | 454.00000 | 0.00000 | |
| 15 | CPMAU | BF | 200.00000 | 0.00000 | | 200.00000 | 0.00000 | |
| 16 | CPMGS | BF | 460.47217 | 460.57217 | .10000 | | 0.00000 | |
| 17 | CPMDU | BF | 307.74194 | 307.74194 | -0.00000 | | 0.00000 | |
| 18 | CPMAU | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 19 | CPMEH | BF | 2.25806 | -2.25806 | | 0.00000 | 0.00000 | |
| 20 | MYDMX | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| 21 | FLOMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 22 | FDOMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 23 | ETEMX | BF | 100.00000 | 0.00000 | | 100.00000 | 0.00000 | |
| 24 | ETEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 25 | FEDMN | BF | 89.00000 | 90.00000 | 1.00000 | | 0.00000 | |
| 26 | PEEMX | BF | 136.50000 | 187.50000 | | 324.00000 | 0.00000 | |
| 27 | PEEMN | BF | 187.50000 | 187.50000 | -0.00000 | | 0.00000 | |
| 28 | PODMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 29 | PDOMX | UP | 16.00000 | 0.00000 | | 16.00000 | 0.00000 | |
| 30 | PPOMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 31 | PPOMX | UP | 102.00000 | 0.00000 | | 102.00000 | 0.00000 | |
| 32 | PPEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 33 | CAFMN | BF | 7.71374 | 7.71374 | -0.00000 | | 0.00000 | |
| 34 | MSDMN | BF | 11.26772 | 11.26772 | -0.00000 | | 0.00000 | |
| 35 | FDOMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 36 | XYDMX | BF | 5.00000 | 0.00000 | | 5.00000 | 0.00000 | |
| 37 | XYEMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| 38 | XYEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 39 | TODMX | BF | 0.00000 | 0.00000 | | 6.00000 | 0.00000 | |
| 40 | TODMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 41 | TOEMX | BF | 16.00000 | 0.00000 | | 16.00000 | 0.00000 | |
| 42 | TOEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| 43 | AZDMX | UP | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |

1450/[illegible] /PROFS* #* #77#

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| * | * | * | * | * | * | * | * | * |
| * | *ZDMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *FMDMX | *F* | 1.00000* | 0.00000* | * | 1.00000* | 0.00000* | * |
| * | *E DMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *VCDMX | *F* | 10.00000* | 0.00000* | * | 10.00000* | 0.00000* | * |
| * | *VCDMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *VCEMX | *F* | 25.00000* | 0.00000* | * | 25.00000* | 0.00000* | * |
| * | *VDMX | *F* | 24.00000* | 0.00000* | * | 24.00000* | 0.00000* | * |
| * | *VDMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *VEMX | *F* | 120.00000* | 0.00000* | * | 120.00000* | 0.00000* | * |
| * | *VEMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *EADMN | *F* | 3.00000* | 3.00000* | -0.00000* | * | 0.00000* | * |
| * | *EAEMN | *F* | 9.00000* | 9.00000* | -0.00000* | * | 0.00000* | * |
| * | *SYDMX | *F* | 5.00000* | 0.00000* | * | 5.00000* | 0.00000* | * |
| * | *SYDMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *SYEMX | *F* | 45.00000* | 0.00000* | * | 45.00000* | 0.00000* | * |
| * | *SYEMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *TDMX | *F* | 3.00000* | 0.00000* | * | 3.00000* | 0.00000* | * |
| * | *TDMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *TEMX | *F* | 10.00000* | 0.00000* | * | 10.00000* | 0.00000* | * |
| * | *TEMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *LSDMN | *F* | 22.50000* | 22.50000* | -0.00000* | * | 0.00000* | * |
| * | *YDMX | *F* | 5.00000* | 0.00000* | * | 5.00000* | 0.00000* | * |
| * | *YDMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *FDMN | *F* | 156.16752* | 156.16752* | -0.00000* | * | 0.00000* | * |
| * | *SRDMX | *F* | 5.00000* | 0.00000* | * | 5.00000* | 0.00000* | * |
| * | *SRDMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *SREMX | *F* | 20.00000* | 0.00000* | * | 20.00000* | 0.00000* | * |
| * | *SREMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *PSDMX | *F* | 15.00000* | 0.00000* | * | 15.00000* | 0.00000* | * |
| * | *PSDMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *PSEMX | *F* | 108.00000* | 0.00000* | * | 108.00000* | 0.00000* | * |
| * | *PSEMN | *F* | 0.00000* | 0.00000* | -0.00000* | * | 0.00000* | * |
| * | *EZMX | *F* | 1.00000* | 0.00000* | * | 1.00000* | 0.00000* | * |
| * | * | * | * | * | * | * | * | * |
| * | * | * | * | * | * | * | * | * |

T100/.-K #PROF # #* 477#

| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | *EZPOR | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *WMTR | *F* | 982.24345* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *CMATR | *F* | 5.25452* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *LABTR | *F* | 776.83617* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *WTTR | *F* | 7297.11557* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *CATTR | *F* | 647.17216* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *ITXTR | *F* | 395.21666* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *OYTR | *F* | 35.95.57234* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *EXATR | *F* | 3526.03199* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *UTLTR | *F* | 6.10.52914* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *INVTR | *F* | 121291.44751* | .30000* | 0.00000* | NONE | 0.00000* | |
| P | *CLOTR | *F* | 7. 003* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *TRETCOS | *F* | 119[illegible].93897* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *TRETF-COS | *F* | 7269.45452* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *TRETF/COS | *F* | 9.[illegible]* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| P | *GSLINVTR | *F* | 547.1545* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *SCINVTR | *F* | 28154.43224* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *LPINVTR | *F* | 66999.99993* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *QAINVTR | *F* | 9.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *FHINVTR | *F* | 5579.99999* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *SFINVTR | *F* | 3.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *PLINVTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *LEXPTTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *LEXPFTR | *F* | 46873.[illegible]032* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DEXVCTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *LEXPCTR | *F* | 1860.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *FIFLTR | *F* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DTIETTR | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DEIPTTR | *F* | 24300.[illegible]005* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *LEIPDTR | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DEIPFTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DFIC4TR | *F* | 269.48095* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DEIDGTR | *F* | 335.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *LEIPDTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DFIVYTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DFITCTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DFIPVTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DEIEPTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DFIVCTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| P | *DEIPVTR | *F* | 0.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |

I 100/365 #PROFSA 44 #774

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | DEISATR | 750.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISYTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEITTTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEILSTR | .22500 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIYTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPFTR | 1.56166 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DFISTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DFIPSTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DFATR | 4867.00035 | -0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEITR | 26659.79919 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| I | APTT | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | PCIT | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | YIII | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| P | SCVAR | 273.46591 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ARVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LDVAR | 200.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | OXVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | FVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | YVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PLVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | FIGS | 55.71156 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | FIHGS | 413.35051 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PRGGS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | WOTGS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | WAPGS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GAPGS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH2SC | 413.35061 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH3SC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH4SC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | APASC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GGASC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2H6D | 307.74194 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | [illegible] | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | NO2GS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | NO3GS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HLD | 300.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HDA | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | VC1PC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HEH | 7.74194 | 0.00000 | 0.00000 | NONE | 0.00000 | |

IN00/:K *PROF-* ** *77*

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| *C2H6E | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *STYRY | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *C3HPL | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *C4H10 | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *PEPF1 | *F* | 277.3[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *PPPF1 | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *C4C6H | *F* | 7.71374* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *MG001 | *F* | 11.26772* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *MG002 | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *MG003 | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *MG004 | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *MG005 | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *FUEL0 | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *XYXYL | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *TOTOL | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EHEXZ | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *VCVC1 | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *PVPVC | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *FAEOL | *F* | 12.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *SYSTY | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *BTLTA | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *LELDS | *F* | 22.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *PYRTY | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *PFSYS | *F* | 144.4747[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *PPCOH | *F* | 11.79274* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *SPOHR | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *FSPST | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPET | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *FXPPE | *F* | 1[illegible]7.5[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *FXPMP | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPAY | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPTO | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPVC | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPMV | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPEM | *F* | 9.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *FXPSY | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPST | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPSA | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EXPPS | *F* | 0.00000* | 0.00000* | 0.00000* | NONE | 0.00000* | |

```
I[illegible]/A[illegible]K   *PROFS*   ##          *77*

***********************************************************************************************************************
*T *        *S *              *           *           *          *             *                                      *
*Y *VARIABLE*T *     VALUE    *    COST   *   LOWER   *   UPPER  *      DJ     *              COMMENTS                *
*P *  NAME  *A *              *           *   BOUND   *   BOUND  *             *                                      *
*E *        *T *              *           *           *          *             *                                      *
***********************************************************************************************************************
*  *        *  *              *           *           *          *             *                                      *
*[illegible] *[illegible]FL   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]PE   *[illegible]F*    9[illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]PO   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]PP   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]C4   *[illegible]F*      7.71374*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]G    *[illegible]F*     11.26772*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]FG   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]AY   *[illegible]F*    0.[illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]7    *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]EA   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]YC   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]PV   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]EA   *EF*    3.[illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]SY   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]T    *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]ALS  *[illegible]F*     22.5[illegible]*    1.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]Y    *[illegible]F*    [illegible]*    1.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]PF   *[illegible]F*    156.16732*    1.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]5R   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*[illegible] *[illegible]P5   *[illegible]F*    [illegible]*    0.00000*    0.00000*     NONE    *     0.00000*        *
*  *        *  *              *           *           *          *             *                                      *
*  *        *  *              *           *           *          *             *                                      *
***********************************************************************************************************************
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1000/000 *PROF * ** *77*

NON BASIC VARIABLES
**********

| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| * | ETCOST | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | ETHCOST | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible]COST | 0.00000 | 0.00000 | | 0.00000 | .66332 | |
| * | [illegible]UTCOST | 0.00000 | 0.00000 | | 0.00000 | .57643 | |
| * | [illegible]PCOST | 0.00000 | 0.00000 | | 0.00000 | .54616 | |
| * | GASOCOST | 0.00000 | 0.00000 | | 0.00000 | .43293 | |
| * | [illegible]ZCOST | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | IOVGS | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| * | IOVSC | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| * | IOVER | 0.00000 | 0.00000 | | 0.00000 | .21851 | |
| * | IOVLD | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| * | IOVOX | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| * | IOVPC | 0.00000 | 0.00000 | | 0.00000 | .08678 | |
| * | IOVFH | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| * | IOVSH | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| * | IOVPY | 0.00000 | 0.00000 | | 0.00000 | .09291 | |
| * | IOVPL | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| * | IOVSO | 0.00000 | 0.00000 | | 0.00000 | .00587 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | .02000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 16.40516 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 69.97901 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| * | [illegible] | 0.00000 | 0.00000 | | 0.00000 | .63367 | |
| * | LIMLD | 0.00000 | 0.00000 | | 0.00000 | 46.45386 | |
| * | LIMOX | 0.00000 | 0.00000 | | 0.00000 | 64.53623 | |
| * | LIMPC | 0.00000 | 0.00000 | | 0.00000 | 1.16281 | |
| * | LIMPE | 0.00000 | 0.00000 | | 0.00000 | 339.37314 | |
| * | LIMPY | 0.00000 | 0.00000 | | 0.00000 | .58265 | |
| * | LIMPL | 0.00000 | 0.00000 | | 0.00000 | 29.19925 | |
| * | CPASC | 0.00000 | 0.00000 | | 0.00000 | 12.00000 | |

INDO/WAK #PROF5# ## #77#

| VARIABLE NAME | STAT | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| CP4AP | UF | 0.00000 | 0.00000 | | 0.00000 | 24.23261 | |
| CP4LD | UF | 0.00000 | 0.00000 | | 0.00000 | 101.95389 | |
| CP4JV | UF | 0.00000 | 0.00000 | | 0.00000 | 112.53623 | |
| CP4PC | UF | 0.00000 | 0.00000 | | 0.00000 | 14.76000 | |
| CP4SE | UF | 0.00000 | 0.00000 | | 0.00000 | 364.97314 | |
| CP4PY | UF | 0.00000 | 0.00000 | | 0.00000 | 8.78000 | |
| CSMPL | UF | 0.00000 | 0.00000 | | 0.00000 | 89.19925 | |
| FL3A | UF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| CT3A | UF | 0.00000 | 0.00000 | | 0.00000 | 44.00000 | |
| FFPA | UF | 0.00000 | 0.00000 | | 0.00000 | 250.00000 | |
| PD4A | UF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| PDPA | UF | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| CW3A | UF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| [illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| [illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |
| XY3A | UF | 0.00000 | 0.00000 | | 0.00000 | 406.47272 | |
| TQ4A | UF | 0.00000 | 0.00000 | | 0.00000 | 174.16364 | |
| HZ4A | UF | 0.00000 | 0.00000 | | 0.00000 | 90.00000 | |
| FS4A | UF | 0.00000 | 0.00000 | | 0.00000 | 98.00000 | |
| VC4A | UF | 0.00000 | 0.00000 | | 0.00000 | 150.00000 | |
| PV4A | UF | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| FA4A | UF | 0.00000 | 0.00000 | | 0.00000 | 61.42621 | |
| [illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 200.00000 | |
| TM4A | UF | 0.00000 | 0.00000 | | 0.00000 | 150.00000 | |
| LS3A | UF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| FY4A | UF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| PF4A | UF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| SP[illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| PS4A | UF | 0.00000 | 0.00000 | | 0.00000 | 260.00000 | |
| G[illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 18.54783 | |
| C2[illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 56.35657 | |
| C3[illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 18.30175 | |
| C4[illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| [illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| [illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| [illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| FB[illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |
| [illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| XYL[illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 408.47272 | |
| [illegible] | UF | 0.00000 | 0.00000 | | 0.00000 | 94.00000 | |

TR 00/4[illegible] AP 30F [illegible] AF [illegible] 77A

| T | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | TOL[illegible] | 0.00000 | 0.00000 | | 0.00000 | 174.16364 | |
| P | FBZ[illegible] | 0.00000 | 0.00000 | | 0.00000 | 88.00000 | |
| P | PA[illegible] | 0.00000 | 0.00000 | | 0.00000 | 13.59727 | |
| P | GOA[illegible] | 0.00000 | 0.00000 | | 0.00000 | 13.46795 | |
| P | PVC[illegible] | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | EAL[illegible] | 0.00000 | 0.00000 | | 0.00000 | 61.42621 | |
| P | TY[illegible] | 0.00000 | 0.00000 | | 0.00000 | 260.00000 | |
| P | ST[illegible] | 0.00000 | 0.00000 | | 0.00000 | 260.00000 | |
| P | PO[illegible] | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | PE[illegible] | 0.00000 | 0.00000 | | 0.00000 | 250.00000 | |
| P | LG[illegible] | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | VCI[illegible] | 0.00000 | 0.00000 | | 0.00000 | 150.00000 | |
| P | TY[illegible] | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PTA[illegible] | 0.00000 | 0.00000 | | 0.00000 | 150.00000 | |
| P | [illegible] | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | CH2[illegible] | 0.00000 | 0.00000 | | 0.00000 | 18.36000 | |
| P | CH3[illegible] | 0.00000 | 0.00000 | | 0.00000 | 12.52884 | |
| P | CH4[illegible] | 0.00000 | 0.00000 | | 0.00000 | 11.66043 | |
| P | C2X[illegible] | 0.00000 | 0.00000 | | 0.00000 | 56.35687 | |
| P | REVFLDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | FVETDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVFTDEX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | FVPEDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPEDEX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPDEX | 0.00000 | 0.00000 | | 0.00000 | 1.15000 | |
| P | REVC4DEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REV16DEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVFDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVXYDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVXYDEX | 0.00000 | 0.00000 | | 0.00000 | 18.56694 | |
| P | REVTDDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVTDDEX | 0.00000 | 0.00000 | | 0.00000 | 6.96655 | |
| P | REVZDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | FVEZDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVZVCDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVVCDEX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |

IBM 360/65A *PROFS* ** *77*

| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| * | * | * | * | * | * | * | * |
| * | *REVPODEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVPODEX* | 0.00000 | 0.00000 | * | 0.00000 | 1.09524 | * |
| * | *REVPOFEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVPOFEX* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVSYDEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVSYDEX* | 0.00000 | 0.00000 | * | 0.00000 | 1.11111 | * |
| * | *REVTDEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVTDEX* | 0.00000 | 0.00000 | * | 0.00000 | 1.15385 | * |
| * | *REVLODEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVYDEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVFDEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVSDEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVSDEX* | 0.00000 | 0.00000 | * | 0.00000 | 1.36000 | * |
| * | *REVSDEI* | 0.00000 | 0.00000 | * | 0.00000 | 1.00000 | * |
| * | *REVSDEX* | 0.00000 | 0.00000 | * | 0.00000 | 1.10636 | * |
| * | *ZOLA* | 0.00000 | 90.00000 | * | 90.00000 | 20.00000 | * |
| * | *XYOLA* | 0.00000 | 0.00000 | -0.00000 | * | -359.47272 | * |
| * | *YCFLA* | 0.00000 | 0.00000 | -0.00000 | * | -25.00000 | * |
| * | *FSOLA* | 0.00000 | 3.00000 | * | 3.00000 | 188.57380 | * |
| * | *EAELA* | 0.00000 | 9.00000 | * | 9.00000 | 138.57380 | * |
| * | * | * | * | * | * | * | * |
| * | * | * | * | * | * | * | * |

1:00/ \ PROF ## #774

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | [illegible] | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .33666 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .42357 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .45384 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .56707 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .30000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .08149 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .21322 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .20709 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .29413 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .30000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .15000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 17.56694 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 5.96655 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .09924 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .11111 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .15355 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .06000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .10636 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.00000 | 3599.99999 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.00000 | -4486.16572 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.00000 | -11827.24551 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.00000 | 1674.00000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.00000 | -67304.62774 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1.00000 | -1990.72602 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 50.10000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 12.84327 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 6.36800 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 318.17314 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 120.20000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 16.53783 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 56.34687 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 18.29175 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 34.99000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 12.35687 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | .30175 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 4.30000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | NONE | 37.49734 | |

[400/498 =PROFIT# ##  #77#

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| XF | PFC#1 | 0.00000 | 0.00000 | 0.00000 | NONE | 16.71466 | |
| XF | PFFFO | 0.00000 | 0.00000 | 0.00000 | NONE | .58484 | |
| XF | LOMET | 0.00000 | 0.00000 | 0.00000 | NONE | 44.00000 | |
| XF | SOMTO | 0.00000 | 0.00000 | 0.00000 | NONE | 124.16364 | |

MAGEN 6000 JN

CONTROL DATA CORPORATION
CYBERNET SERVICE

THE MAGEN LANGUAGE WAS DEVELOPED BY
AND IS PROPRIETARY TO
HAVERLY SYSTEMS INC DENVILLE N.J.

DATE OF RUN 09/09/71
START TIME 19:29:29
VERSION 1.2*1
CP TIME 3.724 SECONDS
FIELD LENGTH 145000 OCTAL

## INDONESIAN PETROCHEMICAL PROJECT

| UNITS | SIZE TH.TONS/YR | COST,$MM |
|---|---|---|
| STEAM CRACKER | 404 | 26.154 |
| AROMATICS UNIT | | |
| LD POLYETHLENE UNIT | 300 | 87.000 |
| OXYCHLORINATION VICL UNIT | | |
| POLY VICL UNIT | | |
| ETHYL ALCOHOL HYDRATION UNIT | 10 | 5.580 |
| STYRENE UNIT | | |
| POLY STYRENE UNIT | | |
| POLY PROPYLENE UNIT | | |
| GAS SEPARATION | 461 | .547 |
| DUMMY | 308 | |
| BUTADIENE EXTRACTION UNIT(DMF) | | |
| SBR UNIT | | |
| TOTAL | | 121.281 ONSITES ONLY |

| PRODUCTS | DOMEST | EXPT | VALUE DOM.MM$/YR | VALUE EXP.MM$/YR |
|---|---|---|---|---|
| GAS TO FLARE | | | | |
| ETHYLENE POLYMER GRADE | | | | |
| POLYETHYLENE LD | 90 | 188 | 24.300 | 46.875 |
| PROPYLENE POLYMER GRADE | | | | |
| POLYPROPYLENE | | | | |
| MIXED BUTANES/UNSATS | 8 | | .270 | |
| GASOLINE 400EP | 11 | | .338 | |
| FUEL OIL 400PLUS | | | | |
| XYLENES MIXED | | | | |
| TOLUENE | | | | |
| BENZENE | | | | |
| ETHYL BENZENE | | | | |
| VINYL CHLORIDE | | | | |
| POLY VINYL CHLORIDE | | | | |
| ETHYL ALCOHOL | 3 | 9 | .750 | 1.800 |
| STYRENE | | | | |
| BUTADIENE | | | | |

| | | | |
|---|---|---|---|
| LOSS | 66 | .000 | |
| BUTYLENE | | | |
| PROCESS FUEL | 100 | .042 | |
| SYNTHETIC RUBBER | | | |
| POLYSTYRENE | | | |
| TOTAL | | 25.660 | 48.675 |

| | $/MT |
|---|---|
| GROSS REV | 74 |
| FEED COST | 8 |
| MARGIN | 66 |
| OPERATING COSTS | |
| LOCAL | 13 |
| FOREIGN | 14 |
| NET MARGIN | 39 |

INDO/WBK

SOLUTION TYPE = PHASE 2 - OPTIMUM

NUMBER OF BASIS CHANGES
SINCE THE START OF THE PROBLEM = 314
NAME OF THE OBJECTIVE FUNCTION = ≠PROF1≠
NAME OF SELECTED ISET = ≠≠
NAME OF SELECTED RHS = ≠84≠
NAME OF SELECTED RANGES SET = ≠≠
NAME OF SELECTED BOUNDS SET = ≠BND1≠
VALUE OF THE OBJECTIVE FUNCTION = -75922.03712

BASIC VARIABLES

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| F | PROF1 | B | 75922.03712 | -75922.03712 | NONE | NONE | 1.00000 | |
| F | PROF2 | B | 75730.10663 | -75730.10663 | NONE | NONE | 0.00000 | |
| F | PROF3 | B | 74021.92530 | -74021.92530 | NONE | NONE | 0.00000 | |
| F | PROF4 | B | 37555.13268 | -37555.13268 | NONE | NONE | 0.00000 | |
| F | PROF5 | B | 18362.08396 | -18362.08396 | NONE | NONE | 0.00000 | |
| F | PROF6 | B | -830.96481 | 830.96481 | NONE | NONE | 0.00000 | |
| P | INVDU | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | INVSB | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | BFW | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | STM | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | BAG | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | METMX | BF | 196.99255 | 103.00745 | | 300.00000 | 0.00000 | |
| M | METMN | BF | 103.00745 | 103.00745 | -0.00000 | | 0.00000 | |
| P | ETHMX | BF | .68110 | 594.31890 | | 595.00000 | 0.00000 | |
| M | ETHMN | BF | 594.31890 | 594.31890 | -0.00000 | | 0.00000 | |
| M | PROMN | BF | 1.00000 | 1.00000 | -0.00000 | | 0.00000 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| M | BUTMN | BF | 1.00000 | 1.00000 | -0.00000 | | 0.00000 | |
| M | NAPMN | BF | 1.00000 | 1.00000 | -0.00000 | | 0.00000 | |
| P | GAOMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | GAOMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | CPMGS | BF | 1299.67365 | 700.32635 | | 2000.00000 | 0.00000 | |
| P | CPMBU | BF | 195.71429 | 4.28571 | | 200.00000 | 0.00000 | |
| M | CPNGS | BF | 700.22635 | 700.32635 | .10000 | | 0.00000 | |
| M | CPNDU | BF | 454.00000 | 454.00000 | -0.00000 | | 0.00000 | |
| M | CPNBU | BF | 4.28571 | 4.28571 | -0.00000 | | 0.00000 | |
| P | HYDBA | BF | 3.31165 | -3.31165 | | 0.00000 | 0.00000 | |
| M | FLDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | ETDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | ETEMX | BF | 100.00000 | 0.00000 | | 100.00000 | 0.00000 | |
| M | ETEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | PEDMX | BF | 32.50000 | 277.50000 | | 310.00000 | 0.00000 | |
| M | PEDMN | BF | 7.50000 | 277.50000 | 270.00000 | | 0.00000 | |
| P | PEEMX | BF | 16.00000 | 0.00000 | | 16.00000 | 0.00000 | |
| M | PEEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PODMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PPDMN | BF | 2.00000 | 16.00000 | 14.00000 | | 0.00000 | |
| P | PPEMX | BF | 31.91177 | .08823 | | 32.00000 | 0.00000 | |
| M | PPEMN | BF | .08823 | .08823 | -0.00000 | | 0.00000 | |
| M | C4DMN | BF | 7.29958 | 7.29958 | -0.00000 | | 0.00000 | |
| M | MGDMN | BF | 10.20264 | 10.20264 | -0.00000 | | 0.00000 | |
| M | FODMN | BF | .05770 | .05770 | -0.00000 | | 0.00000 | |
| P | XYDMX | BF | 3.91857 | 1.08143 | | 5.00000 | 0.00000 | |
| M | XYDMN | BF | 1.08143 | 1.08143 | -0.00000 | | 0.00000 | |
| P | XYEMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | XYEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | TODMX | BF | 4.91832 | 1.08168 | | 6.00000 | 0.00000 | |
| M | TODMN | BF | 1.08168 | 1.08168 | -0.00000 | | 0.00000 | |
| P | TOEMX | BF | 16.00000 | 0.00000 | | 16.00000 | 0.00000 | |
| M | TOEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | BZDMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | BZDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | EBDMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | EBDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | VCDMN | BF | 10.00000 | 10.00000 | -0.00000 | | 0.00000 | |
| P | VCEMX | BF | 25.00000 | 0.00000 | | 25.00000 | 0.00000 | |
| M | VCEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |

INDO/WBK #PROF1# ## #84#

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| M | PVDMN | BF | 6.00000 | 60.00000 | 54.00000 | | 0.00000 | |
| P | PVEMX | BF | 7.84501 | 97.15499 | | 105.00000 | 0.00000 | |
| M | PVEMN | BF | 7.15499 | 97.15499 | 90.00000 | | 0.00000 | |
| M | EADMN | BF | 1.00000 | 15.00000 | 14.00000 | | 0.00000 | |
| M | EAEMN | BF | 2.00000 | 19.00000 | 17.00000 | | 0.00000 | |
| M | SYDMN | BF | 5.00000 | 5.00000 | -0.00000 | | 0.00000 | |
| P | SYEMX | BF | 45.00000 | 0.00000 | | 45.00000 | 0.00000 | |
| M | SYEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | BTDMN | BF | 3.00000 | 3.00000 | -0.00000 | | 0.00000 | |
| P | BTEMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | BTEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | LSDMN | BF | 24.28758 | 24.28758 | -0.00000 | | 0.00000 | |
| P | BYDMX | BF | 3.71429 | 1.28571 | | 5.00000 | 0.00000 | |
| M | BYDMN | BF | 1.28571 | 1.28571 | -0.00000 | | 0.00000 | |
| M | PFDMN | BF | 236.03397 | 236.03397 | -0.00000 | | 0.00000 | |
| P | SRDMX | BF | 5.00000 | 0.00000 | | 5.00000 | 0.00000 | |
| M | SRDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | SREMX | BF | 20.00000 | 0.00000 | | 20.00000 | 0.00000 | |
| M | SREMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PSDMN | BF | 4.00000 | 40.00000 | 36.00000 | | 0.00000 | |
| M | PSEMN | BF | 12.00000 | 120.00000 | 108.00000 | | 0.00000 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | BEZPUR | BF | 126.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | KWHTR | BF | 3583.20940 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | CWATR | BF | 14.91613 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | LABTR | BF | 2183.14800 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | MNTTR | BF | 23582.37421 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | CATTR | BF | 4265.37318 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | ITXTR | BF | 1082.59302 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | ROYTR | BF | 4914.89669 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXATR | BF | 10737.42307 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | UTLTR | BF | 14960.40350 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | INVTR | BF | 191930.48748 | .00010 | 0.00000 | NONE | 0.00000 | |
| P | CLOTR | BF | 6587.20712 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRMETCOS | BF | 2163.15644 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRETHCOS | BF | 10697.74013 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRPROCOS | BF | 18.30000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRBUICOS | BF | 19.50000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRNAPCOS | BF | 25.00000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRBEZCOS | BF | 11844.00000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | GSINVTR | BF | 830.69087 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SCINVTR | BF | 28666.50701 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ARINVTR | BF | 1200.28507 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LDINVTR | BF | 86999.99993 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | OXINVTR | BF | 15232.13795 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PCINVTR | BF | 28023.21660 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EHINVTR | BF | 4520.90321 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SEINVTR | BF | 4495.53255 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PYINVTR | BF | 15915.78942 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PLINVTR | BF | 4116.85363 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | BUINVTR | BF | 1928.57142 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXETTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXPETR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXPPTR | BF | 17.64614 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXXYTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXTOTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXVCTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXPVTR | BF | 20402.54863 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXEATR | BF | 3800.00001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXSYTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXBTTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXSRTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | DEXPSTR | BF | 28200.00005 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIFLTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIETTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPETR | BF | 74925.00039 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPOTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPPTR | BF | 3680.00001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIC4TR | BF | 255.48518 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIMGTR | BF | 306.07913 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIFOTR | BF | .98090 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIXYTR | BF | 52.99012 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEITOTR | BF | 54.08415 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIBZTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIEBTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIVCTR | BF | 1500.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPVTR | BF | 13800.00003 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIEATR | BF | 3750.00001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISYTR | BF | 1000.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIBTTR | BF | 450.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEILSTR | BF | .24288 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIBYTR | BF | 23.14286 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPFTR | BF | 2.36034 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISRTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPSTR | BF | 10400.00002 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXTR | BF | 52420.19487 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEITR | BF | 110200.36610 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| I | SCINT | B | .39815 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | ARINT | B | .05412 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | OXINT | B | .42787 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | PCINT | B | .82713 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | EHINT | B | .21935 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | SEINT | B | .23786 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | PYINT | B | .84211 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | PLINT | B | .18056 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| P | SCVAR | BF | 517.58971 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ARVAR | BF | 10.28197 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LDVAR | BF | 200.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | OXVAR | BF | 68.45905 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PCVAR | BF | 148.88368 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EHVAR | BF | 19.74194 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SEVAR | BF | 42.81460 | 0.00000 | 0.00000 | NONE | 0.00000 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | PYVAR | BF | 151.57895 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PLVAR | BF | 15.16736 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | METGS | BF | 103.00745 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ETHGS | BF | 594.31890 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PROGS | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | BUTGS | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | NAPGS | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GAOGS | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH2SC | BF | 594.31890 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH3SC | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH4SC | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | NPASC | BF | .90000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GOASC | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2XDU | BF | 454.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MO1AR | BF | 10.81053 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MO4AR | BF | .01260 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MO5AR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HLD | BF | 300.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HOX | BF | 85.57381 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | VC1PC | BF | 165.42631 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HEH | BF | 21.93548 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HSE | BF | 46.49071 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EBZSE | BF | 1.08107 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | STYPY | BF | 168.42105 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C3HPL | BF | 17.87581 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C4MBU | BF | 4.28571 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PEPE1 | BF | 277.50000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PPPP1 | BF | 16.08823 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C4C4M | BF | 7.29958 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGMO1 | BF | 5.77097 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGMO2 | BF | .06000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGMO3 | BF | .03700 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGRAF | BF | 4.33467 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | FOFEG | BF | .05770 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | XYXYL | BF | 1.08143 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | TOTOL | BF | 1.08168 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | VCVC1 | BF | 10.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PVPVC | BF | 157.15499 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EAEAL | BF | 34.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SYSTY | BF | 5.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | BTBTA | BF | 3.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LSLOS | BF | 24.28758 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | BYBTY | BF | 1.28571 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PFGAS | BF | 236.03397 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SRSRR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PSPST | BF | 160.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPET | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPP | BF | .08823 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPV | BF | 97.15499 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPEA | BF | 19.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPS | BF | 120.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMFL | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPE | BF | 277.50000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPO | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPP | BF | 16.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMC4 | BF | 7.29958 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMMG | BF | 10.20264 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMFO | BF | .05770 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMXY | BF | 1.08143 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMTO | BF | 1.08168 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMBZ | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMEB | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMVC | BF | 10.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPV | BF | 60.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMEA | BF | 15.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMSY | BF | 5.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMBT | BF | 3.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMLS | BF | 24.28758 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMBY | BF | 1.28571 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPF | BF | 236.03397 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMSR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPS | BF | 40.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

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NON BASIC VARIABLES

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | METCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ETHCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | PROCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | BUTCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | NAPCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | GAOCOST | NF | 0.00000 | 0.00000 | | 0.00000 | .92351 | |
| P | BEZCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | INVGS | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVSC | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVAR | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVLD | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVOX | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVPC | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVEH | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVSE | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVPY | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVPL | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVBU | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | KWH | NF | 0.00000 | 0.00000 | | 0.00000 | .02000 | |
| P | CWA | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | LAB | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | MNT | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | CAT | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ITX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ROY | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | FUL | NF | 0.00000 | 0.00000 | | 0.00000 | 16.15130 | |
| P | EXA | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | UTL | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | INV | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | CLO | NF | 0.00000 | 0.00000 | | 0.00000 | 69.97901 | |
| P | DEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | DEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | LIMSC | NF | 0.00000 | 0.00000 | | 0.00000 | .00080 | |
| P | LIMAR | NF | 0.00000 | 0.00000 | | 0.00000 | .00029 | |
| P | LIMLD | NF | 0.00000 | 0.00000 | | 0.00000 | 16.76668 | |
| P | LIMOX | NF | 0.00000 | 0.00000 | | 0.00000 | .00180 | |
| P | LIMPC | NF | 0.00000 | 0.00000 | | 0.00000 | .00134 | |
| P | LIMEH | NF | 0.00000 | 0.00000 | | 0.00000 | .00391 | |
| P | LIMSE | NF | 0.00000 | 0.00000 | | 0.00000 | .00095 | |
| P | LIMPY | NF | 0.00000 | 0.00000 | | 0.00000 | .00095 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | LIMPL | NF | 0.00000 | 0.00000 | | 0.00000 | .00303 | |
| P | PROMX | NF | 0.00000 | 1.00000 | | 1.00000 | 8.98906 | |
| P | BUTMX | NF | 0.00000 | 1.00000 | | 1.00000 | 9.66849 | |
| P | NAPMX | NF | 0.00000 | 1.00000 | | 1.00000 | 2.95499 | |
| P | CPMDU | NF | 0.00000 | 454.00000 | | 454.00000 | 122.33479 | |
| P | CPMSC | NF | 0.00000 | 0.00000 | | 0.00000 | .00480 | |
| P | CPMAR | NF | 0.00000 | 0.00000 | | 0.00000 | .01109 | |
| P | CPMLD | NF | 0.00000 | 0.00000 | | 0.00000 | 16.78518 | |
| P | CPMOX | NF | 0.00000 | 0.00000 | | 0.00000 | .01780 | |
| P | CPMPC | NF | 0.00000 | 0.00000 | | 0.00000 | .01694 | |
| P | CPMEH | NF | 0.00000 | 0.00000 | | 0.00000 | .02061 | |
| P | CPMSE | NF | 0.00000 | 0.00000 | | 0.00000 | .00945 | |
| P | CPMPY | NF | 0.00000 | 0.00000 | | 0.00000 | .00945 | |
| P | CPMPL | NF | 0.00000 | 0.00000 | | 0.00000 | .02303 | |
| P | FLBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | ETBA | NF | 0.00000 | 0.00000 | | 0.00000 | 44.00000 | |
| P | PEBA | NF | 0.00000 | 0.00000 | | 0.00000 | 270.00000 | |
| P | POBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PPBA | NF | 0.00000 | 0.00000 | | 0.00000 | 200.00000 | |
| P | C4BA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| P | MGBA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | FOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |
| P | XYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 49.00000 | |
| P | TOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 50.00000 | |
| P | BZBA | NF | 0.00000 | 0.00000 | | 0.00000 | 90.00000 | |
| P | EBBA | NF | 0.00000 | 0.00000 | | 0.00000 | 88.00000 | |
| P | VCBA | NF | 0.00000 | 0.00000 | | 0.00000 | 145.68306 | |
| P | PVBA | NF | 0.00000 | 0.00000 | | 0.00000 | 210.00000 | |
| P | EABA | NF | 0.00000 | 0.00000 | | 0.00000 | 128.26685 | |
| P | SYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 182.01695 | |
| P | BTBA | NF | 0.00000 | 0.00000 | | 0.00000 | 146.25733 | |
| P | LSBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | BYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PFBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | SRBA | NF | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | PSBA | NF | 0.00000 | 0.00000 | | 0.00000 | 231.83831 | |
| P | GASBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.26097 | |
| P | C2HBA | NF | 0.00000 | 0.00000 | | 0.00000 | 160.02557 | |
| P | C3HBA | NF | 0.00000 | 0.00000 | | 0.00000 | 80.47797 | |
| P | C4MBA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | MO1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | MO2BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | MO3BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | FEOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |
| P | RAFBA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | XYLBA | NF | 0.00000 | 0.00000 | | 0.00000 | 49.00000 | |
| P | BEZBA | NF | 0.00000 | 0.00000 | | 0.00000 | 163.95607 | |
| P | TOLBA | NF | 0.00000 | 0.00000 | | 0.00000 | 50.00000 | |
| P | EBZBA | NF | 0.00000 | 0.00000 | | 0.00000 | 119.04530 | |
| P | NPABA | NF | 0.00000 | 0.00000 | | 0.00000 | 28.93082 | |
| P | GOABA | NF | 0.00000 | 0.00000 | | 0.00000 | 27.70540 | |
| P | PVCBA | NF | 0.00000 | 0.00000 | | 0.00000 | 210.00000 | |
| P | EALBA | NF | 0.00000 | 0.00000 | | 0.00000 | 128.26685 | |
| P | STYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 182.01695 | |
| P | PSTBA | NF | 0.00000 | 0.00000 | | 0.00000 | 231.83831 | |
| P | PP1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 200.00000 | |
| P | MO4BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.06418 | |
| P | MO5BA | NF | 0.00000 | 0.00000 | | 0.00000 | 34.92426 | |
| P | PE1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 270.00000 | |
| P | LOSBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | VC1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 145.68306 | |
| P | BTYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | BTABA | NF | 0.00000 | 0.00000 | | 0.00000 | 146.25733 | |
| P | SRRBA | NF | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | CH2BA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00012 | |
| P | CH3BA | NF | 0.00000 | 0.00000 | | 0.00000 | 27.28919 | |
| P | CH4BA | NF | 0.00000 | 0.00000 | | 0.00000 | 29.16863 | |
| P | C2XBA | NF | 0.00000 | 0.00000 | | 0.00000 | 37.69078 | |
| P | REVFLDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVETDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVETDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPEDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPEDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPODEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPPDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPPDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVC4DEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVMGDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVFODEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVXYDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | REVXYDEX | NF | 0.00000 | 0.00000 | | | | |
| P | REVTODEI | NF | 0.00000 | [illegible] | | | | |
| P | REVPVDEI | NF | 0.00000 | 0.00000 | | [illegible] | [illegible] | |
| P | REVPVDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVEADEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVEADEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSYDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSYDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVBTDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVBTDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVLSDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVBYDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPFDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSRDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSRDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPSDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPSDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | PYDMX | NF | 0.00000 | 16.00000 | | 16.00000 | 30.00000 | |
| P | VCDMX | NF | 0.00000 | 10.00000 | | 10.00000 | 4.31694 | |
| P | PVDMX | NF | 0.00000 | 60.00000 | | 60.00000 | 20.00000 | |
| P | EADMX | NF | 0.00000 | 15.00000 | | 15.00000 | 121.73315 | |
| P | EAEMX | NF | 0.00000 | 19.00000 | | 19.00000 | 71.73315 | |
| P | SYDMX | NF | 0.00000 | 5.00000 | | 5.00000 | 17.98305 | |
| P | BTDMX | NF | 0.00000 | 3.00000 | | 3.00000 | 3.74267 | |
| P | PSDMX | NF | 0.00000 | 40.00000 | | 40.00000 | 28.16169 | |
| P | PSEMX | NF | 0.00000 | 120.00000 | | 120.00000 | 3.16169 | |
| P | BEZMX | NF | 0.00000 | 126.00000 | | 126.00000 | 69.95607 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠B4≠

| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | BFWTR | NF | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | STMTR | NF | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | BAGTR | NF | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | TRGAOCOS | NF | 0.00000 | 1.00000 | 0.00000 | NONE | .07649 | |
| P | DUINVTR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | .00010 | |
| P | SBINVTR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | .00010 | |
| I | LDINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | -5026.85484 | |
| P | MO2AR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 11.57864 | |
| P | MO3AR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 15.45696 | |
| P | BTASB | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 109.26411 | |
| P | FLGAS | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 18.25097 | |
| P | FLC2H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 160.01557 | |
| P | FLC3H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 80.46797 | |
| P | FLC4M | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 34.99000 | |
| P | ETC2H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 116.02557 | |
| P | POC3H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 62.47797 | |
| P | MGM04 | NF | 0.00000 | 0.00000 | 0.00000 | NONE | .06418 | |
| P | MGM05 | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 4.92426 | |
| P | BZBEZ | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 73.95606 | |
| P | EBEBZ | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 31.04530 | |
| P | PFC2H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 141.45773 | |
| P | PFC3H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 62.45927 | |
| P | PFC4M | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 16.99746 | |
| P | PFFEO | NF | 0.00000 | 0.00000 | 0.00000 | NONE | .83870 | |
| P | EXPPE | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 20.00000 | |
| P | EXPXY | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 27.00000 | |
| P | EXPTO | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 25.00000 | |
| P | EXPVC | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 20.68306 | |
| P | EXPSY | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 2.01695 | |
| P | EXPBT | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 16.25733 | |
| P | EXPSR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 15.00000 | |
| P | DOMET | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 44.00000 | |

INDO/WBK

SOLUTION TYPE = PHASE 2 - MEDIARY SOLUTION

NUMBER OF BASIS CHANGES
SINCE THE START OF THE PROBLEM = 322
NAME OF THE OBJECTIVE FUNCTION = ≠PROF1≠
NAME OF SELECTED ISET = ≠≠
NAME OF SELECTED RHS = ≠84≠
NAME OF SELECTED RANGES SET = ≠≠
NAME OF SELECTED BOUNDS SET = ≠BND1≠
VALUE OF THE OBJECTIVE FUNCTION = -75920.28187

BASIC VARIABLES

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| F | PROF1 | B | 75920.28187 | -75920.28187 | NONE | NONE | 1.00000 | |
| F | PROF2 | B | 75710.79886 | -75710.79886 | NONE | NONE | 0.00000 | |
| F | PROF3 | B | 73846.40010 | -73846.40010 | NONE | NONE | 0.00000 | |
| F | PROF4 | B | 34044.62866 | -34044.62866 | NONE | NONE | 0.00000 | |
| F | PROF5 | B | 13096.32793 | -13096.32793 | NONE | NONE | 0.00000 | |
| F | PROF6 | B | -7851.97284 | 7851.97284 | NONE | NONE | 0.00000 | |
| P | INVDU | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | INVSB | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | BFW | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | STM | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | BAG | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | LIMSC | BF | 902.78110 | -902.78110 | | 0.00000 | 0.00000 | |
| P | LIMAR | BF | 189.17687 | -189.17687 | | 0.00000 | 0.00000 | |
| P | LIMOX | BF | 114.42619 | -114.42619 | | 0.00000 | 0.00000 | |
| P | LIMPC | BF | 34.57369 | -34.57369 | | 0.00000 | 0.00000 | |
| P | LIMEH | BF | 78.06452 | -78.06452 | | 0.00000 | 0.00000 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | LIMSE | BF | 152.42823 | -152.42823 | | 0.00000 | 0.00000 | |
| P | LIMPY | BF | 31.57895 | -31.57895 | | 0.00000 | 0.00000 | |
| P | LIMPL | BF | 81.12419 | -81.12419 | | 0.00000 | 0.00000 | |
| P | METMX | BF | 196.99255 | 103.00745 | | 300.00000 | 0.00000 | |
| M | METMN | BF | 103.00745 | 103.00745 | -0.00000 | | 0.00000 | |
| P | ETHMX | BF | .68110 | 594.31890 | | 595.00000 | 0.00000 | |
| M | ETHMN | BF | 594.31890 | 594.31890 | -0.00000 | | 0.00000 | |
| M | PROMN | BF | 1.00000 | 1.00000 | -0.00000 | | 0.00000 | |
| M | BUTMN | BF | 1.00000 | 1.00000 | -0.00000 | | 0.00000 | |
| M | NAPMN | BF | 1.00000 | 1.00000 | -0.00000 | | 0.00000 | |
| P | GAOMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | GAOMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | CPMGS | BF | 1299.67365 | 700.32635 | | 2000.00000 | 0.00000 | |
| P | CPMBU | BF | 195.71429 | 4.28571 | | 200.00000 | 0.00000 | |
| M | CPNGS | BF | 700.22635 | 700.32635 | .10000 | | 0.00000 | |
| M | CPNDU | BF | 454.00000 | 454.00000 | -0.00000 | | 0.00000 | |
| M | CPNBU | BF | 4.28571 | 4.28571 | -0.00000 | | 0.00000 | |
| P | HYDBA | BF | 3.31165 | -3.31165 | | 0.00000 | 0.00000 | |
| M | FLDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | ETDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | ETEMX | BF | 100.00000 | 0.00000 | | 100.00000 | 0.00000 | |
| M | ETEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | PEDMX | BF | 32.50000 | 277.50000 | | 310.00000 | 0.00000 | |
| M | PEDMN | BF | 7.50000 | 277.50000 | 270.00000 | | 0.00000 | |
| P | PEEMX | BF | 16.00000 | 0.00000 | | 16.00000 | 0.00000 | |
| M | PEEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PODMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PPDMN | BF | 2.00000 | 16.00000 | 14.00000 | | 0.00000 | |
| P | PPEMX | BF | 31.91177 | .08823 | | 32.00000 | 0.00000 | |
| M | PPEMN | BF | .08823 | .08823 | -0.00000 | | 0.00000 | |
| M | C4DMN | BF | 7.29958 | 7.29958 | -0.00000 | | 0.00000 | |
| M | MGDMN | BF | 10.20264 | 10.20264 | -0.00000 | | 0.00000 | |
| M | FODMN | BF | .05770 | .05770 | -0.00000 | | 0.00000 | |
| P | XYDMX | BF | 3.91857 | 1.08143 | | 5.00000 | 0.00000 | |
| M | XYDMN | BF | 1.08143 | 1.08143 | -0.00000 | | 0.00000 | |
| P | XYEMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | XYEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | TODMX | BF | 4.91832 | 1.08168 | | 6.00000 | 0.00000 | |
| M | TODMN | BF | 1.08168 | 1.08168 | -0.00000 | | 0.00000 | |
| P | TOEMX | BF | 16.00000 | 0.00000 | | 16.00000 | 0.00000 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| M | TOEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | BZDMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | BZDMN- | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | EBDMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | EBDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | VCDMN | BF | 10.00000 | 10.00000 | -0.00000 | | 0.00000 | |
| P | VCEMX | BF | 25.00000 | 0.00000 | | 25.00000 | 0.00000 | |
| M | VCEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PVDMN | BF | 6.00000 | 60.00000 | 54.00000 | | 0.00000 | |
| P | PVEMX | BF | 7.84501 | 97.15499 | | 105.00000 | 0.00000 | |
| M | PVEMN | BF | 7.15499 | 97.15499 | 90.00000 | | 0.00000 | |
| M | EADMN | BF | 1.00000 | 15.00000 | 14.00000 | | 0.00000 | |
| M | EAEMN | BF | 2.00000 | 19.00000 | 17.00000 | | 0.00000 | |
| M | SYDMN | BF | 5.00000 | 5.00000 | -0.00000 | | 0.00000 | |
| P | SYEMX | BF | 45.00000 | 0.00000 | | 45.00000 | 0.00000 | |
| M | SYEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | BTDMN | BF | 3.00000 | 3.00000 | -0.00000 | | 0.00000 | |
| P | BTEMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | BTEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | LSDMN | BF | 24.28758 | 24.28758 | -0.00000 | | 0.00000 | |
| P | BYDMX | BF | 3.71429 | 1.28571 | | 5.00000 | 0.00000 | |
| M | BYDMN | BF | 1.28571 | 1.28571 | -0.00000 | | 0.00000 | |
| M | PFDMN | BF | 236.03397 | 236.03397 | -0.00000 | | 0.00000 | |
| P | SRDMX | BF | 5.00000 | 0.00000 | | 5.00000 | 0.00000 | |
| M | SRDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | SREMX | BF | 20.00000 | 0.00000 | | 20.00000 | 0.00000 | |
| M | SREMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PSDMN | BF | 4.00000 | 40.00000 | 36.00000 | | 0.00000 | |
| M | PSEMN | BF | 12.00000 | 120.00000 | 108.00000 | | 0.00000 | |

INDC/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | BEZPUR | BF | 126.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | KWHTR | BF | 3583.29940 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | CWATR | BF | 14.91673 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | LABTR | BF | 2183.14800 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | MNTTR | BF | 13582.37421 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | CATTR | BF | 4265.37319 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | ITXTR | BF | 1082.59302 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | ROYTR | BF | 4914.89669 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXATR | BF | 10737.42307 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | UTLTR | BF | 14960.40350 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | INVTR | BF | 209483.00758 | .00010 | 0.00000 | NONE | 0.00000 | |
| P | CLOTR | BF | 6587.20712 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRMETCOS | BF | 2163.15644 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRETHCOS | BF | 10697.74013 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRPROCOS | BF | 18.30000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRBUTCOS | BF | 19.50000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRNAPCOS | BF | 25.00000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | TRBEZCOS | BF | 11844.00000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | GSINVTR | BF | 830.69087 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SCINVTR | BF | 35888.75583 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ARINVTR | BF | 1748.89800 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LDINVTR | BF | 86999.99993 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | OXINVTR | BF | 17291.80939 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PCINVTR | BF | 28486.50407 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EHINVTR | BF | 7573.22579 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SEINVTR | BF | 5943.60071 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PYINVTR | BF | 16215.78942 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PLINVTR | BF | 6575.16236 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | HUINVTR | BF | 1928.57142 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXETTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXPETR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXPPTR | BF | 17.64614 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXXYTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXTOTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXVCTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXPVTR | BF | 20402.54863 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXEATR | BF | 3800.00001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXSYTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXBTTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXSRTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | DEXPSTR | BF | 28200.00005 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIFLTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIETTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPETR | BF | 74925.00039 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPOTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPPTR | BF | 3680.00001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIC4TR | BF | 255.48518 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIMGTR | BF | 306.07913 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIFOTR | BF | .98090 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIXYTR | BF | 52.99012 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEITOTR | BF | 54.08415 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIBZTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIEBTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIVCTR | BF | 1500.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPVTR | BF | 13800.00003 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIEATR | BF | 3750.00001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISYTR | BF | 1000.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIBTTR | BF | 450.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEILSTR | BF | .24288 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIBYTR | BF | 23.14286 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPFTR | BF | 2.36034 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISRTR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPSTR | BF | 10400.00002 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXTR | BF | 52420.19487 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEITR | BF | 110200.36610 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| P | SCVAR | BF | 397.21890 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ARVAR | BF | .82313 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LDVAR | BF | 200.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | OXVAR | BF | 45.57381 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PCVAR | BF | 145.42631 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EHVAR | BF | 11.93548 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SEVAR | BF | 27.57177 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PYVAR | BF | 148.42105 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PLVAR | BF | 2.87581 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | METGS | BF | 103.00745 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ETHGS | BF | 594.31890 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PROGS | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | BUTGS | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | NAPGS | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GAOGS | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | CH2SC | BF | 594.31890 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH3SC | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH4SC | BF | 1.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | NPASC | BF | .90000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GOASC | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2XDU | BF | 454.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MO1AR | BF | 10.81053 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MO4AR | BF | .01260 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MO5AR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HLD | BF | 300.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HOX | BF | 85.57381 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | VC1PC | BF | 165.42631 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HEH | BF | 21.93548 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HSE | BF | 46.49071 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EBZSE | BF | 1.08107 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | STYPY | BF | 168.42105 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C3HPL | BF | 17.87581 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C4MBU | BF | 4.28571 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PEPE1 | BF | 277.50000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PPPP1 | BF | 16.08823 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C4C4M | BF | 7.29958 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGMO1 | BF | 5.77097 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGMO2 | BF | .06000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGMO3 | BF | .03700 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGRAF | BF | 4.33467 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | FOFEO | BF | .05770 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | XYXYL | BF | 1.08143 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | TOTOL | BF | 1.08168 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | VCVC1 | BF | 10.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PVPVC | BF | 157.15499 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EAEAL | BF | 34.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SYSTY | BF | 5.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | BTBTA | BF | 3.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LSLOS | BF | 24.28758 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | BYBTY | BF | 1.28571 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PFGAS | BF | 236.03397 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SRSRR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PSPST | BF | 160.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPET | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPP | BF | .08823 | 0.00000 | 0.00000 | NONE | 0.00000 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | EXPPV | BF | 97.15499 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPEA | BF | 19.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPS | BF | 120.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMFL | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPE | BF | 277.50000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPO | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPP | BF | 16.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMC4 | BF | 7.29958 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMMG | BF | 10.20264 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMFO | BF | .05770 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMXY | BF | 1.08143 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMTO | BF | 1.08168 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMBZ | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMEB | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMVC | BF | 10.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPV | BF | 60.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMEA | BF | 15.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMSY | BF | 5.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMBT | BF | 3.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMLS | BF | 24.28758 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMBY | BF | 1.28571 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPF | BF | 236.03397 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMSR | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPS | BF | 40.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

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NON BASIC VARIABLES

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | METCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ETHCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | PROCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | BUTCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | NAPCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | GAOCOST | NF | 0.00000 | 0.00000 | | 0.00000 | .92354 | |
| P | BEZCOST | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | INVGS | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVSC | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVAR | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVLD | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVOX | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVPC | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVEH | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVSE | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVPY | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVPL | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | INVBU | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | KWH | NF | 0.00000 | 0.00000 | | 0.00000 | .02000 | |
| P | CWA | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | LAB | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | MNT | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | CAT | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ITX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ROY | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | FUL | NF | 0.00000 | 0.00000 | | 0.00000 | 16.15130 | |
| P | EXA | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | UTL | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | INV | NF | 0.00000 | 0.00000 | | 0.00000 | .00010 | |
| P | CLO | NF | 0.00000 | 0.00000 | | 0.00000 | 69.97901 | |
| P | DEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | DEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | LIMLD | NF | 0.00000 | 0.00000 | | 0.00000 | 16.76214 | |
| P | PROMX | NF | 0.00000 | 1.00000 | | 1.00000 | 8.98988 | |
| P | BUTMX | NF | 0.00000 | 1.00000 | | 1.00000 | 9.66945 | |
| P | NAPMX | NF | 0.00000 | 1.00000 | | 1.00000 | 2.95579 | |
| P | CPMDU | NF | 0.00000 | 454.00000 | | 454.00000 | 122.34051 | |
| P | CPMSC | NF | 0.00000 | 0.00000 | | 0.00000 | .00400 | |
| P | CPMAR | NF | 0.00000 | 0.00000 | | 0.00000 | .01080 | |
| P | CPMLD | NF | 0.00000 | 0.00000 | | 0.00000 | 16.78064 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | CPMOX | NF | 0.00000 | 0.00000 | | 0.00000 | .01600 | |
| P | CPMPC | NF | 0.00000 | 0.00000 | | 0.00000 | .01560 | |
| P | CPMEH | NF | 0.00000 | 0.00000 | | 0.00000 | .01670 | |
| P | CPMSE | NF | 0.00000 | 0.00000 | | 0.00000 | .00850 | |
| P | CPMPY | NF | 0.00000 | 0.00000 | | 0.00000 | .00850 | |
| P | CPMPL | NF | 0.00000 | 0.00000 | | 0.00000 | .02000 | |
| P | FLBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | ETBA | NF | 0.00000 | 0.00000 | | 0.00000 | 44.00000 | |
| P | PFBA | NF | 0.00000 | 0.00000 | | 0.00000 | 270.00000 | |
| P | POBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PPBA | NF | 0.00000 | 0.00000 | | 0.00000 | 200.00000 | |
| P | C4BA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| P | MGBA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | FOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |
| P | XYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 49.00000 | |
| P | TOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 50.00000 | |
| P | BZBA | NF | 0.00000 | 0.00000 | | 0.00000 | 90.00000 | |
| P | EBBA | NF | 0.00000 | 0.00000 | | 0.00000 | 88.00000 | |
| P | VCBA | NF | 0.00000 | 0.00000 | | 0.00000 | 145.68440 | |
| P | PVBA | NF | 0.00000 | 0.00000 | | 0.00000 | 210.00000 | |
| P | EABA | NF | 0.00000 | 0.00000 | | 0.00000 | 128.26726 | |
| P | SYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 182.01695 | |
| P | BTBA | NF | 0.00000 | 0.00000 | | 0.00000 | 146.25733 | |
| P | LSBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | BYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PFBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | SRBA | NF | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | PSBA | NF | 0.00000 | 0.00000 | | 0.00000 | 231.83732 | |
| P | GASBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.26097 | |
| P | C2HBA | NF | 0.00000 | 0.00000 | | 0.00000 | 160.03012 | |
| P | C3HBA | NF | 0.00000 | 0.00000 | | 0.00000 | 80.48100 | |
| P | C4MBA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| P | MO1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | MO2BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | MO3BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | FEOBA | NF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |
| P | RAFBA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | XYLBA | NF | 0.00000 | 0.00000 | | 0.00000 | 49.00000 | |
| P | BEZBA | NF | 0.00000 | 0.00000 | | 0.00000 | 163.95478 | |
| P | TOLBA | NF | 0.00000 | 0.00000 | | 0.00000 | 50.00000 | |

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| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | EBZBA | NF | 0.00000 | 0.00000 | | 0.00000 | 119.04625 | |
| P | NPABA | NF | 0.00000 | 0.00000 | | 0.00000 | 28.93171 | |
| P | GOABA | NF | 0.00000 | 0.00000 | | 0.00000 | 27.70623 | |
| P | PVCBA | NF | 0.00000 | 0.00000 | | 0.00000 | 210.00000 | |
| P | EALBA | NF | 0.00000 | 0.00000 | | 0.00000 | 128.26726 | |
| P | STYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 182.01696 | |
| P | PSTBA | NF | 0.00000 | 0.00000 | | 0.00000 | 231.83732 | |
| P | PP1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 200.00000 | |
| P | MO4BA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.06437 | |
| P | MOSBA | NF | 0.00000 | 0.00000 | | 0.00000 | 34.92442 | |
| P | PE1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 270.00000 | |
| P | LOSBA | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | VC1BA | NF | 0.00000 | 0.00000 | | 0.00000 | 145.68440 | |
| P | BTYBA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | BTABA | NF | 0.00000 | 0.00000 | | 0.00000 | 146.25733 | |
| P | SRRBA | NF | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | CH2BA | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00012 | |
| P | CH3BA | NF | 0.00000 | 0.00000 | | 0.00000 | 27.29001 | |
| P | CH4BA | NF | 0.00000 | 0.00000 | | 0.00000 | 29.16959 | |
| P | C2XBA | NF | 0.00000 | 0.00000 | | 0.00000 | 37.68961 | |
| P | REVFLDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVETDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVETDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPEDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPEDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPODEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPPDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPPDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVC4DEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVMGDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVFODEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVXYDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVXYDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVTODEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVTODEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVBZDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVEBDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVVCDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVVCDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPVDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | REVPVDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVEADEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVEADEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSYDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSYDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVBTDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVBTDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVLSDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVBYDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPFDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSRDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSRDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPSDEI | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPSDEX | NF | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | PPDMX | NF | 0.00000 | 16.00000 | | 16.00000 | 30.00000 | |
| P | VCDMX | NF | 0.00000 | 10.00000 | | 10.00000 | 4.31560 | |
| P | PVDMX | NF | 0.00000 | 60.00000 | | 60.00000 | 20.00000 | |
| P | EADMX | NF | 0.00000 | 15.00000 | | 15.00000 | 121.73274 | |
| P | EAEMX | NF | 0.00000 | 19.00000 | | 19.00000 | 71.73274 | |
| P | SYDMX | NF | 0.00000 | 5.00000 | | 5.00000 | 17.98305 | |
| P | BTDMX | NF | 0.00000 | 3.00000 | | 3.00000 | 3.74267 | |
| P | PSDMX | NF | 0.00000 | 40.00000 | | 40.00000 | 28.16268 | |
| P | PSEMX | NF | 0.00000 | 120.00000 | | 120.00000 | 3.16268 | |
| P | BEZMX | NF | 0.00000 | 126.00000 | | 126.00000 | 69.95478 | |

INDO/WBK ≠PROF1≠ ≠≠ ≠84≠

| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | BFWTR | NF | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | STMTR | NF | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | BAGTR | NF | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| P | TRGAOCOS | NF | 0.00000 | 1.00000 | 0.00000 | NONE | .07646 | |
| P | DUINVTR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | .00010 | |
| P | SBINVTR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | .00010 | |
| IF | SCINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | 1.20000 | |
| IF | ARINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | .05800 | |
| I | LDINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | -5025.49074 | |
| IF | OXINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | .36000 | |
| IF | PCINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | .26800 | |
| IF | EHINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | .39100 | |
| IF | SEINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | .19000 | |
| IF | PYINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | .19000 | |
| IF | PLINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | .30000 | |
| P | MO2AR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 11.57872 | |
| P | MO3AR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 15.45707 | |
| P | BTASB | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 109.26411 | |
| P | FLGAS | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 18.25097 | |
| P | FLC2H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 160.02012 | |
| P | FLC3H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 80.47100 | |
| P | FLC4M | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 34.99000 | |
| P | ETC2H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 116.03012 | |
| P | POC3H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 62.48100 | |
| P | MGMO4 | NF | 0.00000 | 0.00000 | 0.00000 | NONE | .06437 | |
| P | MGMO5 | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 4.92442 | |
| P | BZBEZ | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 73.95478 | |
| P | EBEBZ | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 31.04625 | |
| P | PFC2H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 141.46228 | |
| P | PFC3H | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 62.46231 | |
| P | PFC4M | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 16.99746 | |
| P | FFFEO | NF | 0.00000 | 0.00000 | 0.00000 | NONE | .83870 | |
| P | EXPPE | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 20.00000 | |
| P | EXPXY | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 27.00000 | |
| P | EXPTO | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 25.00000 | |
| P | EXPVC | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 20.68440 | |
| P | EXPSY | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 2.01695 | |
| P | EXPBT | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 16.25733 | |
| P | EXPSR | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 15.00000 | |
| P | DOMET | NF | 0.00000 | 0.00000 | 0.00000 | NONE | 44.00000 | |

MAGEN 6000 RUN

CONTROL DATA CORPORATION
CYBERNET SERVICE

THE MAGEN LANGUAGE WAS DEVELOPED BY
AND IS PROPRIETARY TO
HAVERLY SYSTEMS INC DENVILLE N.J.

| | |
|---|---|
| DATE OF RUN | 09/02/71 |
| START TIME | 20:36:43 |
| VERSION | 1.2*1 |
| CP TIME | 4.012 SECONDS |
| FIELD LENGTH | 145000 OCTAL |

INDONESIAN PETROCHEMICAL PROJECT

| UNITS | SIZE TH.TONS/YR | COST.$MM | |
|---|---|---|---|
| STEAM CRACKER | 597 | 35.889 | |
| AROMATICS UNIT | 11 | 1.749 | |
| LD POLYETHLENE UNIT | 300 | 87.000 | |
| OXYCHLORONATION VICL UNIT | 86 | 17.292 | |
| POLY VICL UNIT | 165 | 28.487 | |
| ETHYL ALCOHOL HYDRATION UNIT | 22 | 7.573 | |
| STYRENE UNIT | 48 | 5.944 | |
| POLY STYRENE UNIT | 168 | 16.216 | |
| POLY PROPYLENE UNIT | 18 | 6.575 | |
| GAS SEPARATION | 700 | .831 | |
| DUMMY | 454 | | |
| BUTADIENE EXTRACTION UNIT(DMF) | 4 | 1.929 | |
| SBR UNIT | | | |
| TOTAL | | 209.483 | ONSITES ONLY |

| PRODUCTS | DOMEST | EXPT | VALUE DOM.MM$/YR | VALUE EXP.MM$/YR |
|---|---|---|---|---|
| GAS TO FLARE | | | | |
| ETHYLENE POLYMER GRADE | | | | |
| POLYETHYLENE LD | 277 | | 74.925 | |
| PROPYLENE POLYMER GRADE | | | | |
| POLYPROPYLENE | 16 | 0 | 3.680 | .018 |
| MIXED BUTANES/UNSATS | 7 | | .255 | |
| GASOLINE 400EP | 10 | | .306 | |
| FUEL OIL 400PLUS | 0 | | .001 | |
| XYLENES MIXED | 1 | | .053 | |
| TOLUENE | 1 | | .054 | |
| BENZENE | | | | |
| ETHYL BENZENE | | | | |
| VINYL CHLORIDE | 10 | | 1.500 | |
| POLY VINYL CHLORIDE | 60 | 97 | 13.800 | 20.403 |
| ETHYL ALCOHOL | 15 | 19 | 3.750 | 3.800 |
| STYRENE | 5 | | 1.000 | |
| BUTADIENE | 3 | | .450 | |
| LOSS | 24 | | .000 | |

| | | | | |
|---|---|---|---|---|
| BUTYLENE | 1 | | .023 | |
| PROCESS FUEL | 236 | | .002 | -434- |
| SYNTHETIC RUBBER | | | | |
| POLYSTYRENE | 40 | 120 | 10.400 | 28.200 |
| TOTAL | | | 110.200 | 52.420 |

| | $MM/YR |
|---|---|
| GROSS REV | 163 |
| FEED COST | 25 |
| MARGIN | 138 |
| OPERATING COSTS | |
| LOCAL | 32 |
| FORGN | 30 |
| NET MARGIN | 76. |

N

SOLUTION TYPE = PHASE 2 - OPTIMUM

NUMBER OF BASIS CHANGES
SINCE THE START OF THE PROBLEM = 181
NAME OF THE OBJECTIVE FUNCTION = *PROFS*
NAME OF SELECTED ISET = **
NAME OF SELECTED RHS = *77*
NAME OF SELECTED RANGES SET = **
NAME OF SELECTED BOUNDS SET = *BND1*
VALUE OF THE OBJECTIVE FUNCTION = -16733.61424

BASIC VARIABLES
**********

| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| F | *PROF1 | 57021.06256 | -57021.06256 | NONE | NONE | 0.00000 | |
| F | *PROF2 | 56606.72658 | -56606.72658 | NONE | NONE | 0.00000 | |
| F | *PROF3 | 55691.13374 | -55691.13374 | NONE | NONE | 0.00000 | |
| F | *PROF4 | 3.167.24165 | -3167.24165 | NONE | NONE | 0.00000 | |
| F | *PROF5 | 16733.61424 | -16733.61424 | NONE | NONE | 1.00000 | |
| F | *PROF6 | 3299.98581 | -3299.98581 | NONE | NONE | 0.00000 | |
| B | *INV01 | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| B | *INV58 | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| B | *AF. | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| B | *ST4 | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| B | *RAS | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| B | *LETRX | 220.93059 | 79.96931 | | 300.00000 | 0.00000 | |
| B | *RETMN | 79.96931 | 79.96931 | -0.00000 | | 0.00000 | |
| B | *ETRMX | 179.25340 | 485.74652 | | 595.00000 | 0.00000 | |
| B | *ETMMN | 485.74652 | 485.74652 | -0.00000 | | 0.00000 | |
| B | *PROMX | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |

INDO/MLX *PROFMX ** *77*

| T | S | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| Y | VARIABLE NAME | | | | | | |
| E | T | | | | | | |
| | | | | | | | |
| *PMAX | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *UTMX | *F* | 1.[illegible] | 0.00000 | | 1.00000 | 0.00000 | |
| *UTMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *NAPMX | *F* | 1.[illegible] | 0.00000 | | 1.00000 | 0.00000 | |
| *NAPMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *GAUMX | *F* | 1.[illegible] | 0.00000 | | 1.00000 | 0.00000 | |
| *GAUMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *CPIGS | *F* | 1454.20417 | 565.71583 | | 2000.00000 | 0.00000 | |
| *CPIUD | *F* | 43.46115 | 370.13835 | | 454.00000 | 0.00000 | |
| *CPAPD | *F* | 200.00000 | 0.00000 | | 200.00000 | 0.00000 | |
| *CPIGS | *F* | 565.61533 | 565.71583 | .10000 | | 0.00000 | |
| *CPUD | *F* | 370.13865 | 370.13865 | -0.00000 | | 0.00000 | |
| *CPNAD | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *HYDSA | *F* | 3.21799 | -3.21799 | | 0.00000 | 0.00000 | |
| *ELDMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *ETDMX | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *ETDMX | *F* | [illegible] | 0.00000 | | 100.00000 | 0.00000 | |
| *ETDMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *PEDMN | *F* | 99.[illegible] | 99.00000 | 1.00000 | | 0.00000 | |
| *PEDMX | *F* | 136.50000 | 187.50000 | | 324.00000 | 0.00000 | |
| *PEDMN | *F* | 187.50000 | 187.50000 | -0.00000 | | 0.00000 | |
| *PDUMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *PPDMX | *F* | 5.23455 | 12.76542 | | 18.00000 | 0.00000 | |
| *PPDMN | *F* | 12.76542 | 12.76542 | -0.00000 | | 0.00000 | |
| *PPEMX | *F* | 102.00000 | 0.00000 | | 102.00000 | 0.00000 | |
| *PPEMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *CADMN | *F* | 9.27776 | 9.27776 | -0.00000 | | 0.00000 | |
| *MGUMN | *F* | 13.55233 | 13.55233 | -0.00000 | | 0.00000 | |
| *FDUMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *XYDMX | *F* | [illegible] | 0.00000 | | 5.00000 | 0.00000 | |
| *XYDMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *XYPMX | *F* | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| *XYPMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *TDUMX | *F* | [illegible] | 0.00000 | | 6.00000 | 0.00000 | |
| *TDUMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *TDEMX | *F* | 16.00000 | 0.00000 | | 16.00000 | 0.00000 | |
| *TDEMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *ZDMX | *F* | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| *ZDMN | *F* | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| *EMDMX | *F* | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |

[illegible] APRUF[illegible] ## A77#

| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | [illegible] | [illegible] | -0.00000 | | 0.00000 | |
| [illegible] | VCO[illegible] | [illegible] | 15.00000 | -0.00000 | | 0.00000 | |
| [illegible] | VCE[illegible] | 25.00000 | 25.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PVD[illegible] | 24.[illegible] | 0.00000 | | 24.00000 | 0.00000 | |
| [illegible] | VD[illegible] | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | VS[illegible] | 120.[illegible] | 0.00000 | | 120.00000 | 0.00000 | |
| [illegible] | PVE[illegible] | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | FA[illegible] | 3.[illegible] | 3.00000 | -0.00000 | | 0.00000 | |
| [illegible] | [illegible] | 9.[illegible] | 9.00000 | -0.00000 | | 0.00000 | |
| [illegible] | [illegible] | [illegible] | 5.00000 | -0.00000 | | 0.00000 | |
| [illegible] | [illegible] | 45.[illegible] | 45.00000 | -0.00000 | | 0.00000 | |
| [illegible] | [illegible] | [illegible] | [illegible] | | 3.00000 | 0.00000 | |
| [illegible] | TO[illegible] | [illegible] | [illegible] | -0.00000 | | 0.00000 | |
| [illegible] | TC[illegible] | 10.[illegible] | 0.00000 | | 10.00000 | 0.00000 | |
| [illegible] | ATEN | [illegible] | [illegible] | -0.00000 | | 0.00000 | |
| [illegible] | LSO[illegible] | 23.91838 | 23.91838 | -0.00000 | | 0.00000 | |
| [illegible] | YO[illegible] | 5.[illegible] | 0.00000 | | 5.00000 | 0.00000 | |
| [illegible] | Y[illegible] | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | FO[illegible] | 187.17103 | 187.17103 | -0.00000 | | 0.00000 | |
| [illegible] | [illegible] | 5.[illegible] | 0.00000 | | 5.00000 | 0.00000 | |
| [illegible] | [illegible] | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | [illegible] | 20.[illegible] | 0.00000 | | 20.00000 | 0.00000 | |
| [illegible] | [illegible] | [illegible] | 0.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PS[illegible] | 15.[illegible] | 15.00000 | -0.00000 | | 0.00000 | |
| [illegible] | PSE[illegible] | 1[illegible].75647 | 97.24353 | | 105.00000 | 0.00000 | |
| [illegible] | [illegible] | 97.24353 | 97.24353 | -0.00000 | | 0.00000 | |

[illegible] #77#

| VARIABLE NAME | | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| *EZPUR | *BF* | 126.[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *KWHTR | *BF* | 1528.[illegible]177* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *CWATR | *BF* | 5.24452* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *LABTR | *BF* | 1261.[illegible]6611* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *BNTTR | *BF* | 9948.[illegible]* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *CATTR | *BF* | [illegible]* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *ITXTR | *BF* | 753.[illegible]* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *RDYTR | *BF* | 41[illegible].91252* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *FXATR | *BF* | [illegible]* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *OTLTR | *BF* | 11525.[illegible]* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *PLVTR | *BF* | 13[illegible].27427* | .30000* | 0.00000* | NONE | 0.00000* | |
| *CLOTR | *BF* | 1314.23957* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *TRETCOSTR | *BF* | 1579.35555* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *TPETCOSTR | *BF* | 1743.43731* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *TPRFZCOSTR | *BF* | 11944.[illegible]* | 1.00000* | 0.00000* | NONE | 0.00000* | |
| *GSLOVTR | *BF* | 67[illegible].2521[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *SCLOVTR | *BF* | 23315.43232* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *LDTOVTR | *BF* | 65999.99993* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *OXIOVTR | *BF* | 3079.[illegible]243[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *EHLOVTR | *BF* | 1595.612[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *SFLOVTR | *BF* | [illegible]283.[illegible]9352* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *PYLOVTR | *BF* | 11155.27710* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *PLLOVTR | *BF* | 3265.57174* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEXETTR | *BF* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEXFETR | *BF* | 46275.[illegible]032* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEXVCTR | *BF* | 31[illegible].[illegible]001* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEXSCTR | *BF* | 1[illegible].[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEXSYTR | *BF* | 51[illegible].[illegible]062* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEXPSTR | *BF* | 22452.2286[illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEIPLTR | *BF* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEISTTR | *BF* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEIMETR | *BF* | 243[illegible].[illegible]065* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEIPOTR | *BF* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEIHPTR | *BF* | 2936.4627* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEICATR | *BF* | 324.72155* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEISSTR | *BF* | 4[illegible].55944* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEIFDTR | *BF* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEIXYTR | *BF* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEITDTR | *BF* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *DEIMZTR | *BF* | [illegible]* | 0.00000* | 0.00000* | NONE | 0.00000* | |

INDX *PROFI* ** *77*

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| *F* | *DEISPTR* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEIVCTR* | 1506.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEIPVTR* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEIFUTR* | 750.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEIFSYTR* | 1000.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEIBTTR* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEILSTR* | .23913 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEIRYTR* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEIPETR* | 1.47171 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEISRTR* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEIPSTR* | 3900.00001 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEXTR* | 67752.22902 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DEITR* | 35119.44664 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| *I* | *SCINT* | .32353 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| *I* | *ACINT* | 0.00001 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| *I* | *DXINT* | .00557 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| *I* | *PCINT* | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| *I* | *PHINT* | .77742 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| *I* | *FINT* | .22052 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| *I* | *PYINT* | .59576 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| *I* | *PLINT* | .14327 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| *F* | *SCVAR* | 420.99032 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *APVAR* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *LDVAR* | 200.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *DXVAR* | 13.65854 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *PCVAR* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *PHVAR* | 6.95774 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *FFVAR* | 43.79137 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *PYVAR* | 106.33597 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *PLVAR* | 12.13474 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *ETGS* | 79.95931 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *ETHGS* | 485.74652 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *PRGS* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *RUTGS* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *APGS* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *GAOGS* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *CH2SC* | 485.74652 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *CH3SC* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *CH4SC* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| *F* | *SPASC* | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

DOC/PR APROFS# ## #77#

| VARIABLE NAME | TYPE | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| [illegible] | F | 0.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| C2XDU | F | 370.13[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| [illegible] | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| [illegible] | F | 0.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| [illegible] | F | 0.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| [illegible] | F | 0.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| C2HLO | F | 3[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| C2HOX | F | 17.27317 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| VC1PC | F | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| C2HEP | F | 7.74194 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| C2HSF | F | 45.32374 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| STYRY | F | 11[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| C3HPL | F | 14.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| C4[illegible] | F | [illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| PPP1 | F | 277.5[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| PPPP1 | F | 12.73542 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| C4C41 | F | 9.27776 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| 4G401 | F | 13.55233 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| 4GM03 | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| 4GR4F | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| 4G[illegible] | F | 0.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| FOFEO | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| XYXYL | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| TOTOL | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| FREHZ | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| VCVC1 | F | 35.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| PVPVC | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| FAEAL | F | 12.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| YSTY | F | 30.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| TBTX | F | 0.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| LSLCS | F | 23.9183 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| HYRIY | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| PFGAS | F | 187.17103 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| SW3-3 | F | 0.[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| PSPST | F | 112.24353 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| EXPET | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| EXPPE | F | 187.5[illegible] | 0.00000 | 0.00000 | NONE | 0.00000 | |
| EXPPP | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| EXPAY | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| EXPTO | F | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

IN00/[illegible] #PROF5# ## #77#

| T | VARIABLE NAME | S T A T | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | EXPVC | BF | 25.[illegible]00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPV | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPEA | BF | 9.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPSY | BF | 45.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPT | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPSR | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPS | BF | 97.24353 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMFL | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPE | BF | 98.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPO | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPP | BF | 12.76542 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMCA | BF | 9.27776 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMAG | BF | 13.55233 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMFO | BF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMAY | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMZ | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMEB | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMVC | BF | 10.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPV | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMEA | BF | 3.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMSY | BF | 5.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPT | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPS | BF | 23.91[illegible]5 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMSY | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPF | BF | 187.17163 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMSR | BF | 0.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DOMPS | BF | 15.[illegible]0000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

I.00/.6A #PROF5# ## #77#

NON BASIC VARIABLES
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| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | ETCOST | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ETHCOST | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | PROCOST | F | 0.00000 | 0.00000 | | 0.00000 | .78698 | |
| P | PUTCOST | F | 0.00000 | 0.00000 | | 0.00000 | .71728 | |
| P | MAPCOST | F | 0.00000 | 0.00000 | | 0.00000 | .60326 | |
| P | GADCOST | F | 0.00000 | 0.00000 | | 0.00000 | .47735 | |
| P | PEZCOST | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | INVGS | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVSC | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVAR | F | 0.00000 | 0.00000 | | 0.00000 | .05494 | |
| P | INVLO | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVOX | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVPC | F | 0.00000 | 0.00000 | | 0.00000 | .25022 | |
| P | INVEH | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVSE | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVPY | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVPL | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | INVPO | F | 0.00000 | 0.00000 | | 0.00000 | .00587 | |
| P | KAM | F | 0.00000 | 0.00000 | | 0.00000 | .02000 | |
| P | CHA | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | LAH | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ANT | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | CAT | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | ITA | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | POY | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | FUL | F | 0.00000 | 0.00000 | | 0.00000 | 16.40516 | |
| P | EXA | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | UTE | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | INV | F | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| P | CLU | F | 0.00000 | 0.00000 | | 0.00000 | 69.97901 | |
| P | TEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | DEX | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | LIMSC | F | 0.00000 | 0.00000 | | 0.00000 | 2.40000 | |
| P | LIMAR | F | 0.00000 | 0.00000 | | 0.00000 | .15933 | |
| P | LIMLO | F | 0.00000 | 0.00000 | | 0.00000 | 44.07484 | |
| P | LIMOX | F | 0.00000 | 0.00000 | | 0.00000 | 5.40000 | |
| P | LIMPC | F | 0.00000 | 0.00000 | | 0.00000 | 3.35288 | |
| P | LIMEH | F | 0.00000 | 0.00000 | | 0.00000 | 11.73000 | |
| P | LIMSE | F | 0.00000 | 0.00000 | | 0.00000 | 2.85000 | |
| P | LIMPY | F | 0.00000 | 0.00000 | | 0.00000 | 2.85000 | |

I*00/*** #PROF5* ** #77#

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | LIMPL | NF | 0.00000 | 0.00000 | | 0.00000 | 9.09091 | |
| P | CP15C | NF | 0.00000 | 0.00000 | | 0.00000 | 14.40000 | |
| P | CP4AR | NF | 0.00000 | 0.00000 | | 0.00000 | 6.09306 | |
| P | CP1LD | NF | 0.00000 | 0.00000 | | 0.00000 | 99.57484 | |
| P | CP4OX | NF | 0.00000 | 0.00000 | | 0.00000 | 53.40000 | |
| P | CP1PC | NF | 0.00000 | 0.00000 | | 0.00000 | 42.38643 | |
| P | CP1SH | NF | 0.00000 | 0.00000 | | 0.00000 | 61.83000 | |
| P | CP1SE | NF | 0.00000 | 0.00000 | | 0.00000 | 28.35000 | |
| P | CP1PY | NF | 0.00000 | 0.00000 | | 0.00000 | 28.35000 | |
| P | CP1PL | NF | 0.00000 | 0.00000 | | 0.00000 | 69.09091 | |
| P | FL5A | NF | 0.10000 | 0.00000 | | 0.00000 | .01000 | |
| P | ET5A | NF | 0.00000 | 0.00000 | | 0.00000 | 44.00000 | |
| P | PE5A | NF | 0.10000 | 0.00000 | | 0.00000 | 250.00000 | |
| P | PO5A | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PP5A | NF | 0.10000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | C4GA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| P | MGAA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | FO5A | NF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |
| P | XY5A | NF | 0.00000 | 0.00000 | | 0.00000 | 49.00000 | |
| P | TO5A | NF | 0.00000 | 0.00000 | | 0.00000 | 165.08963 | |
| P | ZN5A | NF | 0.00000 | 0.00000 | | 0.00000 | 90.00000 | |
| P | ER5A | NF | 0.00000 | 0.00000 | | 0.00000 | 88.00000 | |
| P | VC5A | NF | 0.00000 | 0.00000 | | 0.00000 | 122.31357 | |
| P | PV5A | NF | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | FA5A | NF | 0.00000 | 0.00000 | | 0.00000 | 102.85140 | |
| P | SY5A | NF | 0.00000 | 0.00000 | | 0.00000 | 156.68000 | |
| P | BT5A | NF | 0.00000 | 0.00000 | | 0.00000 | 150.00000 | |
| P | LS5A | NF | 0.10000 | 0.00000 | | 0.00000 | .01000 | |
| P | AY5A | NF | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | PF5A | NF | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | CS5A | NF | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | PS5A | NF | 0.00000 | 0.00000 | | 0.00000 | 235.00000 | |
| P | GA5AA | NF | 0.10000 | 0.00000 | | 0.00000 | 18.54783 | |
| P | C2HAA | NF | 0.00000 | 0.00000 | | 0.00000 | 58.73592 | |
| P | C3HAA | NF | 0.00000 | 0.00000 | | 0.00000 | 38.41009 | |
| P | C4HAA | NF | 0.00000 | 0.00000 | | 0.00000 | 35.00000 | |
| P | MO1AA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | MO2AA | NF | 0.00000 | 0.00000 | | 0.00000 | 31.84231 | |
| P | MO3AA | NF | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | FE0AA | NF | 0.00000 | 0.00000 | | 0.00000 | 17.00000 | |

INDU/WRK #PROF5# ## #77#

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | AFBA | F | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | XYLBA | F | 0.00000 | 0.00000 | | 0.00000 | 49.00000 | |
| P | BEZBA | F | 0.00000 | 0.00000 | | 0.00000 | 156.38377 | |
| P | TOLBA | F | 0.00000 | 0.00000 | | 0.00000 | 165.08963 | |
| P | EBZBA | F | 0.00000 | 0.00000 | | 0.00000 | 68.00000 | |
| P | IPABA | F | 0.00000 | 0.00000 | | 0.00000 | 15.09326 | |
| P | GOABA | F | 0.00000 | 0.00000 | | 0.00000 | 14.80038 | |
| P | PVCBA | F | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | EALBA | F | 0.00000 | 0.00000 | | 0.00000 | 102.85140 | |
| P | STYBA | F | 0.00000 | 0.00000 | | 0.00000 | 156.68000 | |
| P | PSTBA | F | 0.00000 | 0.00000 | | 0.00000 | 235.00000 | |
| P | PDIBA | F | 0.00000 | 0.00000 | | 0.00000 | 230.00000 | |
| P | [illegible] | F | 0.00000 | 0.00000 | | 0.00000 | 30.00000 | |
| P | MOSBA | F | 0.00000 | 0.00000 | | 0.00000 | 36.09056 | |
| P | PFIBA | F | 0.00000 | 0.00000 | | 0.00000 | 250.00000 | |
| P | LOSBA | F | 0.00000 | 0.00000 | | 0.00000 | .01000 | |
| P | VCIBA | F | 0.00000 | 0.00000 | | 0.00000 | 122.31357 | |
| P | RTYBA | F | 0.00000 | 0.00000 | | 0.00000 | 18.00000 | |
| P | RTABA | F | 0.00000 | 0.00000 | | 0.00000 | 150.00000 | |
| P | SRXBA | F | 0.00000 | 0.00000 | | 0.00000 | 265.00000 | |
| P | CH2BA | F | 0.00000 | 0.00000 | | 0.00000 | 18.36000 | |
| P | CH3BA | F | 0.00000 | 0.00000 | | 0.00000 | 14.68186 | |
| P | CH4BA | F | 0.00000 | 0.00000 | | 0.00000 | 14.40702 | |
| P | C2ABA | F | 0.00000 | 0.00000 | | 0.00000 | 58.73592 | |
| P | EFVFLDEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVETDFI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVETDEX | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVPPDEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVPLDEX | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVPODEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVPPDEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVPPDEX | F | 0.00000 | 0.00000 | | 0.00000 | 1.15000 | |
| P | EVCHDEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVCGDEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVFODEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVAYDEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVAYDEX | F | 0.00000 | 0.00000 | | 0.00000 | 2.22727 | |
| P | EVTODEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | EVTODEX | F | 0.00000 | 0.00000 | | 0.00000 | 6.60359 | |
| P | EVEZDEI | F | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |

[illegible] #PPCF5# ## #77#

| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | REVERDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVVCDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVVCDEX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPVDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPVDEX | 0.00000 | 0.00000 | | 0.00000 | 1.09524 | |
| P | REVEADEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVEADEX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSYDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSYDEX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSTDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSTDEX | 0.00000 | 0.00000 | | 0.00000 | 1.15365 | |
| P | REVLSDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPYDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPFDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVSPDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPSDEX | 0.00000 | 0.00000 | | 0.00000 | 1.06000 | |
| P | REVPSDEI | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | REVPSDEX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| P | PFDMX | 0.00000 | 90.00000 | | 90.00000 | 20.00000 | |
| P | VCDMX | 0.00000 | 10.00000 | | 10.00000 | 27.68643 | |
| P | VCEMX | 0.00000 | 25.00000 | | 25.00000 | 2.68643 | |
| P | EADMX | 0.00000 | 3.00000 | | 3.00000 | 147.14860 | |
| P | EAEMX | 0.00000 | 9.00000 | | 9.00000 | 97.14860 | |
| P | SYDMX | 0.00000 | 5.00000 | | 5.00000 | 43.32000 | |
| P | SYEMX | 0.00000 | 45.00000 | | 45.00000 | 23.32000 | |
| P | PSDMX | 0.00000 | 15.00000 | | 15.00000 | 25.00000 | |
| P | REZMX | 0.00000 | 126.00000 | | 126.00000 | 62.38377 | |

IN90/#6X #PROF5# ## #77#

| *T* | *S* | | | | | | |
|---|---|---|---|---|---|---|---|
| *Y* | *VARIABLE* | VALUE | COST | LOWER | UPPER | DJ | COMMENTS |
| *P* | NAME | | | BOUND. | BOUND | | |
| *E* | *T* | | | | | | |
| *P* | *-FVTR | 0.00000* | 1.00000* | 0.00000* | NONE | 1.00000* | |
| *P* | *STATR | 0.00000* | 1.00000* | 0.00000* | NONE | 1.00000* | |
| *P* | *VAGTR | 0.00000* | 1.00000* | 0.00000* | NONE | 1.00000* | |
| *P* | *IPP*OCOS* | 0.00000* | 1.00000* | 0.00000* | NONE | .21902* | |
| *P* | *TR*OTCOS* | 0.00000* | 1.00000* | 0.00000* | NONE | .28272* | |
| *P* | *TRN*PCOS* | 0.00000* | 1.00000* | 0.00000* | NONE | .39674* | |
| *P* | *TPG*COS* | 0.00000* | 1.00000* | 0.00000* | NONE | .52265* | |
| *P* | *DUIP/TR | 0.00000* | 0.00000* | 0.00000* | NONE | .30000* | |
| *P* | *ARIMVTR | 0.00000* | 0.00000* | 0.00000* | NONE | .24506* | |
| *P* | *PCIMVTR | 0.00000* | 0.00000* | 0.00000* | NONE | .04978* | |
| *P* | *-UIMVTR | 0.00000* | 0.00000* | 0.00000* | NONE | .29413* | |
| *P* | *SRIMVTR | 0.00000* | 0.00000* | 0.00000* | NONE | .30000* | |
| *P* | *DEXPPTR | 0.00000* | 0.00000* | 0.00000* | NONE | .15000* | |
| *P* | *DEXXYTR | 0.00000* | 0.00000* | 0.00000* | NONE | 1.22727* | |
| *P* | *DEXTOTR | 0.00000* | 0.00000* | 0.00000* | NONE | 5.60359* | |
| *P* | *DEXPVTR | 0.00000* | 0.00000* | 0.00000* | NONE | .09524* | |
| *P* | *DEXRTTR | 0.00000* | 0.00000* | 0.00000* | NONE | .15385* | |
| *P* | *DEXSPTR | 0.00000* | 0.00000* | 0.00000* | NONE | .06000* | |
| *I* | *LOIUT | 1.00000* | 0.00000* | 0.00000* | 1.00000* | -3772.45062* | |
| *P* | *004A2 | 0.00000* | 0.00000* | 0.00000* | NONE | .95091* | |
| *P* | *6R2S5 | 0.00000* | 0.00000* | 0.00000* | NONE | 19.33840* | |
| *P* | *STAS1 | 0.00000* | 0.00000* | 0.00000* | NONE | 102.87200* | |
| *P* | *FLGAS | 0.00000* | 0.00000* | 0.00000* | NONE | 18.53783* | |
| *P* | *FLC2H | 0.00000* | 0.00000* | 0.00000* | NONE | 58.72592* | |
| *P* | *FLC3H | 0.00000* | 0.00000* | 0.00000* | NONE | 38.40009* | |
| *P* | *FLC4H | 0.00000* | 0.00000* | 0.00000* | NONE | 34.99000* | |
| *P* | *ETC2H | 0.00000* | 0.00000* | 0.00000* | NONE | 14.73592* | |
| *P* | *PDC3H | 0.00000* | 0.00000* | 0.00000* | NONE | 20.41009* | |
| *P* | *6M02 | 0.00000* | 0.00000* | 0.00000* | NONE | 1.84231* | |
| *P* | *6M05 | 0.00000* | 0.00000* | 0.00000* | NONE | 6.09056* | |
| *P* | *PZ3EZ | 0.00000* | 0.00000* | 0.00000* | NONE | 66.38377* | |
| *P* | *PFC2H | 0.00000* | 0.00000* | 0.00000* | NONE | 39.87639* | |
| *P* | *PFC3H | 0.00000* | 0.00000* | 0.00000* | NONE | 20.10834* | |
| *P* | *PFC4H | 0.00000* | 0.00000* | 0.00000* | NONE | 16.71466* | |
| *P* | *PFFEO | 0.00000* | 0.00000* | 0.00000* | NONE | .58484* | |
| *P* | *DOMET | 0.00000* | 0.00000* | 0.00000* | NONE | 44.00000* | |
| *P* | *DOMTO | 0.00000* | 0.00000* | 0.00000* | NONE | 115.08963* | |

MAGEN 6000 RUN

CONTROL DATA CORPORATION
CYBERNET SERVICE

THE MAGEN LANGUAGE WAS DEVELOPED BY
AND IS PROPRIETARY TO
HAVERLY SYSTEMS INC DENVILLE N.J.

DATE OF RUN 09/09/71
START TIME 17:31:53
VERSION 1.2#1
CP TIME 3.772 SECONDS
FIELD LENGTH 145000 OCTAL

INDONESIAN PETROCHEMICAL PROJECT

| UNITS | SIZE TH.TONS/YR | COST,$MM |
|---|---|---|
| STEAM CRACKER | 463 | 30.534 |
| AROMATICS UNIT | | |
| LD POLYETHLENE UNIT | 300 | 87.000 |
| OXYCHLORINATION VICL UNIT | | |
| POLY VICL UNIT | | |
| ETHYL ALCOHOL HYDRATION UNIT | 10 | 5.580 |
| STYRENE UNIT | 45 | 5.753 |
| POLY STYRENE UNIT | 118 | 11.943 |
| POLY PROPYLENE UNIT | | |
| GAS SEPARATION | 528 | .627 |
| DUMMY | 353 | |
| BUTADIENE EXTRACTION UNIT(DMF) | | |
| SBR UNIT | | |
| TOTAL | | 141.436 ONSITES ONLY |

| PRODUCTS | DOMEST | EXPT | VALUE DOM.MM$/YR | VALUE EXP.MM$/YR |
|---|---|---|---|---|
| GAS TO FLARE | | | | |
| ETHYLENE POLYMER GRADE | | | | |
| POLYETHYLENE LD | 90 | 188 | 24.300 | 46.875 |
| PROPYLENE POLYMER GRADE | | | | |
| POLYPROPYLENE | | | | |
| MIXED BUTANES/UNSATS | 9 | | .310 | |
| GASOLINE 400EP | 13 | | .386 | |
| FUEL OIL 400PLUS | | | | |
| XYLENES MIXED | | | | |
| TOLUENE | | | | |
| BENZENE | | | | |
| ETHYL BENZENE | | | | |
| VINYL CHLORIDE | | | | |
| POLY VINYL CHLORIDE | | | | |
| ETHYL ALCOHOL | 3 | 9 | .750 | 1.800 |
| STYRENE | 5 | 45 | 1.000 | 8.100 |

| | | | | |
|---|---|---|---|---|
| LOSS | 22 | | .000 | |
| BUTYLENE | | | | |
| PROCESS FUEL | 179 | | .002 | |
| SYNTHETIC RUBBER | | | | |
| POLYSTYRENE | 15 | 97 | 3.900 | 22.852 |
| TOTAL | | | 30.650 | 79.627 |

| | $MM/YR |
|---|---|
| GROSS REV | 11 |
| FEED COST | 24 |
| MARGIN | 89 |
| OPERATING COSTS | |
| LOCAL | 17 |
| FORGN | 15 |
| NET MARGIN | 54 |

1000/WBK

SOLUTION TYPE = PHASE 2 - MEDIARY SOLUTION

NUMBER OF BASIS CHANGES
SINCE THE START OF THE PROBLEM = 249
NAME OF THE OBJECTIVE FUNCTION = ≠PROF5≠
NAME OF SELECTED ISET = ≠≠
NAME OF SELECTED RHS = ≠77≠
NAME OF SELECTED RANGES SET = ≠≠
NAME OF SELECTED BOUNDS SET = ≠BND1≠
VALUE OF THE OBJECTIVE FUNCTION = -11760.13739

BASIC VARIABLES

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| F | PROF1 | B | 54176.86622 | -54176.86622 | NONE | NONE | 0.00000 | |
| F | PROF2 | B | 54035.42998 | -54035.42998 | NONE | NONE | 0.00000 | |
| F | PROF3 | B | 52776.64743 | -52776.64743 | NONE | NONE | 0.00000 | |
| F | PROF4 | B | 25903.76153 | -25903.76153 | NONE | NONE | 0.00000 | |
| F | PROF5 | B | 11760.13739 | -11760.13739 | NONE | NONE | 1.00000 | |
| F | PROF6 | B | -2383.48679 | 2383.48679 | NONE | NONE | 0.00000 | |
| P | INVDU | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | INVSR | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | PFW | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | STM | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | BAG | BF | 0.00000 | 0.00000 | | 0.00000 | 0.00000 | |
| P | LIMSC | BF | 1036.65922 | -1036.65922 | | 0.00000 | 0.00000 | |
| P | LIMEH | BF | 90.00000 | -90.00000 | | 0.00000 | 0.00000 | |
| P | LIMSE | BF | 154.67626 | -154.67626 | | 0.00000 | 0.00000 | |
| P | LIMPY | BF | 81.84892 | -81.84892 | | 0.00000 | 0.00000 | |
| P | PETMX | BF | 235.23461 | 64.76539 | | 300.00000 | 0.00000 | |

INDO/A3K *PROFS* ** *77*

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| M | ETAN | BF | 64.76539 | 64.76539 | -0.00000 | | 0.00000 | |
| P | ETHR | BF | 131.65922 | 463.34076 | | 595.00000 | 0.00000 | |
| M | ETHN | BF | 463.34079 | 463.34078 | -0.00000 | | 0.00000 | |
| P | PROMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | PROMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | BUTMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | BUTMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | GAPMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | GAPMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | GAOMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | GAOMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | CPMGS | BF | 1471.99383 | 525.10517 | | 2000.00000 | 0.00000 | |
| P | CPMOJ | BF | 100.93432 | 353.06568 | | 454.00000 | 0.00000 | |
| P | CPMBU | BF | 200.00000 | 0.00000 | | 200.00000 | 0.00000 | |
| M | CPMGS | BF | 525.10615 | 525.10518 | .10000 | | 0.00000 | |
| M | CPMOJ | BF | 353.06569 | 353.06568 | -0.00000 | | 0.00000 | |
| M | CPMBU | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | CPMEM | BF | 2.25806 | -2.25806 | | 0.00000 | 0.00000 | |
| P | HYDPA | BF | 3.21799 | -3.21799 | | 0.00000 | 0.00000 | |
| M | FLDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | ETDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | ETEMX | BF | 100.00000 | 0.00000 | | 100.00000 | 0.00000 | |
| M | ETEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PEDMN | BF | 59.00000 | 90.00000 | 1.00000 | | 0.00000 | |
| P | PEEMX | BF | 135.50000 | 187.50000 | | 324.00000 | 0.00000 | |
| M | PEEMN | BF | 187.50000 | 187.50000 | -0.00000 | | 0.00000 | |
| M | PDDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | PPDMX | BF | 18.00000 | 0.00000 | | 18.00000 | 0.00000 | |
| M | PPDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | PPEMX | BF | 102.00000 | 0.00000 | | 102.00000 | 0.00000 | |
| M | PPEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | C4DMN | BF | 8.84941 | 8.84941 | -0.00000 | | 0.00000 | |
| M | RGDMN | BF | 12.92721 | 12.92721 | -0.00000 | | 0.00000 | |
| M | FDDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | XYDMX | BF | 5.00000 | 0.00000 | | 5.00000 | 0.00000 | |
| M | XYDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | XYEMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | XYEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | TDDMX | BF | 6.00000 | 0.00000 | | 6.00000 | 0.00000 | |
| M | TDDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |

INDO/NBK #PROFS# ## #77#

| TYPE | VARIABLE NAME | STATUS | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| P | TOEMX | BF | 16.00000 | 0.00000 | | 16.00000 | 0.00000 | |
| M | TOEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | HZDMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | HZDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | EPDMX | BF | 1.00000 | 0.00000 | | 1.00000 | 0.00000 | |
| M | EPDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | VCDMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | VCDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | VCEMX | BF | 25.00000 | 0.00000 | | 25.00000 | 0.00000 | |
| P | PVDMX | BF | 24.00000 | 0.00000 | | 24.00000 | 0.00000 | |
| M | PVDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | PVEMX | BF | 120.00000 | 0.00000 | | 120.00000 | 0.00000 | |
| M | PVEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | EADMN | BF | 3.00000 | 3.00000 | -0.00000 | | 0.00000 | |
| M | EAEMN | BF | 9.00000 | 9.00000 | -0.00000 | | 0.00000 | |
| M | SYDMN | BF | 5.00000 | 5.00000 | -0.00000 | | 0.00000 | |
| M | SYEMN | BF | 45.00000 | 45.00000 | -0.00000 | | 0.00000 | |
| P | PTDMX | BF | 3.00000 | 0.00000 | | 3.00000 | 0.00000 | |
| M | PTDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | PTEMX | BF | 10.00000 | 0.00000 | | 10.00000 | 0.00000 | |
| M | PTEMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | LSDMN | BF | 22.50000 | 22.50000 | -0.00000 | | 0.00000 | |
| P | YDMX | BF | 5.00000 | 0.00000 | | 5.00000 | 0.00000 | |
| M | YDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PFDMN | BF | 178.82455 | 178.82455 | -0.00000 | | 0.00000 | |
| P | SRDMX | BF | 5.00000 | 0.00000 | | 5.00000 | 0.00000 | |
| M | SRDMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| P | SREMX | BF | 20.00000 | 0.00000 | | 20.00000 | 0.00000 | |
| M | SREMN | BF | 0.00000 | 0.00000 | -0.00000 | | 0.00000 | |
| M | PSDMN | BF | 15.00000 | 15.00000 | -0.00000 | | 0.00000 | |
| P | PSEMX | BF | 10.75647 | 97.24353 | | 108.00000 | 0.00000 | |
| M | PSEMN | BF | 97.24353 | 97.24353 | -0.00000 | | 0.00000 | |

IJDO/*PR *PROF** ** *77*

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | *AEZPUR | 126.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *KWHTR | 1033.09940 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *CMATR | 5.25452 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *LAETR | 1164.46372 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *MNITR | 9243.72927 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *CATTR | 791.78514 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *ITXTR | 743.00332 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *POYTR | 3702.29715 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *EXATR | 6516.91457 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *UTLTR | 11338.46142 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *INVTR | 141435.24162 | .30000 | 0.00000 | NONE | 0.00000 | |
| P | *CLOTR | 0.00000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *TRMETCOS | 1356.77325 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *TRETHCOS | 834[illegible].13406 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *TRSEZCOS | 11844.00000 | 1.00000 | 0.00000 | NONE | 0.00000 | |
| P | *GSINVTR | 627.25957 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *SCINVTR | 30533.63124 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *LBINVTR | 86999.99993 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *OXINVTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *EHINVTR | 5579.99999 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *SEINVTR | 5752.51798 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *PYINVTR | 11942.84174 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *PLINVTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEXETTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEXPETR | 46875.00032 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEXVCTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEXFATR | 1860.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEXSYTR | 8130.00002 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEXPSTR | 22852.22860 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIFLTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIETTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIPETR | 24300.00005 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIPOTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIPPTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIC4TR | 369.74331 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIM6TR | 387.81624 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIFOTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIXYTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEITOTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | *DEIBZTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

T4D5/93K *PROF5* ** *77*

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | DEIEPTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIVCTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPVTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIEATR | 751.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEISYTR | 1000.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIBITR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DFILSTR | .22500 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIBYTR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEIPFTR | 1.78625 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DFISETR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DFIPSTR | 3990.00021 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DEXTR | 79527.22901 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| P | DFITR | 30049.57288 | -1.00000 | 0.00000 | NONE | 0.00000 | |
| I | APINT | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| I | PCINT | 0.00000 | 0.00000 | 0.00000 | 1.00000 | 0.00000 | |
| P | SCVAR | 263.34079 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LRVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LOVAR | 200.10000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GXVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PCVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SFVAR | 25.32374 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PYVAR | 98.15198 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PLVAR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ETGS | 64.76559 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ETHGS | 463.34078 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PROGS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | BUTGS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | DAPGS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GADGS | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH2SC | 463.34078 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH3SC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | CH4SC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LPASC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GDASC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2ADD | 353.16568 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | D01AR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | D02AR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | D03AR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | D05AR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HLD | 300.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

TNUM/ OF IPROUF-T ## #77#

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| P | C2HOX | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | VC1PC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2HEH | 7.74194 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C2H5E | 45.32374 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | STYRY | 116.15196 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C3HPL | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C4H10 | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PEPE1 | 277.57000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PPPP1 | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | C4C4= | 8.84931 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MGCO1 | 12.92721 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | MG4O4 | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GRAF | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | GRUB | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | FOFFO | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | XYXYL | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | TOTOL | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ERE4Z | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | VCVCI | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PVPVC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EAEAL | 12.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SYSTY | 50.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | ETOTA | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | LSLOS | 22.50000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PYPTY | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PFGAS | 165.29500 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PFC3H | 13.52955 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | SRSRO | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | PSPST | 112.24353 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPET | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPE | 167.50000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPP | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPAY | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPTO | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPVC | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPPV | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPEA | 9.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPSY | 45.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPST | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |
| P | EXPSR | 0.00000 | 0.00000 | 0.00000 | NONE | 0.00000 | |

IMPS/ABK #PROFS# ## #77#

| *T* | *S* | | | | | | |
|---|---|---|---|---|---|---|---|
| *Y* | *VARIABLE*T* | VALUE | COST | LOWER | UPPER | DJ | COMMENTS |
| *S* | NAME *A* | | | BOUND | BOUND | | |
| *F* | *T* | | | | | | |
| * | * * | | | | | | |
| *P* | *EXPPS *-F* | 97.24353* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMFL * F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMPE *-F* | 90.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMPO *-F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMPP **F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMCA *-F* | 8.84951* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMGS *-F* | 12.92721* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMFD *-F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMXY **F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMXZ **F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMFR **F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMVC *-F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMPY *-F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMFA *-F* | 3.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMSY **F* | 5.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMLT **F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMLS *-F* | 22.5[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMCY *-F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMPF **F* | 175.32455* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMSP *-F* | 0.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| *P* | *DOMPS **F* | 15.[illegible]000* | 0.00000* | 0.00000* | NONE | 0.00000* | |
| * | * * | | | | | | |
| * | * * | | | | | | |

IMPD/[illegible] *PROF[illegible] ** *77*

NON BASIC VARIABLES
**********

| VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|
| ETCOST | [illegible] | 0.00000 | | 0.00000 | 1.00000 | |
| PTHCOST | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| [illegible]COST | [illegible] | 0.00000 | | 0.00000 | .66884 | |
| [illegible]TCOST | 0.00000 | 0.00000 | | 0.00000 | .57643 | |
| [illegible]PCOST | 0.00000 | 0.00000 | | 0.00000 | .54616 | |
| GADCOST | 0.00000 | 0.00000 | | 0.00000 | .45202 | |
| [illegible]/COST | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| INVGS | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| INVSC | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| INVAR | 0.00000 | 0.00000 | | 0.00000 | .06957 | |
| INVLD | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| INVOX | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| INVPC | 0.00000 | 0.00000 | | 0.00000 | .06678 | |
| INVEH | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| INVSS | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| INVPY | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| INVPL | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| INVPU | 0.00000 | 0.00000 | | 0.00000 | .00587 | |
| [illegible] | 0.00000 | 0.00000 | | 0.00000 | .02000 | |
| [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| LEG | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| CAT | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| ITX | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| ROY | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| FUL | 0.00000 | 0.00000 | | 0.00000 | 16.40516 | |
| [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| UTL | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| INV | 0.00000 | 0.00000 | | 0.00000 | .30000 | |
| CLO | 0.00000 | 0.00000 | | 0.00000 | 69.97901 | |
| [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| [illegible] | 0.00000 | 0.00000 | | 0.00000 | 1.00000 | |
| LIMAR | 0.00000 | 0.00000 | | 0.00000 | .20176 | |
| LIMLD | 0.00000 | 0.00000 | | 0.00000 | 46.45389 | |
| LIMOX | 0.00000 | 0.00000 | | 0.00000 | 64.53623 | |
| LIMPC | 0.00000 | 0.00000 | | 0.00000 | 1.16281 | |
| LIMPL | 0.00000 | 0.00000 | | 0.00000 | 29.19925 | |
| CPASC | 0.00000 | 0.00000 | | 0.00000 | 12.00000 | |
| CPAR | 0.00000 | 0.00000 | | 0.00000 | 7.71569 | |
| CPALD | 0.00000 | 0.00000 | | 0.00000 | 101.95389 | |

I 00/ PROFS ** *77*

| *T* *Y* *W* *F* | *S* *VARIABLE* *NAME* *A* *T* | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| * | * | * | * | * | * | * | * |
| *P | *CPMX | 0.00000 | 0.00000 | * | 0.00000 | 112.53623 | * |
| *P | *CPPC | 0.00000 | 0.00000 | * | 0.00000 | 14.70000 | * |
| *P | *CPJE | 0.00000 | 0.00000 | * | 0.00000 | 25.50000 | * |
| *P | *CPWY | 0.00000 | 0.00000 | * | 0.00000 | 25.50000 | * |
| *P | *CPPL | 0.00000 | 0.00000 | * | 0.00000 | 89.19925 | * |
| *P | *PLMA | 0.00000 | 0.00000 | * | 0.00000 | .01000 | * |
| *P | *ETMA | 0.00000 | 0.00000 | * | 0.00000 | 44.00000 | * |
| *P | *PEMA | 0.00000 | 0.00000 | * | 0.00000 | 250.00000 | * |
| *P | *WJMA | 0.00000 | 0.00000 | * | 0.00000 | 18.00000 | * |
| *P | *PPMA | 0.00000 | 0.00000 | * | 0.00000 | 230.00000 | * |
| *P | *CHMA | 0.00000 | 0.00000 | * | 0.00000 | 35.00000 | * |
| *P | *WGMA | 0.00000 | 0.00000 | * | 0.00000 | 30.00000 | * |
| *P | *FOMA | 0.00000 | 0.00000 | * | 0.00000 | 17.00000 | * |
| *P | *YMMA | 0.00000 | 0.00000 | * | 0.00000 | 49.00000 | * |
| *P | *TOMA | 0.00000 | 0.00000 | * | 0.00000 | 164.26262 | * |
| *P | *SZMA | 0.00000 | 0.00000 | * | 0.00000 | 90.00000 | * |
| *P | *EBMA | 0.00000 | 0.00000 | * | 0.00000 | 88.00000 | * |
| *P | *VCMA | 0.00000 | 0.00000 | * | 0.00000 | 150.00000 | * |
| *P | *PVMA | 0.00000 | 0.00000 | * | 0.00000 | 230.00000 | * |
| *P | *SAMA | 0.00000 | 0.00000 | * | 0.00000 | 61.42621 | * |
| *P | *SYMA | 0.00000 | 0.00000 | * | 0.00000 | 159.53000 | * |
| *P | *ATMA | 0.00000 | 0.00000 | * | 0.00000 | 150.00000 | * |
| *P | *LSMA | 0.00000 | 0.00000 | * | 0.00000 | .01000 | * |
| *P | *RYMA | 0.00000 | 0.00000 | * | 0.00000 | 18.00000 | * |
| *P | *PFMA | 0.00000 | 0.00000 | * | 0.00000 | .01000 | * |
| *P | *SPMA | 0.00000 | 0.00000 | * | 0.00000 | 265.00000 | * |
| *P | *PSMA | 0.00000 | 0.00000 | * | 0.00000 | 235.00000 | * |
| *P | *GASMA | 0.00000 | 0.00000 | * | 0.00000 | 18.54783 | * |
| *P | *CZMMA | 0.00000 | 0.00000 | * | 0.00000 | 56.35687 | * |
| *P | *CJMMA | 0.00000 | 0.00000 | * | 0.00000 | 18.30175 | * |
| *P | *CAMMA | 0.00000 | 0.00000 | * | 0.00000 | 35.00000 | * |
| *P | *CIMMA | 0.00000 | 0.00000 | * | 0.00000 | 30.00000 | * |
| 2 | | 0.00000 | 0.00000 | | 0.00000 | 31.68263 | |

I 00/ PROFS ** *77*

| *T* *Y* *W* *F* | *S* *VARIABLE* *NAME* *A* *T* | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| * | * | * | * | * | * | * | * |
| *P | *GMMA | 0.00000 | 0.00000 | * | 0.00000 | 13.50727 | * |
| *P | *GUMMA | 0.00000 | 0.00000 | * | 0.00000 | 14.04046 | * |
| *P | *PVCMA | 0.00000 | 0.00000 | * | 0.00000 | 230.00000 | * |
| *P | *CALMA | 0.00000 | 0.00000 | * | 0.00000 | 61.42621 | * |
| *P | *STMMA | 0.00000 | 0.00000 | * | 0.00000 | 159.53000 | * |
| *P | *BSJMA | 0.00000 | 0.00000 | * | 0.00000 | 235.00000 | * |
| *P | *[illegible] | 0.00000 | 0.00000 | * | 0.00000 | 230.00000 | * |

| | | | | | | |
|---|---|---|---|---|---|---|
| *P | *[illegible]A | * F* | [illegible]* | 0.00000* | * | 0.00000* | 30.00000* |
| *P | *[illegible]A | * F* | [illegible]* | 0.00000* | * | 0.00000* | 34.97849* |
| *P | *PF1HA | * F* | [illegible]* | 0.00000* | * | 0.00000* | 250.00000* |
| *P | *[illegible]A | * F* | [illegible]* | 0.00000* | * | 0.00000* | [illegible].01000* |
| *P | *VC1SA | * F* | [illegible]* | 0.00000* | * | 0.00000* | 150.00000* |
| *P | *STYHA | * F* | [illegible]* | 0.00000* | * | 0.00000* | 18.00000* |
| *P | *ST1HA | * F* | [illegible]* | 0.00000* | * | 0.00000* | 150.00000* |
| *P | *SRRSA | * F* | [illegible]* | 0.00000* | * | 0.00000* | 265.00000* |
| *P | *CH2SA | * F* | [illegible]* | 0.00000* | * | 0.00000* | 18.36000* |
| *P | *CH3HA | * F* | [illegible]* | 0.00000* | * | 0.00000* | 12.62980* |
| *P | *CH[illegible]A | * F* | [illegible]* | 0.00000* | * | 0.00000* | 11.66043* |
| *P | *C2X-A | * F* | [illegible]* | 0.00000* | * | 0.00000* | 56.35687* |
| *P | *REVFLOFI* F* | | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVFTOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVETOEX* F* | | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVPEOFI* F* | | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVPEOEX* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVPOFI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVPPOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVPPOEX* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.15000* |
| *P | *REVCSOFI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVSOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVFOOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVXYOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVXYOEX* F* | | [illegible]* | 0.00000* | * | 0.00000* | 2.22727* |
| *P | *REVTOOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVTOOEX* F* | | [illegible]* | 0.00000* | * | 0.00000* | 6.57051* |
| *P | *REVZOFI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVZOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVVCOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVVCOEX* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVPVOEI* F* | | [illegible]* | 0.00000* | * | 0.00000* | 1.00000* |
| *P | *REVPVOEX* F* | | 0.00000* | 0.00000* | * | 0.00000* | 1.09524* |
| * | * | * | * | * | * | * | * |
| * | * | * | * | * | * | * | * |

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INPUT/OUT *PROFSA ** *77*

| TYPE | VARIABLE NAME | VALUE | CONSTRAINT VALUE | CONSTRAINT LOWER BOUND | CONSTRAINT UPPER BOUND | DUAL VALUE | COMMENTS |
|---|---|---|---|---|---|---|---|
| *P | *PEVFAPFI*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EVFMDEX*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EVSYDEI*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EVSYDEX*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EV-TDEI*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EV-TDEX*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.15385* | |
| *P | **EVL-DEI*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EV-YDEI*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EVPRDEI*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EVSSDEI*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EV-DEX*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EVSDEI*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | **EVSDEX*F* | 0.00000* | 0.00000* | * | 0.00000* | 1.00000* | |
| *P | *PEL*X *F* | 0.00000* | 90.00000* | * | 90.00000* | 20.00000* | |
| *M | *VCE*N *F* | 0.00000* | 0.00000* | -0.00000* | * | -25.00000* | |
| *P | *EA*X *F* | 0.00000* | 3.00000* | * | 3.00000* | 188.57380* | |
| *P | *EA*X *F* | 0.00000* | 9.00000* | * | 9.00000* | 138.57380* | |
| *P | *SY*X *F* | 0.00000* | 5.00000* | * | 5.00000* | 40.47000* | |
| *P | *SYE*X *F* | 0.00000* | 45.00000* | * | 45.00000* | 20.47000* | |
| *P | *PSD*X *F* | 0.00000* | 15.00000* | * | 15.00000* | 25.00000* | |
| *P | *LEZ*X *F* | 0.00000* | 126.00000* | * | 126.00000* | 68.06814* | |

INDO/WBK #PPUFS# ## #77#

| TYPE | VARIABLE NAME | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|
| BF | NTR | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| STM | TR | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| AST | R | 0.00000 | 1.00000 | 0.00000 | NONE | 1.00000 | |
| TRPROCOS | F | 0.00000 | 1.00000 | 0.00000 | NONE | .33116 | |
| TRBUTCOS | F | 0.00000 | 1.00000 | 0.00000 | NONE | .42357 | |
| TRAAFCOS | F | 0.00000 | 1.00000 | 0.00000 | NONE | .45384 | |
| TRGAACOS | F | 0.00000 | 1.00000 | 0.00000 | NONE | .54798 | |
| BUIDVTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .30000 | |
| AFTDVTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .23043 | |
| PCIDVTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .21322 | |
| SUIDVTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .29413 | |
| SMIDVTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .30000 | |
| DEAMPTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .15000 | |
| DEXXYTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | 1.22727 | |
| DEXLYTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | 5.57051 | |
| DEXMYTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .09524 | |
| FXRTTR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .15385 | |
| FXSETR | F | 0.00000 | 0.00000 | 0.00000 | NONE | .06000 | |
| IF*SCINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | 3599.99999 | |
| I *LOINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | -4486.16572 | |
| IF*OXINT | LO | 0.00000 | 0.00000 | 0.00000 | 1.00000 | -11627.24581 | |
| IF*ZHINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | 1674.00000 | |
| IF*SCINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | 570.00000 | |
| IF*FYINT | UP | 1.00000 | 0.00000 | 0.00000 | 1.00000 | 570.00000 | |
| IF*PLINT | LO | 0.00000 | 0.00000 | 0.00000 | 1.00000 | -1990.72602 | |
| EHVA | F | 0.00000 | 0.00000 | 0.00000 | NONE | 50.10000 | |
| DHA | F | 0.00000 | 0.00000 | 0.00000 | NONE | 2.16013 | |
| FHZS | F | 0.00000 | 0.00000 | 0.00000 | NONE | 14.00890 | |
| PTA | F | 0.00000 | 0.00000 | 0.00000 | NONE | 104.01200 | |
| FLGS | F | 0.00000 | 0.00000 | 0.00000 | NONE | 18.53783 | |
| FLC2H | F | 0.00000 | 0.00000 | 0.00000 | NONE | 56.34607 | |
| FLC3H | F | 0.00000 | 0.00000 | 0.00000 | NONE | 18.29175 | |
| FLC4H | F | 0.00000 | 0.00000 | 0.00000 | NONE | 34.09000 | |
| FTC2H | F | 0.00000 | 0.00000 | 0.00000 | NONE | 12.35687 | |
| FUC3H | F | 0.00000 | 0.00000 | 0.00000 | NONE | .30175 | |
| IG40 | F | 0.00000 | 0.00000 | 0.00000 | NONE | 1.68263 | |
| GA3 | F | 0.00000 | 0.00000 | 0.00000 | NONE | 4.97849 | |
| ZHEZ | F | 0.00000 | 0.00000 | 0.00000 | NONE | 72.06814 | |
| FFC2H | F | 0.00000 | 0.00000 | 0.00000 | NONE | 37.49734 | |
| FFC4H | F | 0.00000 | 0.00000 | 0.00000 | NONE | 16.71466 | |

LOG/WAX #PROFS# ## #77#

| TYPE | VARIABLE NAME | STATUS | VALUE | COST | LOWER BOUND | UPPER BOUND | DJ | COMMENTS |
|---|---|---|---|---|---|---|---|---|
| 2 | PEFEU | LF | 0.00000 | 0.00000 | 0.00000 | NONE | .58484 | |
| 2 | MJUET | UF | 0.00000 | 0.00000 | 0.00000 | NONE | 44.00000 | |
| 2 | MJATO | LF | 0.00000 | 0.00000 | 0.00000 | NONE | 114.26282 | |

World Bank

# PLANNING FOR INDUSTRIAL DEVELOPMENT IN INDONESIA

Chapters XI - XII

Timber-based Industries and Minerals

# BASIC DATA

(original with Chapter I)

# CHAPTER XI

## TIMBER BASED INDUSTRIES

11.1 The timber based industries, covering the production of sawmill products, plywood, pulp, paper and including final products such as furniture, offer some of the best opportunities for development in Indonesia. This is because of the resource endowment of the country in forest land and also because the scale of efficient operation in many of these products is relatively small and the technology well known so that they are well suited to early development. These conditions are not uniformly true for all products (e.g. pulp) but do describe many product lines.

11.2 This chapter assesses the potential for development of timber based industries and particularly notes certain qualifications that must be made in evaluating the resource base. In some respects the base is not as extensive as it has sometimes been assumed. The current status of development is next examined and the efficiency of present practices in exploiting the forests is discussed, with particular reference to the conduct under the concessionary agreements. This material supplements the material presented in Chapter VI. Finally, a major part of this chapter is devoted to a pre-feasibility study of a wood-products complex (including sawmills, plywood, pulp, and paper), and it is concluded that such a complex is economically desirable. A recommendation is made that a full feasibility study be undertaken.

## POTENTIAL FOR THE DEVELOPMENT OF TIMBER BASED INDUSTRIES

### Natural Resources

11.3 Forest Areas - Indonesia has one of the largest forest land areas in the world, surpassed only by those in Canada, Brazil, Congo, U. S., and Australia. The total area of forest land in Indonesia is 122 million Ha., but the area of forest damaged or destroyed by shift cultivation, conversion to permanent agriculture, or other reasons has been variously estimated at between 10 million Ha.1/and 38 million Ha.2/. A recent Japanese survey team estimated this area at 26 million Ha. On the basis of the latter figure3/ distribution of forest land by use is as follows:

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1/ Ref. 7, page 22 (the figure given, however, apparently excluded West Irian unstocked land). (For list of references see Table 11.7).
2/ Ref. 5, pp. 18/19.
3/ Ref. 1, page 44.

| | Hectares (million) |
|---|---|
| - Reserved or needed for protection of land and hydrological regulation | 48 |
| - Conversion to crop land after one cutting | 18 |
| - Under exploitation or potentially productive | 24 |
| - Denuded forest | 26 |
| - Other types | 6 |
| | 122 |

Of this total, man-made forests comprised (at the end of 1967) 1,193,000 Ha., mostly in teak and pine trees.

11.4 Forest land in Java and Bali has largely been converted into agricultural land, but in other islands it still has a dominant role.

| | Forest land areas (million Ha.)1/ | Ratio of forested area to total geographical area |
|---|---|---|
| Djawa (Java) and Madura | 2.9 | 0.23 |
| Dali, Nusa Tengarve (Lombok Sumbawa, Flores, Sumba and Timor) | 1.5 | 0.18 |
| Kalimantan (Borneo) | 41.5 | 0.77 |
| Sumatra | 28.4 | 0.60 |
| Sulawesi (Celebes) | 9.9 | 0.46 |
| Maluku (Moluccas) | 6.0 | 0.80 |
| Irian Barat (West New Guinea) | 31.0 | 0.73 |
| | 121.7 | 0.64 |

11.5 Types of forest - Only about 12% of the forested area has been surveyed, even in a preliminary way. The greatest proportion of the forested area (73%) belongs to tropical jungle, but in Java very little tropical forest is found, while teak and mixed deciduous forest are the most common. Needleleaf softwoods, mainly pine (Pinus merkusii) and Agathis are found in the Takengon area, near Lake Tawar, in the Atjeh province, Northern Sumatra, as well as in the area around

1/ Ref. 5, pp. 17 and 26, and Ref. 1, page 43

the Slamet mountain in central Java, and in Sulawesi and Southern Kalimantan. Great mangrove areas exist in Southeastern Sumatra and West Irian. Among the tropical hardwoods, Diptrocarpacea are predominant, and among them species of the Shorea, Eusideroxylon, and Dryobalanaps genera. A breakdown showing frequency of the different species, however, is not available except for very small and unrepresentative areas. Furthermore, terminology is sometimes confusing. For instance, two different species, belonging to the Hopea and the Vatica genera are sold under the same name: resak[1]. Kapur also seems to be a name used for species belonging to two different genera.[2]

11.6 Volume of Timber - "Indonesia so far has even less data on volume, species distribution, and timber quality than they have on forested area."[3] Small reconnaissance surveys have been made in accessible localities. Since samples are not randomized, and the methodology is not uniform, data obtained in these surveys is not applicable to all areas. Data obtained from concessionaires are not being systematically collected and analyzed for use in the valuation of prospects for the development of timber-based industries.

11.7 The volume of timber in some areas[4] has been estimated at more than 120 $m^3$ (r) per Ha.,[5] or even at higher figures. According to some concessionaires visited by the Mission, actual yields, however, are much smaller. Two possible reasons for yields being smaller than expected are that sampled areas may be unrepresentative and different methods of measurement may be applied. Apparently, the Forestry Directorate staff counts as exploitable timber all trees more than 50 cm (approximately 20") in diameter (measured one foot above top root level), but concessionaires are generally exploiting only "meranti" (Shorea species) and a few other types of timber. The systems of measurement seem not to have been completely unified, differences of about 10% between official and concessionaires' figures having been reported.[6] Yields as low as from 10 to 20$m^3$(r) of "meranti" have been indicated for Sumatra and between 30 and 40$m^3$(r) per Ha. for Kalimantan. Other calculations have been made on the bases of 50$m^3$(r)[7] or 40$m^3$ per Ha.[8]. On the basis of the latter figure and assuming a wastage of 20% and a cycling term of 35 years for self-sustained operation of production forests, and assuming further that forest areas earmarked for permanent conversion to agriculture will be cleared in 50 years, the volume of

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1/ Ref. 8, page 9 of English summary and Appendix 1
2/ Ref. 4, country report on Indonesia, page 11
3/ Ref. 7, page 23
4/ For instance, in the agreement between the GOI and A-Soriano.
5/ Cubic meters in the round without bark.
6/ Ref. 9.
7/ Ref. 2, page 3.
8/ Ref. 7, page 54.

potential Indonesian timber production could reach 30 million $m^3$(r) annually[1]. Additionally, there is the possible managed utilization of pine and Agathis plantations--whose yields have been estimated at 110 to 150$m^3$(r) per Ha.[2] --and the utilization of timber increments from forest left for protection. This possibility, however, seems remote and should not be approached without due regard to the possible impairment of the protective function of those forests. The curtailing of shifting cultivation could free considerable extension of land for reforestation, but this cannot be foreseen to take place in the near future.

Limitations to the Possible Development of Forest Industries.

11.8 There are many factors that can limit and even seriously damage the prospects for a vigorous and healthy development of timber-based industries. The most important ones are the following:

11.9 Limitations on the number of marketable species - This element has already been taken partially into account in the volume of standing timber per Ha. used in the potential logging output. But, as it has been repeatedly pointed out in many studies, the great diversity of species in many of the Indonesian forests raises serious problems in the full utilization of those resources. "A combination of industrially-oriented research by Government and aggressive marketing by industry could result in a substantial broadening of the wood products base . . . It must, however, be recognized that marketing of secondary species has been a high priority concern in other countries for many years and that it has seldom met with outstanding success."[3]

11.10 Forest mismanagement - Concession agreements made available to the Mission contain policy statements supporting sustained yield management of forest resources, and everybody agrees on the need to attain this objective if Indonesia is to gain more than a temporary financial benefit. It is, however, not sure that the application of these principles is carried in more than a fraction of the areas under exploitation. Visits made by forest experts disclose that there are logged-over areas where a two-storied cover has developed, in which the overstory is composed of defective trees or trees belonging to unmerchantable species, while the understory

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1/ See Appendix 11.1
2/ Ref. 1, page 135
3/ Ref. 10, page 53

is made up of mixed species, not all merchantable, and where individual trees may be in poor condition. "Some stands will be converted by present cutting practices to unproductive and unmerchantable stands in as little as one cutting cycle unless steps are taken to incorporate some stand improvement measures promptly." 1/

11.11 In some cases, where there are no roads and rivers are too shallow to permit the use of barges, "sinkers" are left in the stand. A second-stage cutting operation undertaken at a later date, when transportation can be arranged, will result in considerable damage to younger trees and the loss of a number of years in the recycling of forest exploitation. One of the most serious threats to a well managed utilization of Indonesian forests is shifting cultivation. Unauthorized cutting or cutting authorized in small areas by local authorities is also a source of economic losses, confusion and solution of problems posed by these threats involves more than the application of sound forestry techniques by management; serious social, legal and political issues must also be faced.

11.12 Efficient forest management will neither automatically result from steps taken voluntarily by the concessionaires nor by Government fiat, unbacked by technical and administrative competence. It will require knowledgeable cooperation at all levels between the public and the private sectors, and within each one of these sectors.

11.13 Lack of coordination in forest administration - There is very little communication between the Ministries of Agriculture and Industries. Clauses dealing with the developing of processing industries by timber concessionaires are generally written or approved by personnel of the Forestry Directorate, without consulting the Directorate of Chemical Industries (except in the case of the agreement with A. Soriano and Cia, in which officials from the two directorates are reported to have cooperated). On the other hand, terms of reference for studies on the pulp and paper industry in Indonesia, as well as for specific reports on specific projects such as the proposed Takegon and Notog paper plants and a study to be made on the possible utilization of pine and agathis plantations in Central Java, have been prepared by the Directorate of Chemical Industries without the collaboration of the Forestry Directorate.

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1/ Ref. 7, page 28

11.14 There is dual responsibility in the administration of forest resources. Felling of trees in the past has been authorized by province governors in areas as large as 10,000 Ha. Even at present, provincial authorities can issue permits to cut areas of up to 100 Ha. The reach of the provincial authorities extends, however, much farther; the 1957 regulation under which provincial Governors were given the responsibility for management of the forest resources has not been rescinded. The provincial governments pay salaries and office expenses for two thirds of the forestry personnel in their provinces; the status is unclear, but generally it is assumed that the Directorate of Forestry has the technical control of the forest management personnel, but that administratively, they depend upon the provincial governments. The Governors have veto power over the appointment of regional directors. Even if the issue were not clouded by legal ambiguity, in fact, the Governors would have a large influence on forest management, given the wide geographical dispersion of the country's territories and the political realities under which its unity has been attained, not to mention their control of local authorities, means of transportation, protection against outlaws, etc.

11.15 Size and duration of concessions - Many concessions are too small or have been given for such terms that exploitation can be carried out only for a period much shorter than a cutting cycle. The concessionaires often have little economic interest in sustained yield management or stand improvement in their areas. There is no cooperative effort between concessionaires to form "working cycle" blocks of their areas under unit management. Plans to correct this situation through pressure from above are not in sight.

11.16 Lack in human resources - One of the reasons for the situation described above is the serious scarcity of human resources in all levels. Although there is overt and hidden unemployment in Java and some urban centers in other islands, labor - even unskilled labor - is scarce in the main tropical forested areas, and wages are higher than in Java. Forest services are understaffed and existing staff is underpaid.[1] Total number of people employed in forestry (excluding Perhutani, which is a public agency engaged in sawmilling, and other commercial operations), is nearly 11,400 or 92 per million Ha. of forest land. Although much lower than similar figures for Germany or India, which were 2,675 and 1,000 respectively in 1960[2], the main problem is not with the total number, but with the relatively small number of professional foresters, rangers and trained guards.[3]

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1/ High officials in the Directorate General of Forestry can earn less than $1,000 a year

2/ Ref. 4, page Q6 and country paper on India, page 28

3/ Ref. 7, page 16

11.17 Problems of infrastructure - Forests are located in areas where infrastructure facilities are generally lacking. Exceptions are the teak forests in Java, a large proportion of which can be reached by road. The pine plantations located around Slamet Mountain in Central Java are also within easy reach of the Banjumas crossroads, where highways to the west (Bandung and Djakarta), to the east (Jogjakarta and Surabaya), north to the Java seacoast, and south to the Tjilatjap port meet. Power is not generally available to concessionaires or to industries and enterprises having large demand requirements must install their own power plants. Water for industrial enterprises is generally obtained from their own wells or by treating river water. Waste disposal can be an important problem in Java, and even in the largely underpopulated outer islands, it may become an important issue. Eash project for the larger plants must be carefully studied in this respect and pollution levels eventually monitored.

11.18 Legal deficiencies - In spite of her large forestry resources, the question of what the actual volume of available supplies is must be raised. Because of the number of agreements already signed and the area covered by them, there is some doubt that there will be sufficient forest reserves to insure that processing facilities are actually installed. The terms of concession agreements 1/ have been discussed in Chapter VI. Suffice to say now that "they provide no assurance that local demand in the timber industry will be met by the operations of the companies."2/ None of the agreements contain any provisos for the purchase by future public or privately-owned plants installed in Indonesia of the unprocessed logs produced by forest concessionaires.

11.19 Lack of financial resources - Problems related to the lack of adequate human resources, infrastructure and efficient technical forestry management can be partially ascribed to lack of financial resources. But, there is little evidence of efforts being made to overcome this deficiency. Funds for training programs, construction of ports and roads, improvement of other infrastructure facilities and development of forestry and forestry-based industries as well as for studies leading to the same objectives could be made available if their need is demonstrated and their sound use is reasonably assured. For this, a coordinated effort on the part of officials in the public sector and leaders in private enterprise is needed.

11.20 Concession areas and projected volume of log extraction - Tables 11.01, 11.02, and 11.03 show the area of forest concessions granted or applied for; the area of concessions owned by foreign enterprises or by mixed ventures, and the volume of logging and level of investments expected to be readied. Total area of concessions already granted cover almost 50% of the area allocated for exploitation and another 34% is in drafts ready for approval by the Government or in

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1/ The wordings "concession" or "concession agreements" are used throughout this report in substitution of "working contract."

2/ Ref. 11, page 36.

applications being processed. Log extraction is expected to reach 18.8 million $m^3(r)$ by 1973 or an average of approximately $1.3m^3(r)/Ha$. On the basis of a 35-year cutting cycle this is equivalent to assume that the average stock of merchantable timber in the concessions is $57m^3/Ha$. (if the average waste is 20% of stock). Projected investment is more than $570 million, of which, more than one-half would be for two concessions: A. Soriano & Cia. and Korea Development Co. As it has been mentioned in Chapter VI there is no assurance that these projected investments will be carried out.

## CURRENT STATUS OF DEVELOPMENT

### Production of Timber and Timber Products

11.21 Forest Removals - No reliable information exists on removals for Indonesia. FAO figures for total removals in the fifties and the sixties are frankly incompatible, for they include an unexplained growth of fuelwood from 1.4 million $m^3(r)$ in 1950 to 75.3 million $m^3(r)$1/ in 1960. After 1960, figures are practically the same, and after 1963, they are repetitions of that year's figures. Indonesian sources give very divergent figures (Table 11.01), which, however, if fuelwood is excluded, do show two important trends:

(i) A dip in production in 1965/66.
(ii) A very rapid growth after 1966, mainly because of recent developments in Kalimantan.

The following figures are representative of removals other than fuelwood:

| | Removals2/ (Excluding Fuelwood) | | Geographical distribution (%)3/ | | | |
|---|---|---|---|---|---|---|
| | Million $m^3(r)$ | Index | Java | Sumatra | Kalimantan | Other |
| 1962 | 2.0 | 100 | 55 | 34 | 8 | 3 |
| 1963 | 2.0 | 100 | 46 | 42 | 9 | 3 |
| 1964 | 1.9 | 95 | 47 | 39 | 8 | 6 |
| 1965 | 1.8 | 90 | 47 | 46 | 3 | 4 |
| 1966 | 2.0 | 100 | 41 | 42 | 13 | 4 |
| 1967 | 2.9 | 145 | 39 | 42 | 14 | 5 |
| 1968 | 3.8 | 190 | 43 | 35 | 16 | 5 |
| 1969 | 7.2 | 360 | 22 | 25 | 44 | 9 |
| 1970 (est.) | 11.5 | 575 | n.a. | n.a. | n.a. | n.a. |

Most of the present production is in typical tropical hardwoods. Approximately 0.5 million $m^3(r)$ of teak is cut annually.

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1/ Cubic meters in the round without bark. It usually refers to the Hoppus system.
2/ Source: Table 11.4
3/ Ref. 1, page 50 for 1963/68 figures. Ref. 2 pp. 5/6 for 1962 and 1969 figures (list of references in Table 11.17 at end of Chapter).

11.22 Use of Logs - The uncertainty in the amount of fuelwood consumed is so extreme that no meaningful relationships can be found when it is considered in the calculations. The Central Statistical Office figures as published by Bank Negara Indonesia, show only about 1.5 million $m^3$ of timber being used as fuelwood; The Directorate-General of Chemistry indicates a consumption of 5 million $m^3(r)$; and, FAO statistics report a figure of 79.2 million $m^3(r)$. Excluding consumption for fuel, end use for exports was relatively small until 1967, but in the last two years it has become the most important end-use for logs felled in Indonesia. Internal consumption, on the other hand, does not seem to have increased significantly. Discrepancies in data from different sources are again encountered in relation to exports (Table 11.5). According to official Indonesian figures, exports grew more than 30-fold in only five years from about 0.2 million $m^3(r)$ in 1965 to not less than 7 million $m^3(r)$ in 1970. But there are indications that Indonesian export figures may be under-reported.[1/]

TIMBER EXPORTS ACCORDING TO INDONESIAN SOURCES

| | Volume 000's m.t. | Value US $ million | Unit Value $/m.t. |
|---|---|---|---|
| 1961 | 102 | 1,328 | 13.02 |
| 1965 | 137 | 2,022 | 14.70 |
| 1966 | 203 | 3,500 | 17.21 |
| 1967 | 401 | 6,304 | 15.72 |
| 1968 | 837 | 11,102 | 13.26 |
| 1969 | 2,430 | 25,424 | 10.46 |
| 1970 | 5,161 | 86,118 | 16.68 |
| 1971 Jan/Mar. | 1,437 | 30,576 | 21.27 |

The most important buyers of Indonesian sawlogs and peeler logs are Japan and Korea; smaller volumes are absorbed by China (Taiwan), other Far East countries, and Western Europe (about 26,000 $m^3$ in 1968). Due to the recent slow-down in the Japanese "boom", 1971 figures may not reach the 1970 level.

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1/ According to the 1969 FAO Yearbook, non-coniferous wood exports from Indonesia, taken from importers' data, were 1,879,000 $m^3(r)$ in 1968 - equivalent to about 1,340,000 m.t. - and were valued at US $ 53.4 million. The latter figure is c.i.f., but even after halving it, f.o.b. values would be much higher than those reported by Indonesian sources.

Capacity and Evaluation of Existing Timber Processing Industries

11.23 The most important timber-based industries are sawmilling, furniture-making, shipyards and - on a smaller scale - some other manufacuting. Since a great majority of the plants are very small (for instance many "sawmilling establishments" employ 2 or 3 persons), value added and gross value of production, as well as physical production figures, are at best educated guesses. Value added in 1970 by all timber-based industries (large or medium-sized and small establishments) has been estimated in a recent study at US $50.2 million[1/], excluding furniture making. Unfortunately, this figure apparently includes value added in the logging of timber used in industry. After deduction of this value, manufacturing would account for US $19.8 million in value added or 2.7% of industrial contribution to GNP. In the same study, the contribution of furniture making to GNP is given as being $56.1 million, but this figure seems to be overestimated. Total annual timber inputs to industry have been estimated at 3.9 million $m^3$(r) for sawmills and 0.2 million $m^3$(r) for all other, including one small paper mill which uses about 1000 $m^3$(r) of pine timber for pulp. (Pulp and paper plants will be described in the following section).

Sawmills - There are approximately 4,000 "establishments," but only 412 use power equipment. Timber input for the latter is estimated to be between 600,000 and 900,000 $m^3$(r), but including smaller units, total sawnwood is thought to be nearer to 4 million in $m^3$(r)[2/]. Recorded production between 1960 and 1965 averaged 1,602,000 $m^3$(s)[3/] annually. Most of the sawmills are private, but the 15 operated by Perhutani (the Central Government timber processing enterprise) are among those having better facilities. Eight of those mills are located in Java and they process mainly teak. Their capacity is estimated at 80 $m^3$/day working one shift. Outside Java, Perhutani operates 7 other mills, with a total capacity of about 80,000 $m^3$/yr. (Table 11.6).

Plywood - There are four plants, two of which, located in Java, are very small and apparently only occasionally operative. The two other ones are located in Sumatra and most of their production is used to make tea chests for exports. Combined capacity of the two plants is between 25,000 and 30,000 $m^3$/yr. but they operate at about half capacity[3/]. A larger mill has been established in Sulawesi, but

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1/ Ref. 3
2/ Source: Ref. 5, pp. 17.
3/ Source: Ref. 4, report on Indonesia, pp. 14
4/ Source: Ref. 1, pp. 58

is reported not working. One reason advanced for this situation is difficulty in securing regular supplies. There is also one very small - about 1500 tpy - hardboard plant in East Java which is based on use of sugarcane bagasse.

Matches - In 1967, there were 11 plants manufacturing matches with a total annual capacity of 100,000 cases of 7,250 boxes each but competition from imports (in spite of 40% duties imposed on them) has resulted in an output averaging only 50% of capacity. Timber required by this industry (mostly pine and agathis), has been variously estimated at between 40,000 $m^3$(r)/yr.1/

Pencils - One plant in Java operates at about 40% of its 30,000 gross/yr. capacity. Demand is about 25,000 gross annually, and a decade ago it was largely covered by domestic plants. Now imports have practically substituted local production. Timber required at present is less than 5000 $m^3$(r) per year.

Wood Boxes - There are 27 small plants using about 37,000 $m^3$(r) of timber annually operating at a little more than 60% of capacity3/.

Furniture - Most of the furniture is made using hand tools. There were more than 355 establishments registered in 1967 with a total consumption of approximately 116,000 $m^3$(r) of wood, two-thirds of which was teak4/. Quality of the furniture made, however, generally does not justify using high quality materials. Including numerous cottage-type furniture makers, total consumption of wood in furniture can easily double the figure given for registered enterprises.

Other end uses - Building ships, bus bodies, and similar activities have been estimated to use 70,000 $m^3$(r) timber annually.

## Pulp and Paper Production

11.24 There are seven paper mills in Indonesia, of which one began production in 1969 and another in 1970. (The latecomers are partly the reason for some of the divergent production figures received by the mission). Four of the plants are located in Java,

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1/ Ref. 1, pp. 58
2/ Ref. 4, pp. 16
3/ Ref. 6
4/ Ref. 5, pp. 36

one in Sumatra, one in Sulawesi, and one in Kalimantan. Only two of them depend partially on wood for their supply of cellulosic fibers. All of them are small and face technical and economic problems.

Capacity and Production - Total capacity of the seven Central Government-owned mills is 147 t/d (approximately 44,000 t/yr.), but actual production has recently not been more than 65% of capacity.

| | No. of mills in operation | Capacity t/y | Production m.t.[1] | Capacity Utilization (%) |
|---|---|---|---|---|
| 1965 | 4 | 17,100 | 11,122 | 65 |
| 1966 | 4 | 17,100 | 9,866 | 58 |
| 1967 | 5 | 21,600 | 8,678 | 40 |
| 1968 | 5 | 34,300 | 11,308 | 33 |
| 1969 | 6 | 42,100 | 15,559 | 37 |
| 1970 | 7 | 44,100 | 18,453 | 42 |

Private mills working manually on very small quantities of rice straw and waste, have a combined additional capacity estimated at about 3,000 t/yr.[2].

The main products are white writing paper, Kraft and wrapping papers, and paperboard. Some mills have integrated forward into manufacture of ruled notebooks.

| | Estimated 1969 Production (m.t.) |
|---|---|
| White writing and typing paper | 9,144 |
| Notebooks | 1,180 |
| Kraft and wrapping paper | 2,184 |
| Paperboard | 1,480 |
| Cigarette paper | 250 |
| Other, including newsprint | 1,321 |
| | 15,559 |

11.25 Location and raw materials - The seven existing mills have been located generally on the basis of availability of raw materials,

1/ Ref. 1, pp. 63/64 and direct communication from the Direc orate General of Chemical Industries

2/ Ref. 5, pp. 33-34.

but these have not always been secured in sufficient quantities or at economically attractive prices, so that most of them are not able to operate at their capacity, which is small to begin with. The location, capacity, and main cellulosic raw materials for these mills are the following:

| Mills | Location | Capacity t/d | Main Cellulosic raw materials |
|---|---|---|---|
| Padalarang | W. Java | 12 | Rice straw and imported pulp (10%) |
| Blabak | C. Java | 20 | Rice straw and imported pulp (10/30%) |
| Letjes | E. Java | 30 | Rice straw and imported pulp (10/20%) |
| Banjuwangi | E. Java | 30 | Bamboo |
| Gowa | S. Sulawesi | 30 | Bamboo |
| Siantor | N. Sumatra | 15 | Wastepaper, pinus merkusii and imported pulp |
| Martapura | S. Kalimantan | 10 | KP from rubber trees, GP from Agathis and imported pulp (about 10%) |

11.26 Other Inputs - There is one 3,000-tpy caustic soda plant located in Waru, near Surabaya. It was built by Asahi Glass Co. (Japan) in 1956 and is owned by the Indonesian Government, but because of difficulties in placing by-product chlorine, production has been frequently suspended, and equipment has been damaged by corrosion. At present, existing paper mills import caustic soda. Salt is available from a state-owned solar evaporation plant located in Madura, as well as from private companies. Combined capacity is estimated at 600,000 t/yr. while demand was 465,000 m.t. in 1968. There are several sulphur deposits in Indonesia, but none is known that is large enough or has adequate sulphur content for economic exploitation. Limestone deposits appropriate for pulp production are known to exist in Adjibarang and Karangbolong in Java, around Lake Tawar, in northern Sumatra, and in Baturadja, near Palembang, where a 10,000-tpy calcining furnace is in operation. Power is not generally available at present paper plant sites, except for Padalarang and Letjes, and even in these two plants, captive power plants are required to satisfy part of the demand or to assure continued operations.

11.27 Plant equipment and operation problems - There is a great variety in type and origin of equipment used in the existing plants, and they all have problems, only some of which are derived from their small size:

(a) The Padalarang mill is the oldest having been inaugurated in 1922. It has two 5/6 t/d German-made paper machines 240cm and 225cm wide. It has good infrastructure and supplies of rice straw

are secured in a radius of 150 km from the plant. The main problems are very low plant capacity and very old equipment.

(b) The Blabak mill was completed in 1961 and was originally planned to use the Pomilio process. However, this was later changed to the conventional soda process, but capacity was lowered to 10 t/d. It comprises one Pomilio digester, a 260 cm-wide paper machine, a 240 cm rewinder, a 140 cm paper cutter, and two 820 KVA diesel generators. The main problems, besides low capacity, are: power shortages due to one generator efficiency being only 60%; width imbalance in the paper machine, rewinder, and cutter; filter clogging by silica because of process deficiencies; time lost because of lack of roll grinders.

(c) Letjes was established in 1939. Its original capacity was 10 t/d. In 1964, with the aid of West Germany, an expansion plan was started, which, however, was discontinued in a short time, and not begun again until 1968. Work on this plan was completed in May 1970 and present capacity is 30 t/d with two 270 cm-wide paper machines. The plant has an excellent location, with good water supply, raw materials (rice straw) bought within a radius of 100 km, and transportation facilities for its product. Increased production may require collection of raw materials from areas further away than at present and it may have to buy pulp from Banjuwangi.

(d) Construction of the Banjuwangi paper mill was started in 1963, as part of the Japanese war reparation program, but was suspended later and not resumed until 1968. Operations started in 1969. The plant comprises two $50m^3$ digesters, five $24m^3$ bleaching towers, hydropulper, steel and stone refiners, 285 cm paper machine, 9-stage calendar, recovery boiler and two 2500 km generators (one is a stand-by). Main problems are insufficient soda recovery, shut-downs because of lack of spare parts, high cost of imported liquid chlorine and caustic soda, lower quality from use of bleaching powder instead of chlorine, and high cost ($17/m.t.) for the cellulosic raw material (bamboo) bought from Perhutani. Water supply is adequate for present capacity, but river source used will not allow production expansion in dry season, unless recirculated.

(e) The Gowa mill, as the preceding one, was started by Japan in 1963 as part of war reparations. Completed in 1965, operations could not begin because of lack of funds due to run-away inflation. In 1966 electrolytic facilities were added, also as part of reparations, and operations started in 1967. The following year the process was changed from Kraft to soda, and in March 1970 work was suspended because of lack of working capital. Main problems: small size; lack of funds; shortage of spare parts; defective chemical plants; insufficient technical training of operating personnel, and high trans-

portation costs of products to Java (the paper market in Makassar has been estimated at 300 t/yr.). For regular operation, more regular water sources must be found.

(f) The Permatangsiantar (Siantar) paper mill was the first to be built by Japan as a war reparation project. It was completed in 1962, additional facilities having been added in the years 1965/68. It comprises wood room equipment, including a 2m diameter drum barker, two 450 kw pulp grinders, one 200 cm-wide paper machine, one pulper, three boilers, and two 1250 KVA diesel generators. Main problems: need to combine mechanical pulping of coniferous wood and use of imported pulp and/or purchased waste paper, the latter being, however, in very short supply (about 40 tons in a period of 3 or 4 months). Other problems are water shortages, lack of spare parts, bad state of power generating facilities, and lack of working capital generally.

(g) The Martapura paper mill was the last to be finished among the war reparation projects, in spite of equipment having arrived at Surabaya in 1960. It comprises wood room equipment, 300 hp grinder, digester, bleaching equipment, 150 cm paper machine, 140 cm rewinder, 145 cm paper cutter, and chemical and heat recovery equipment. It was originally planned to be fed with Agathis pulpwood to be brought from forests located some 300 km upstream on the Barito river. Stock of this timber has later been proven smaller than expected and increased demand for it in construction made supply look uncertain. The fact that waste rubber tree wood is abundantly available in the neighborhood of the mill and the development of processes for its pulping (partly through research in the Bandung Cellulose Research Institute), led to a decision to make ground pulp from Agathis and Kraft pulp from rubber trees. This is the fundamental weakness of this plant: too small a size for combined mechanical grinding and Kraft pulping of two raw materials, which are not particularly abundant or cheap. Furthermore, demand for paper in the area is extremely low and transportation costs to Java are high.

## THE CHARACTER OF FUTURE MARKETS

11.28 Future Demand for Wood - By 1985, total industrial demand for wood has been estimated to exceed 2400 million $m^3$(r) more than twice the level of about 1,189 million $m^3$ in 1968. Of that total demand, approximately 42% will go to paper and paperboard, and the balance to construction, furniture and other uses. These figures and the resulting average growth rate - 4.2% annually - are based on known factors and trends and could be affected both by technological breakthroughs and by changes in patters of consumption. Processes to make entirely new products from wood may be developed, and, by the same token, new raw

materials for present end-uses of wood resources may be found to be economically available. Steel and concrete have already replaced great quantities of the potential demand for construction wood, and plastics (and metals) have substituted wood in furniture and other articles. There are other remote, but not unthinkable possibilities which could upset any long-range projections. To mention only a few: sharp curtailment of newsprint because of substitution of newspapers by special TV circuits independently operable by the viewer; manufacture of non-woven fabrics from wood; construction of medium-durable houses (good for about 5 years' use), etc.

11.29 The general pattern of trade - The present overall pattern of trade in the Far East shows Indonesia and Malaysia exporting logs to Japan, Korea, and other countries in the process of being industrialized. At the same time, large quantities of plywood are being exported from Japan, Korea, and - in a smaller proportion - the Philippines to the U. S. and Canada (Graph 11.2). Woodpulp, on the other hand, is imported in large quantities only by Japan, and in smaller volumes by Korea and China (Taiwan). The most important paper importer is Hong Kong, followed by Japan and Singapore (Table 11.7). Japan, however, is a net exporter of paper products (Table 11.7). Projected trends[1] for the main net importers through 1975 show the following deficits:

| | Deficit million $m^3$(r) | | Present Suppliers |
|---|---|---|---|
| | Saw and Peeler Logs | Pulpwood | |
| European Common Market and the United Kingdom | 56.5 | 88.5 | N. Europe, USSR, Canada and W. Africa |
| United States | 28.0 | 21.0 | Canada, and S.E. Asia |
| Japan | 20.0 | - | S.E. Asia, US, Canada, and USSR |
| | 104.5 | 119.5 | |

1/ Ref. 12, page 36.

11.30 The international market for sawnwood - A recent study by FAO[1/], concludes that broadleafed sawnwood consumption in the more developed countries, including those with a central-planned economy, is expected to increase from about 61 to 90 million $m^3$ between 1962 and 1985, but production would increase only from 60 to 85 million $m^3$. As a consequence, the deficit in broadleafed sawnwood in those countries, which was 1.0 million $m^3$ in 1962 would reach 5.7 million $m^3$ in 1985. This deficit would be partly covered by a surplus in sawnwood production in Asia which would increase 2½ times to an estimated volume of 20 million $m^3$ by 1985. This surplus production would undoubtedly be taken up to a large degree by exports from Indonesia, Malaysia and the Philippines. Furthermore, the volume given is based on an admittedly over-optimistic calculation of the expansion in production of coniferous sawnwood in the US and the centrally-planned economy countries, which may not be realized.

11.31 Of special potential interest is the development of the tropical sawnwood market in Western Europe. A special study prepared for GATT in 1967[2/] concludes that total tropical woods imports by the European Common Market countries and the United Kingdom will reach 2,232,000 $m^3$ by 1975. It further shows that one possible development is that about 803,000 $m^3$(s) equivalent will be imported as roundwood, and the balance of more than 1.4 million $m^3$(s) as sawnwood. This would be a level 50% higher than that registered in 1965. A further analysis of imports in the same study further highlights the importance that this market may have for Indonesia and other S.E. Asian countries (as well as for Africa and Latin America). Between 1956 and 1965, tropical broadleafed log imports by the EEC countries and the UK, increased by 9.6% annually and tropical sawnwood by 6.2%, while temperate broadleafed timber increased by only 3.4% annually on the average. Furthermore, the trend for tropical sawnwood imports swung upwards in the last three years studied, reaching an average rate of 10% annually, while that for tropical sawlogs diminished to 5.4%[3/].

11.32 The international market for woodbased panels - The worldwide rate of increase in consumption was more than 10% annually since 1950. Much of the growth was due to the impetus received from a relatively new product: particleboard. Expected growth through 1985 is projected to slowdown to 5.6% annually for plywood and 6.5% for fibreboard and particleboard. In spite of these conservative assumptions, a very substantial world market of 79.3 million $m^3$ would be reached by then.[4/] According to the same FAO projections (Table 11.8)

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1/ Ref. 13, page 6.
2/ Ref. 14, pp. XXVII and XXVIII.
3/ Ref. 14, page 11.
4/ Ref. 13, page 7.

plywood and veneer consumption in the market-economy developed countries would be 6.1 million $m^3$ higher than production. Even after assuming that the centrally planned economy countries should take up 1 million $m^3$ of this deficit - as the study does - production in the less developed countries is expected to rise much faster than consumption. From Asia alone, a surplus of 3.0 million $m^3$ has been projected.1/ In the case of fiberboard, a smaller deficit of 1.6 million m.t. (equivalent to 2.7 million $m^3$) of production in relation to consumption in the more developed countries has been projected but would be substantially offset by a surplus in the centrally-planned-economy countries.

11.33 The international market for other wood products - Parquetry imports are important in the Netherlands, the United Kingdom, and West Germany, with a total value of more than $12 million annually.2/ Import statistics for the US do not show parquet blocks or elements differentiated from hardwood flooring. The market, however, is not thought to be substantial because in general parquetry has found little acceptance in private housing, and in office and apartment buildings, other materials and use of wall-to-wall carpeting, make for a very small consumption of parquet. Imports into the US have been estimated at about US $1.3 million annually. Penetration of the European market will probably be easier for exports of individual blocks or strips to be further manufactured in the consuming country.2/ Flush doors installed have been estimated at 1.7 million units annually in the U. S. and 1.1 million units in Western Europe3/, but imports are very small in relation to consumption (for instance only 187,700 doors, of all types, were imported by the U. S. in 1968). Dimensioned stock is imported in great quantities by the U. S., mainly from Canada. Tropical hardwood dimensioned stock imports from Thailand, Japan and the Philippines amounted to U. S. $4.4 million in 1967. Prices ranged from $85 to $300/$m^3$ 4/. Imports of hardwood mouldings by the U. S. in 1967 were 76,500 thousand linear feet for a value of U. S. $2,135,000. Imports into Europe, in recent years, have been about 160,000 $m^3$ annually.

11.34 The international market for furniture - The market for imported wood furniture in the U. S. is about $25 million, and it is very limited in other countries. The main suppliers at present are Denmark, Greece and Yugoslavia. General trend of the market shows a growth rate of 4 to 5% annually5/. Importers interviewed about

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1/ Plywood imports by the U. S. alone, in 1969, were about U. S. $ 240 million

2/ Ref. 15, pp. 58 and 60

3/ Ref. 17, p. 12.

4/ Ref. 18, p. 10

5/ Ref. 16, page 75

the more important conditions to be considered in choosing suppliers gave the following answers:

i) Capacity to fulfull orders
ii) Design
iii) Competitive prices
iv) High quality (absence of damaged wood)
v) Punctuality in delivering (or maintenance of local stocks)
vi) Flexibility in manufacturing

In general, it is thought that furniture-making for export should be in the hands of small independent operators. The same applies to furniture components, which however, could have the advantage of facilitating joint-venture agreements, in which merchandising, specifications, and an important part of the design work would be the responsibility of the foreign enterprise.

11.35 Wood pulp - In the decade of the sixties world demand for wood pulp increased at an annual compound rate of 5.7% to reach a total volume of nearly 100 million m.t. by 1969. Even with a lower rate of growth (5%/yr.) in the years ahead[1/] consumption would reach 170 million tons by 1980. For a long time, pulp production was preponderantly based on coniferous wood. Furthermore, its manufacture was generally resource-oriented (although Japan is importing chips from the U. S. West Coast). The distribution of manufacturing capacity, however, is not directly related to availability of total timber resources. The U. S., Canada, and Western Europe, with less than one quarter of the world's stocked forest area, has an 82% share of total wood pulp production[2/]. This lack of balance and the threat of future shortages have brought technological changes in pulp and paper making and new pulps - mainly hardwood pulps - have been developed. Although favorable pricing of these pulps is still an important reason for the demand for them, their capacity to satisfy specific characteristics to the end-products is also important. For better printability, for instance, addition of bleached hardwood kraft pulp is desirable. The ratio of bleached and semi-bleached hardwood sulphate pulps to total sulphate sales in the U. S., Canada and Scandinavia increased from 25% in 1964 to 30% in 1969. This trend has been undoubtedly helped by the fact that although physically integrated large-scale pulp-and-paper mills still have a significant cost advantage over non-integrated mills in the manufacture of low-priced, large-volume products, new specifications for many types of white paper require paper mills to use blended

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1/ Ref. 19, page 4
2/ The shares are not strictly speaking totally comparable as forest areas are 1963 figures and production shares are based on 1969 figures. Up-dated figures, however, would not materially change the relationships.

feeds. Non-integrated mills have versatility in making various end-products and by buying hardwood and softwood pulps from diverse sources, they can meet changing demands. For these paper mills to build their own pulp mills, or for existing balanced integrated operations to enlarge their capacity fractionally, would require building large new mills in remote locations or costly additions in localities already facing difficult problems in pollution control. The ratio of "market" to "captive" bleached and semi-bleached sulphate pulp in the U. S., Canada and Scandinavia has grown from 47% in 1960 to 72% in 1969, and, on the basis of new capacity estimates, it is expected to continue increasing to about 82% by 1972[1/]. And, the growth of hardwood bleached and semi-bleached sulpahte pulp - 100% between 1964 and 1969 - was much faster than that for softwood bleached and semi-bleached sulphate pulp - 53% for the same five-year period. Projected world supply and demand for unbleached sulphate "market" pulp and white pulps are shown below. The estimated supply is based on actual figures for 1969, and 95% of estimated installed capacity for the future (Table 11.9). Projected demand has been calculated on the basis of annual growth rates of 6% for total paper-grade chemical pulp (i.e. a slightly lower rate than that observed for the 1960-69 period) and 0.5% for unbleached sulphate pulp (or at the same rate as during the 1960-69 years)[2/]. Lack of known projects under construction or well underway in preparatory stages (although some are known to exist in early planning stages) will lead to deficits in projected supply in relation to demand after 1972.

Supply and Demand for Paper-grade Woodpulp

| | Total "market and "captive" pulp | | | | "Market" pulp | |
|---|---|---|---|---|---|---|
| | Total paper-grade chemical pulp | | Bleached & semi-bleached sulphate pulp | | Total paper-grade chemical pulp | |
| | Supply | Demand | Supply | Demand | Supply | Demand |
| 1969 | 56.1 | 55.8 | 23.4 | 23.0 | 15.9 | 15.9 |
| 1972 | 65.0 | 66.3 | 28.4 | 29.1 | 19.1 | 18.9 |
| 1973 | 67.4 | 70.1 | 29.8 | 31.5 | 19.1[3/] | 20.1 |
| 1974 | 69.7 | 74.5 | 31.3 | 33.9 | 19.1[3/] | 21.3 |

1/ Ref. 19, page 14
2/ Ref. 19, page 25/26
3/ Ref. 19, page 15

11.36 Part of the developing deficit (probably at least 40%[1/]) will be covered by hardwood pulp. Although there is as yet no operation at a significant scale of "market" chemical pulp being commercially produced from mixed tropical hardwoods, intensive research and some large-scale tests carried out recently would tend to show that economic manufacture of woodpulp from hardwoods similar to those found in Indonesia is already possible or on the point of becoming possible. The Bank Group has helped in the financing of one project based on this proposition, and several other projects using tropical hardwoods in other parts of the world, are either operating in small scale or under study. In Indonesia, at least two or three years will be required for any serious proposal to be underway. In this time, any doubts about the technical and economic factors involved should be resolved and the industrial complex proposed will therefore depend to a high degree for its realization on the outcome of the feasibility studies where these factors will be considered.

International Trade Prospects

11.37 The volume of trade will show greater rates of growth than either production or deficits of production in relation to consumption. The final pattern of trade will depend on those values, but also on:

i) Opportunities for profits resulting from the economic factors affecting production costs;
ii) Quality, quantity and timing demands of the market;
iii) Resistance to trade flow offered by tariff and trade regulations in the importing countries (and conversely subsidies, negative duties or other export promotion measures in the supplying countries);
iv) The cooperation or resistance offered by established international merchandising, distribution, transportation and sales channels.

A projection of potential exports in 1975 and 1985 for the main wood products is shown in Table 11.8. According to agreements now in effect tariffs on the more common wood-based materials which would be effective in 1972 are shown in Table 11.10.

The Domestic Market for Wood Products

11.38 Present demand for sawnwood in Indonesia - approximately 1.6 million $m^3$ annually - is mostly used in construction, shipbuilding and sleepers (these latter are included as sawnwood). It is estimated

1/ Ref. 19, page 15

that no more than 15% is used for furniture. The GOI should strongly pursue a policy of increasing teak prices, promoting exports, and safeguarding quality of the teak exports. A large share of the international teak market is held by other S.E. Asia countries due to the poor quality of Indonesian teak or to lack of uniformity in specifications. At present less than 10% of teak produced is exported and the balance is processed often for uses for which less fine timber could be substituted.1/ Some teak is even used as fuelwood. But, to attain this objective of increasing teak exports, treated and dried sawnwood from other species must be made available for sleepers, furniture making and shipbuilding.

11.39 Plywood is used at present mostly by the furniture industry, which imported about 1,000 m.t. in 1968, and in the manufacture of tea chests, which uses up most of the local production of plywood. Additional volumes of plywood and chipboard will be required in order to substitute teak now used in furniture, and also for large-volume production of furniture for village health centers, as envisaged in the development plan. Still another potential use for plywood and chipboard will be in shipbuilding. No projections of wood panel demand by these activities can be made. But for the purpose of the sales estimates made for the industrial complex described later in this chapter, such projections are not needed. Export markets are large enough to absorb proposed levels of production, and the only reason for including estimated local sales of plywood and chipboard in the study, is because this is a more conservative approach since prices in the internal market are assumed to be lower than for exports. An industrial complex of the type envisaged here should have a promotional aspect, and this is assumed to be the basis for assigning lower prices for local sales of plywood and chipboard.

The Domestic Market for Pulp and Paper

11.40 Paper and paperboard demand has grown rapidly in the last few years as is shown below.3/ Domestic production has almost doubled but imports have grown even more rapidly between 1966 and 1970.

| | Value (US$ million) | Quantity (000's of m.t.) | | |
|---|---|---|---|---|
| | Imports 2/ | Domestic Production 3/ | Imports | Total |
| 1966 | 7.3 | 9.9 | 44.7 | 54.6 |
| 1967 | 10.8 | 8.7 | 67.6 | 76.3 |
| 1968 | 13.7 | 11.3 | 87.9 | 99.2 |
| 1969 | 13.8 | 15.6 | 88.0 | 104.3 |
| 1970 | 20.2 | 18.5 | 116.0 | 134.5 |

1/ Nearly 150,000 teak sleepers were sold by Perhutani in 1967

2/ Due to distortions in exchange rates no value has been estimated for domestic production

3/ Ref. 6 and 43.

Projected demand of paper and paper-board has been estimated individually for each type of product as follows:

| | Average 1968/70 Demand1/ (000's m.t.) | Projected rate of growth (%/year) | Demand (1975) (000/s m.t.) | Distribution (%) 1969/70 Avge. | 1975 Proj. |
|---|---|---|---|---|---|
| Printing & Writing | 40.0 | 6.5 | 58.4 | 35.5 | 29.7 |
| Kraft | 14.8 | 20.0 | 44.2 | 13.1 | 22.5 |
| Paperboard | 5.3 | 30.0 | 25.6 | 4.7 | 13.0 |
| Newsprint | 28.4 | 5.8 | 39.8 | 25.2 | 20.3 |
| Cigarette | 6.5 | 4.1 | 8.3 | 5.8 | 4.2 |
| Others | 17.7 | 2.3 | 20.3 | 15.7 | 10.3 |
| | 112.7 | 9.7 | 196.6 | 100.0 | 100.0 |

THE DIRECTIONS OF DEVELOPMENT

11.41 In a general way, the pattern of development may fall into one of the following directions:

(a) The "natural" development of small-sized sawmills followed by other mechanical wood processing and finally by pulp and paper making.

(b) Planned development of industries starting with those where investment per worker, minimum economic size, and technological sophistication are lower. Since these three parameters increase as one moves from sawmilling to veneer and plywood manufacuting and to pulp and paper making, this line of development would, in a broad way, parallel the traditional or natural development.

(c) Establishment and promotion of planned industrial complexes in which industries of varying degrees of complexity and capital intensity would be started more or less at the same time, to benefit from integrated operations and joint economies in production.

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1/ Figures for newsprint as shown in Ref. 1, page 67 have been modified according to findings of the Japanese Survey Team for the Development Plan of the Pulp and Paper Indusary in the Republic of Indonesia (Ref. 1, page 69). The main reason for this change is that some paper classified as newspring is probably used for wrapping and writing.

2/ Rates of growth implicit in the same study (Ref. 1, page 68), except that Kraft and paperboard rates after 1973 have been cut down. Rates for these are based on estimated 1969/73 consumption for cement and other articles.

11.42 The first two alternatives seem attractive, among other reasons, because the problems of investment seem minimized. Capital would be required in small doses over a long period of time and could be supplied both by the public sector, and by local and foreign private investors, without too much strain on the country's fiscal balance or need to look for special sources of financing, which, if available, may be required for other pressing needs. In fact, it would seem that the second of the three alternative lines of development described above is the one chosen by the Directorate-General of Forestry. Investment obligations generally involving only the installation of relatively small sawmills are the only ones considered in most concessions. In no way - through mechanisms for the cooperative exploitation of timber resources in industry or the obligatory sale of logs to independent processors - are concessionaires bound to look for the possible development of industries larger than those normally assumed to be profitable for the size of the concessions. Only in one agreement known to the mission, (A. Soriano & Cia.), with the largest concession area, is paper manufacture mentioned, and in this case, it is envisioned as a step to be undertaken after 12 years of timber exploitation. Paper manufacture will probably also be included after 10 years of operations in an agreement being negotiated with a group of Japanese enterprises. If the concessionaires carry out plans considered in the agreements, it is possible that a number of plywood plants will be established, some smaller than the size considered economically desirable at present. It is also possible or even probable that the feasibility reports prepared by the concessionaires will be negative and that no wood processing plants will be built at all. There is little likelihood that the GOI will be able to muster, in a short time, enough expertise - in numbers as well as in quality - to develop its own feasibility studies for each important concession and to dispute the results obtained by the concessionaires.

11.43 There is no assurance that by following alternative "A" or "B", the over-all investment made in the timber-based industries will result in the most value added, or that non-productive investments will not be made, or capacity will not remain unused. A more detailed analysis of the factors involved follows. It is possible that individual plants could be proven profitable, even while the country incurs in losses because of extra costs in transportation and power generation, wasted timber, and eventual misallocation of human resources.

11.44 The small-scale processing of timber presents several problems:

(a) Timber supplies - Uniformity of timber supplies is of paramount importance in sawmilling if sawnwood is going to be exported. In order to secure this uniformity, relatively important inventories must be carried, and small sawmills are in no position to do it. To make pulp from mixed tropical hardwoods, it will be necessary to segregate chips of different densities and chemical properties in order to have lower processing costs.

(b) Marketing - Buyers of many timber products require dependability in their supplies. This cannot be attained unless stocks are kept which normally cannot be carried by small operators. But if products are exported this is not the main difficulty. Sales of wood products are subject to a large number of varying - and, in some cases, very exacting - specifications in many countries. Knowledge of, and effective manufacturing in conformity to them, as well as payment for distribution and marketing services, customs; brokers, and other services, will become prohibitively costly if only small lots are involved. Customs' brokers fees and landing charges may become important even in the case of inter-island shipments in Indonesia.

(c) Transportation - In a recent study on maritime freight rates, one of the reasons given for high rates between the Philippines, and Japan and the United States, was the large number of ports of call and the small size of lots shipped.

(d) Waste Utilization - In small mills waste disposal becomes a problem. Only a large integrated mill can make efficient use of practically all the residues from mechanical operation in timber processing. This also applies to primary waste (waste left in the forest) from logging operations. Limbs, branches and culled logs are generally not useable unless there is a combined or related pulp mill.

(e) Economies of scale - Strictly speaking there are no problems of scale in the case of sawmills, since there is sawing equipment of all sizes available and large output is generally obtained by having more than one line in parallel. It is generally recognized that plywood plants are optimized at sizes between 50,000 and 100,000 $m^3$(r) of log inputs annually (although smaller veneer plants for external types of tropical hardwoods are still being built). For an integrated system, the deciding element is the pulp mill: minimum economic size is estimated to require at least 600,000 $m^3$(r) per year.

11.45 In distinct contrast to the type of development discussed above, an integrated large volume timber processing complex has the following advantages:

i) Economy of scale in the operation of a pulp mill
ii) Availability of commercial volumes of various hardwood species and consequent possibility of their utilization to the best advantage of the processor;
iii) Better possibilities in marketing of sawnwood and other timber products because of availability in the qualities required and dependability in uniform supplies;

iv) Economies in transportation and merchandising costs;
v) Better utilization of waste, whether primary forest waste (limbs, branches, culled trees, etc.) or mill waste, including bark and sawdust;
vi) Better allocation of limited managerial, technical and other human resources;
vii) Possibility of creating additional development opportunities in the region.

11.46 The last of the alternatives listed above, involving the development of an integrated wood products complex in an appropriate location, has distinct advantages for Indonesia in terms of the increase in domestic value added (and employment), the possibilities of greatly expanded foreign exchange earnings, and the general impetus that could be given to economic development in the region selected. This alternative is superior in several important respects to the passive, piecemeal approach that is explicit in the first two alternatives. Moreover, as is shown in the results of the prefeasibility study that is presented in the next section of this chapter, the prospects for developing such a complex are favorable. Before presenting the actual results of the study, some collateral issues are worth examining.

11.47 No one advocates the establishment of one timber-based industrial complex to the exclusion of other similar establishment or of small sawmills and other processing plants. Given the magnitude of Indonesian forest resources and the far-flung dispersion of her islands, it is not only possible but desirable that, in the long run, a number of industrial centers to process wood products should develop. The question before us is where and how should the GOI exert its initial effort to develop those resources. Figures given below will show that a complex whose size is such that it will use only a fraction of the volume of timber already being cut at present is viable. Several such complexes could be in existence before the end of the century.

11.48 Pine and Agathis stands in natural and plantation forests in northern Sumatra and in central Java may be developed for newsprint by private interests, if the timber resources prove adequate. Because of the type of paper to be made, they would not interfere with an industrial complex based on the exploitation of tropical hardwoods. The location chosen for this plant must be studied in feasibility studies to be carried out as the next stage in the development of this group of industries. One alternative considered would place the main industrial plant in Java at or near a port. Logs would be transported from Kalimantan and Sumatra in rafts and barges (because of the high proportion of "sinkers" in some forest areas). Advantages of such a location would be: availability of skilled and unskilled labor,

possible utilization of pine and Agathis (mainly from Notog), and proximity and availability of transportation networks for that part of the industry's products that is sold domestically (most of which would be marketed in the larger urban areas of Java). The main disadvantages are: continued centralization of industrial activities in Java, pollution problems more difficult to solve than in other locations, and higher costs of transportation, at least until a fleet of log carriers, barges and tug boats is developed.

11.49 The location chosen for the prefeasibility study given below is East Kalimantan. The main disadvantage of this location is lack of labor and scarcity of food products. The main advantage is that such a complex would have a decisive influence in the creation and development of a new growth pole. Samarindo and Balikpapan are already joined by a road and the latter is a minor but growing port, where Pertamina has installed a petroleum refinery. Development of gas resources discovered in the general area would give enormous impetus to the creation of an industrial zone in East Kalimantan. Other advantages are that rivers are generally deep enough for transportation all year round or most of the year and coastal transportation is not seriously impaired by prevailing winds, currents, and waves. Residual fuel oil is available at near-by locations.

11.50 Backward linkages in forest industries are non-existent (unless the possible utilization of cleared land in agriculture is so considered). The most important forward linkages are with construction, housing, furniture making, manufacture of paper products, and printing. A healthy, well developed timber-based industry will have a positive effect in all these fields. Integration with them is not believed to be convenient. Technical, management and merchandising problems are too diverse, and size of possible operations in some cases - for instance in furniture making - do not warrant the necessary increase in complexity which would be required in the corporate structure of the industrial complex.

11.51 The organization and operation of the complex could be quite flexible; several alternative arrangements can easily be imagined: one, a large conglomerate, in which equity shares would be held by concessionaires, foreign technical partners, and the GOI, directly or through Perhutani; another alternative would consit of one common service company and several manufacturing enterprises each operating an individual plant. A third possibility is that one single large investor might take a majority position in the whole complex of plants. The first scheme, although simpler in terms of overall design, would be undoubtedly very difficult to implement. The second scheme would in practice be a specialized type of industrial estate. A holding company, formed by the GOI and interested concessionaires would own the

land, power plant and other utilities, the pier and port warehouses, and would be responsible for the financing arrangements for individual plants. It would be desirable, but not indispensable, that this company should have minority equity participation in the individual plants and conversely, owners of individual plants could have a minority participation in the holding company. The main advantage of an arrangement of this type is that technical foreign partners could take a commanding position in those lines in which they are specially competent and responsibility for results would not be diluted. Also, there would be more flexibility in the arrangements to be made between different parties in each individual plant. Main disadvantages would be the possible disarray in overall planning that might result from delays in individual plant construction and start-up, and difficulties which could be encountered in setting fair prices for inter-plant transfer and utility rates. The third alternative would avoid these kinds of problems but would require a greater concentration of financial, technical and merchandising capacity in the participating company. The type of organization to be eventually selected, however, would not significantly affect the over-all results and the economic advantages obtained from setting up a timber-based industrial complex such as the one described in the following section.

11.52 It is assumed that between 50% and 60% of the total fixed investment including capitalized interest and other expenses during construction, could be secured from international lending agencies. This type of financing is reasonable, and there are comparable projects that have been financed in this proportion. Equity would of course be supplied by private investors. Suppliers' credits may also be utilized, especially in the case where the technical partner should insist in specific types and makes of some equipment. There are no unusual features to the complex that should cause any difficulty in finance; quite the contrary, the aspects are favorable if, as shown below, the whole project is economically feasible.

# FEASIBILITY OF A TIMBER-BASED INDUSTRIAL COMPLEX IN EAST KALIMANTAN

## Rationale for the complex and its capacity

11.53 The proposed industrial complex is based on the integral utilization of available timber resources within a chosen area which in this case is assumed to be within 100 Km. from the Balikpapan-Samarindo road. Most of the timber in this area can be reached by river or short access roads. Total area of concessions in this region (Graph 11.04) is 1,800,000 Ha., not including 800,000 Ha. in one Perhutani concession located a little farther away and some tree areas left between concessions or adjacent to them.

11.54 Assuming average timber stock yields of $40m^3(r)$ per Ha. in sawlogs and peeler logs - which is much smaller than figures generally given by the survey of the Forestry Directorate - a total annual production of $1,440,000m^3(r)$ should be attainable from the area described above.

$$Y = \frac{0.8 \times 40\ m^3(r)/Ha. \times 1,800,000\ Ha.}{40\ yrs.\ cutting\ cycle} = 1,440,000\ m^3(r).$$

Not all of the timber produced in this area will be, or should necessarily be available to the industrial complex. On the other hand, a strong point can be made that even concessionaires who are not involved with the complex - whether as shareholders or through supply contracts - should agree to supply the complex with a percentage of their production at prices similar to those they obtain in their overseas markets less freight, insurance, and other shipping charges.

11.55 The minimum economic size of a woodpulp mill, as it has been mentioned before, is about 500 short tons per day, requiring, in the case of sulphate pulps, about $600,000\ m^3(r)$ of pulpwood and waste annually. In a similar type of forest, this volume is approximately 65% of the volume of sawlogs and peelers. Applying this proportion to the area chosen, availability of primary waste and pulpwood could reach over $900,000\ m^3(r)$ per year, so there is ample feed for the pulpmill. The capacity of the complex envisioned in this study is the minimum for which an economic scale in pulp production is achieved: 1.65 million $m^3(r)$ in total input, of which 1 million $m^3(r)$ would be in sawlogs and peeler logs, 0.2 million $m^3(r)$ in pulpwood, and the balance in primary forest waste.

11.56 Graph 11.03 shows the general flow of materials and products in the complex. All the timber received will be bucksawed and barked in a central location. A proportion of the more valuable logs will be exported. Sawlogs and peelers will be sent to the sawmill and the veneer and plywood plant. Some of the primary waste, from valuable species in sizes not appropriate for sawmilling, as well as some

trimmings from the sawmill, will be used in parquetry. Most of the "solid" waste from mechanical wood processing (including cores from the plywood plant) will be chipped. Separate chippers will be used for the pulpmill and to feed a chipboard plant. The latter will allow the utilization of chips from some species which are not adequate for pulp making. Bark and sawdust from all sections of the complex will be pressed for reduction of water contents and burned for steam generation and power. Some unbleached pulp may be sold as such, but the bleaching plant will have enough capacity to treat all of the woodpulp which is not used for Kraft paper and linerboard. The paper mill will be able to make the latter products as well as white writing and printing papers.

11.57 The complex will comprise: (a) a wood reception area, including bucksawing and barking equipment, log yard handling equipment, and waste storage and handling facilities; (b) sawmill; (c) veneer and plywood plant; (d) parquettry plant; (e) remanufacturing plant, including joinery, dimensioned stock and flushed door making equipment; (f) chippers; (g) chipboard plant; (h) pulp and paper mills, including bleaching plant, and electrolytic caustic soda and chlorine plant; (i) hogged and sawdust fuel storage; (j) power plant; (k) water supply and treatment system; (l) pier and warehousing; and, (m) other services. These plants will be located in common grounds in an area large enough to allow future expansion and modification without problems because of the need to relocate existing facilities. Some of the features of the individual units are set forth below.

Sawmill - Except for some common facilities, the sawmill will comprise two parallel lines, each with required deck saws, band saws, log handling equipment, saw doctoring equipment and drying kilns. Only one impregnating plant is considered necessary. Total annual input has been set at 300,000m$^3$(r) of logs.

Plywood plant - This will also be built in two stages, each as a separate parallel line, comprising veneer lather, continuous dryer, deck tray system, core lathe system, hot presses, patcher, cutting saws, sander, glue spreader, etc. Projected annual capacity is 450,000m$^3$(r).

Barking - Hydraulic drum barkers with capacity for the whole proposed input will be used.

Chippers - In addition to chippers for the pulp mill, specialized chippers for the chipboard plant are included.

Pulp mill - The capacity chosen is 500 short tons per day considered to be the minimum economical size. Batch digesters are thought to be more convenient because of their greater flexibility for utilization with a mixed or changing feed. To economize in

chemical consumption, different types of pulpwood and waste may have to be processed separately. Also time required is different for pulp to be bleached and for pulp to be used unbleached. Complete heat and chemical recovery equipment will be included.

Paper mill - Standard paper machines will be used for linerboard, Kraft sack paper, and writing paper. Paper equipment must be able to handle all of the unbleached pulp made, and the capacity chosen is 300 t/d. Sale of bleached and unbleached pulp in markets located at great distances from the mill requires pulp dryers. These are expensive. Considerable cost savings could be obtained by flash drying or by buying a second-hand paper machine to be used for this purpose. A repulper will also be needed to incorporate imported long-fiber woodpulp in the paper blend.

Chipboard plant - A two-line chipboard plant having an annual capacity of 60,000m$^3$ of finished chipboard is proposed. The two lines will be complementary for preparation of three-layer board, with finer chips in the surface layers. It will include multiple-window presses, cutting saw, trimmers, sanders, etc.

Power plant - Power required will be 33,000 Kw in the manufacturing plants. Including offices, housing, and other services, power demand has been estimated at 38,000 Kw. Because of the need to avoid costly stoppages, and the impossibility of purchasing electricity from other sources, continuity of power supply must be assured. Three 18,000 Kw steam turbine generators have been considered. Steam will be generated in three boilers; one is part of the pulp mill recovery system; a second one will burn sawdust and mill waste not used elsewhere; and the third one will be residual oil-fired, with a maximum capacity of 308,000 lbs. steam per hour.

Water supply system - Total fresh water required is 16,000 GPM, of which 1,260 GPM must be chlorinated and 880 GPM passed through ion exchangers. Liquid waste should be mixed with salt-water effluent from the power plant. Cost for treatment of effluent has not been included in the calculations.

## Investment required

11.58 Total fixed investment for the whole complex in plant buildings and equipment, including installation costs, utilities, engineering and other construction overhead, and contingencies[1/] amount to US $93.8 million (Table 11.11). Calculation of the investment

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1/ Technical contingencies were included in cost of equipment and buildings of each unit. An additional overall contingency of 5% for price escalation has been added.

required has been mostly based on the costs of similar plants known by the Bank Group 1/. Certain other costs have been estimated on the basis of other studies.2/ Pre-operating expenses and fees, interest during construction, and other capitalized expenses have been estimated at US $10.2 million for a total investment of US $104.0 million, excluding working capital, or $117.8 million including working capital. After redistribution of the initial costs of the power plant and other common facilities, investment required is divided between mechanical wood processing facilities and pulp and paper making as follows:

| | US $ million | |
|---|---|---|
| | Fixed assets and capitalized expenses | Total investment including W.C. |
| Pulp and paper mills | 58.6 | 65.7 |
| Mechanical wood processing | 41.1 | 47.7 |
| Shipping department | 4.3 | 4.4 |
| | 104.0 | 117.8 |

Sales projections

11.59 Sales prices for all export products are f.o.b. prices calculated on the basis of known prices now being paid f.o.b. South East Asian ports 3/ or on prices in the main external market less transportation and landing costs, including duties where applicable 4/. Sales of mechanically processed wood products in the domestic market have been assumed to be at lower than international prices, in the case of sawnwood because of the competition from small marginal operators, and in the case of wood panel products because of the need to promote their use and to facilitate the introduction of cheaper mass-produced furniture, housing elements, transportation equipment, etc. The only domestic sales where tariff protection is thought to be necessary for a number of years (at least until pre-operating and other capitalized expenses are amortized) are in all types of paper, where the sales prices have been calculated on the basis of c.i.f. prices plus 10% to 20% duty plus landing, customs' brokerage fees, and other landing and transportation to warehouse

1/ References 20/23

2/ References 24/27

3/ References 23 and 29

4/ References 30 and 31

costs. On the other hand, small sales of unbleached pulp to Government-owned paper mills are assumed to be made at prices below those prevailing for imports c.i.f. Indonesian ports. Sales projections are shown in Table 11.12. The assumptions on which they are based follow.

Logs - It is assumed that logs whose size fetch best prices, or a proportion of them, up to 25% of the total volume of sawlogs and peelers received by the plant, will be exported. Present price is $25/m^3(r)$ f.o.b. ship East Kalimantan for logs longer than 6m and with diameters larger than 600cm, but for shorter cuts and smaller diameters, the average price has in recent months fallen from $21/m^3(r)$. For this project we will use $21.80/m^3(r)$ or a total of US$5,450,000 by the fifth year of operations.[1/] For use by the plant, assigned price is $13/m^3(r)$ which is better than the average log cost used in a similar starting forestry project ($10/m^3$). It is understood that the assigned price is a little lower than the average price which could be fetched for the same logs if they were exported or, in other words, that a small short-term profit advantage should be sacrificed to long-term returns, and to company and national stability.

Sawnwood - Price in the export market, which had improved in the second half of last year is now assumed again to stabilize at about $42/m^3$ f.o.b. East Asia port for pre-dried rough sawn timber. $56 for wood kiln-dried to 12% moisture and $66 for impregnated sawnwood. With a 50%: 10%: product-mix the resulting average export price $50 per $m^3(s)$ f.o.b., plant port. In the domestic market, prices are assumed to be 80% of the export prices, but with a higher proportion of treated wood (mainly because of demand for construction materials, sleepers and utility poles). The average price would therefore be $40/m^3(s)$. Total external sales of sawnwood would amount to $7,425,000. Transfer prices for sawnwood used in other parts of the complex has been set at $35/m^3(s)$.

Plywood - Prices that ranged from $57.20 to $80.20 per thousand sq. ft. (¼" basis) for plywood 12 mm to 3 mm thick, had dropped by 7% in the second half of last year, and may continue falling as Japanese plywood manufacturers are forced to curtail production and cut the number of working days. Prices as low as $47.40 have been indicated for some types of plywood. Given a product-mix of approximately 4:4:3 in the 3-ply, 5 mm thick, 3-ply, 6 mm, and 5-ply, 12 mm sheets for external use, average price has been calculated at $63.50 per thousand sq. ft. (¼" basis) equivalent to $107.50 per $m^3$ of product in the export market. Prices in the domestic market are assumed to 5.5% lower. Transfer price to other plants in the complex has been set at $90/m^3$.

Parquet - Imported hardwood flooring, including blocks, have c.i.f. US port prices ranging between $100 and $170/$m^3$. For the

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1/ This sum, however, is not considered as part of the sales. Only the gross profit in the sale of logs is credited to the complex.

proposed plant, an average price of US$85/$m^3$ has been estimated after deduction of 10% duty, freight, and insurance. Total value for sales in the export market (80% of total sales) would therefore be $2,040,000. At a lower price of US$ 80/$m^3$, sales in the internal market would be $480,000 annually.

Remanufacturing and door plant - Prices for the great variety of products that this plant should be able to produce range widely. For hardwood molding, average price is $80/$m^3$ and for dimensioned stock, $120/$m^3$. On the other hand, for solid doors and knocked-down furniture elements, prices range up to $400/500 per $m^3$. An average price f.o.b. plant pier of $193/$m^3$ has been considered conservative and sales would be $1,216,000.

Chipboard - Particle board also shows great variation in prices. For three-layer chipboard without overlays, a price of about $80 is obtained per $m^3$ of 19mm board. An average price of $60/$m^3$ f.o.b. plant pier has been projected for exports and $54 for the internal market, resulting in total sales of $3,564,000 annually.

Bleached Pulp - Given distance to market, bleached pulp must be sold dried. Present contract prices for Kraft bleached hardwood pulp average US$ 155 per short ton, air dried, US delivered pulp, equivalent to US$ 142 per m.t. (imports into the US are duty free) c.i.f. port East Kalimantan. Assuming further than initially pulp from this plant will be sold at a discount ($140/m.t.) in relation to prices for established hardwood pulps, total annual sales have been estimated at US$ 8,400,000. Internal transactions have been calculated at $130/m.t.

Unbleached pulp - Surplus unbleached pulp is expected to be placed with Governmental paper plants and mainly with those which can improve capacity utilization because of present difficulties in securing sufficient and regular raw material supplies (Gowa, Martapura, and, to a lesser degree Banjuwangi). Price for these sales has been set at $120/m.t. (prices c.i.f. Sweden are about $110/m.t.). Internal plant sales are assumed to be made at $80/m.t.

Unbleached Kraft sack paper - Assuming prices to average $215/m.t. c.i.f. port in Java ($200/m.t. has been quoted for unglazed paper used for cement bags, which would constitute about 55% of the market for sack paper), average sales price at plant pier would be $221/m.t. or $6,519,500 annually (assuming 10% ad-valorem duty).

Unbleached linerboard - On the basis of Kraft liner at $130 per short ton US plant, minimum price c.i.f. Java port would be US $178/m.t. Adding landing and clearing costs (approximately $13/m.t.) and an average of only 10% ad valorem duty (at present it is 30%), final price at customer's warehouse in Djakarta would be $208.80/m.t.

Price c.i.f. plant pier would be this price less freight, landing and transportation to warehouse ($29), or $179.80/m.t. and total sales of this product can be estimated at $1,996,000.

Unbleached corrugated medium - The sales price for CM is approximately $4/m.t. less than for linerboard. Sales for 7,400 m.t. annually will be $1,302,000.

White writing paper - Domestic production of white writing paper is being sold at Rp 2,160 per ream (500 sheets 63 cm x 100 cm), which with a discount of 6% for lot sales, results in an average price of US$324.50/m.t. Imported paper is higher priced, averaging $395/m.t. including 40% duty. Assuming that duty should be diminished to 20% and that prices should tend to be equalized, average sales price should not be less than $331/m.t. landed Java port, equivalent to a price of $302/m.t. c.i.f. plant pier. Annual sales under these conditions would reach $9,060,000.

Shipping department - The shipping department is credited with the gross profits from sale of logs, $4.71/$m^3$ (r), and with a charge of $5.00/m.t. of pulp and paper and $3.00/$m^3$ of wood products shipped.

Projections during the phasing-in period

11.60 Full operation sales are those shown in Table 11.12. They are 90% of physical capacity for the pulp mill and lower for the bleaching plant (69%) and the paper mill (71%), because in order to assure flexibility of operation vis-a-vis changes in demand, these plants should be designed to be able to process unbleached pulp now projected to be sold without further processing. Table 11.15 shows sales and cost projections during the phasing-in period for the various components of the complex. These projections are based on a construction and start-up schedule outlined in Table 11.16.

Operating Costs

11.61 The volume of timber inputs and the yields in the different plants of the complex are shown in Appendix 11.9. Cost of other materials and supplies and labor have been computed either on the basis of projects known to the Bank 1/ or other studies2/. In all

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1/ References 20/23

2/ References 24/28 and 32/37

cases, the figures used are conservative, especially for general repair materials and spares since in the location chosen, occasionally they may have to be imported by air or kept in stock, consequently increasing inventory-carrying costs.

11.62 Depreciation has been estimated on a straight-line basis at the following over-all rates for the main plants.

| | |
|---|---|
| Pulp mill | 7.5% annually |
| Bleaching and eletrolytic plants | 10.0% annually |
| Paper mill | 6.5% annually |
| Sawmill | 10.0% annually |
| Plywood plant | 10.0% annually |
| Other wood processing | 10.0% annually |
| Pier and shipping facilities | 5.5% annually |

11.63 A more detailed analysis of some of the cost elements is contained in the following paragraphs; the detailed cost projections are shown in Table 11.13.

Sawmill - The most important cost element in the sawmill is the cost of logs, which is assumed to be $\$13/m^3(r)$, equivalent to $\$22.61/m^3(s)$, given an expected yield of 57.5%, not difficult to attain since many of the smaller sizes of sawnwood which would normally be considered mill waste, can be used in the parquet block plant and in remanufacturing. The cost of maintenance and operating supplies averages $\$0.50/m^3(s)$. Power is not considered as an element of cost, because labor and depreciation charges for power generation have already been apportioned to the various industrial complex plants. But, the cost of fuel and other supplies is charged at the rate of US$336,000 annually or $1.95 per $m^3(s)$. Costs of labor, depreciation and amortization of capitalized expenses are shown in Table 11.13. Repairs, spares and other supplies (as a semivariable cost element) is estimated to comprise about $\$0.20/m^3(s)$ plus 1% of the equipment cost ($54,000 annually). The sawmill is credited with $\$1/m^3$ of "solid" residue usable for chipping (Table 11.13).

Plywood and veneer plant - Cost of logs is the same as for the sawmill. Labor, depreciation, and amortization costs attributed to this plant are shown in Table No. 11.13. The cost of resins and other chemicals averages $9 per $m^3$ of product. Other materials and supplies have been estimated to amount to $\$6/m^3$, of which 50% is assumed to be direct cost and the balance (plus 1% of fixed investment)

is cost of other supplies and repairs not proportional to production. Fuel and lubricants have been estimated to cost $990,000 ($4.40/m$^3$). The plant is credited $1 per m$^3$ of solid "residue" sent to chipping units.

Parquet Plant - The main elements of cost are those of selected small timber from the log yard, charged at $9/m$^3$(r), and sawnwood in small sizes or from some species not generally accepted commercially, estimated at $35/m$^3$(s). The cost of other materials and supplies amount to $8/m$^3$ of output. At first, most of the sales might be as blocks, in which case this item would be considerably reduced. Labor, depreciation and amortization costs are shown in Table 11.13. The other elements of cost are minor.

Remanufacturing Plant - The main input items are sawnwood and plywood charged at $35/m$^3$ and $90/m$^3$ respectively. The other elements vary greatly according to the type of products which will actually be made in the plant. Cost of materials and supplies average $0.40 per m$^3$ of dimensioned stock, $0.76/m$^3$ of joinery, $0.80 per m$^3$ of doors (without fittings) and $15.70/m$^3$ of knocked-down furniture elements, so that an average of $6.00/m$^3$ ($38,000 annually) is conservative.

Chipboard Plant - Chips and chemicals are important in this plant. A charge of $8.00/m$^3$ of chips has been chosen, which, taking into account the losses in sawdust, amounts to $7.60/m$^3$ of material fed to the chippers. Considering the cost of pulpwood ($7.00/m$^3$) and mill waste ($1.00/m$^3$), the average for the feed to the chippers is $5.83/m$^3$ and the 'gross' margin in chipping is $1.77/m$^3$. The cost of chemicals in the chipboard plant has been estimated at $11/m$^3$ of output ($660,000 annually) and that of other materials and supplies at $4/m$^3$ ($240,000 annually), one-half of which is charged as a direct cost; the other half plus 1% of the fixed investment is assumed to be a semivariable cost. The cost of chips is credited to the pulp mill.

Pulp Mill - The cost of pulpwood cannot be ascertained at present, since there is no large operation in Indonesia, and the small paper mills operating there use other raw materials. In the Philippines, unit pulpwood cost is only 50% of the sawlog cost. Conservatively for this study, we have considered a cost of $7.00/m$^3$ of pulpwood and primary waste fed to the chippers (54% of the cost for sawlogs). Mill waste has been valued at $1/m.t. Total costs would therefore be $4,281,200 for pulpwood and $148,500 for mill waste (including materials used for chipboard). The cost of the chemicals used in pulping (mainly saltcake, limestone, and sulfur) has been estimated at $5.50/m.t. of pulp, on the basis of imported salt and sulfur and local limestone. Other direct materials and supplies are estimated to cost $1.10/m$^3$ ($160,000 annually). Approximately 1% of fixed investment ($250,000 annually) is charged to semivariable costs (repair materials, screens, etc.). Cost of labor, depreciation, and other costs are shown in Table 11.13.

Bleaching and Electrolytic Plants - The pulp mill will supply unbleached woodpulp to both the paper mill and the bleaching plant, at a cost which has been set at $80/m.t. (although there might be a small variation in cost for pulp fed to either one of the two other plants). The main chemicals needed in the bleaching plant are chlorine and caustic soda (98/105 Kg/m.t.). Liquid chlorine and solid caustic soda are presently sold at $5.00 (four carloads minimum) and $7.00 per 100 lbs. respectively. Because of the nature of these chemicals, freight, insurance, and handling charges are extremely high, and establishment of an electrolytic mercury-cell plant has been considered as part of this project. Cost of production if salt can be obtained at no more than $3.00 per m.t. and power at 8 mills/kwh would be about $166/m.t. of liquid caustic soda or chlorine gas (on the basis of using all the caustic required by pulping and dumping the balance). If surplus caustic soda could be sold or used elsewhere, the cost of that part used in pulping would diminish (to $117/m.t. of caustic or chlorine used). Since the cost of labor, depreciation, and power in the electrolytic plant has already been included in the bleaching, however, the only chemicals to be considered are salt (and small amounts of sodium carbonate, sulfuric acid, etc.) which are estimated at $8/m.t. of bleached pulp. The cost of operating materials and plants (including screens and filter cloth) can be estimated at $1.00/m.t. ($83,000 annually). In addition, for major repairs and some materials, 1% of the fixed investment ($108,000 annually) is charged to semivariable costs. Cost of labor, depreciation, and other charges, as mentioned before, are shown in Table 11.13.

Paper mill - There are two large inputs to this plant: one, unbleached pulp, valued at $80/m.t. of pulp produced in the same complex ($3,240,000 annually) plus softwood pulp imported at $145/m.t. ($1,580,000 annually); the other is bleached pulp, also combining plant woodpulp transferred at $130/m.t. ($2,860,000 annually), and imported pulp, at US $189/m.t. ($770,000 annually). Cost of chemicals and sizing will be $1.60/m.t. for Kraft containerboard and paper, and $15.50/m.t. of writing paper. Other materials and supplies, including felt, wire, screens, and other supplies and repair materials, are estimated to average $3.10/m.t. ($149,000 annually) for containerboard and sack Kraft, and $6.20/m.t. ($186,000 annually) for white paper. 1% of fixed investment will be charged to semivariable costs to cover major repairs and improvements not related to production. This item has been distributed proportionally to the tonnage of Kraft liner and sack paper, on one hand, and white writing and printing paper on the other.

Shipping department - Cost of shipping materials (pallets, steel strapping, material for boxes, etc.) is estimated to cost $2.50/m.t. of pulp and paper ($379,000 annually), $1.50 per $m^3$ of timber products, excluding logs ($709,000 annually), and $0.80/$m^3$ of logs. Cost of labor and depreciation, as in other cases, has been indicated in Table 11.13.

Economic rate of return

11.64 Gross profits before taxes and interest for full scale operation are shown in Table 11.13. On the basis of those figures and those calculated for the period during which the plants in the complex will be phased into operation (Table 11.15), the internal economic rate of return for the complex as a whole has been found to be more than 20% (Table 11.14). This is a high rate of return on resources even for conditions in Indonesia.

11.65 It has not been thought necessary in this calculation to make any corrections for the few products which will be sold locally behind tariffs. These would be applied to only a small portion (less than 25%) of the total projected sales and the moderate level of protection afforded - 10% and 15% ad valorem - would be needed only temporarily until pre-operating, and other capitalized initial expenses were amortized. Furthermore, shadow pricing would also have to take into account that a number of products have been assumed to be sold locally at prices well below the duty-free imports of similar products which are being imported or would have to be imported. At full operational rate, the positive and negative effects of such correction would practically cancel each other.

11.66 A more detailed analysis of the economic returns for each one of the plants in the complex, under the conditions assumed in this study, would reveal differences in the rates. This is indicative, on one hand, of an incompletely balanced operation of the pulp and paper mills, and, on the other, of inter-plant transfer prices which are not necessarily fair. More balanced individual rates of return and a somewhat higher over-all economic rate of return probably would be obtained if:

(a) Some of the unbleached pulp assumed to be sold locally were further processed into bleached pulp (to be either exported or sold to Government-owned paper mills) or into paper.

(b) The mechanical wood processing plants were to be credited with a lower value for "solid" residues used in chipping and with a small value for bark, sawdust and unchippable residues sent to the power plant. Steam generated in the recovery system (pulp mill) could be credited to that mill.

11.67 The results of this study are favorable and demonstrate the need to carry out a full-fledged feasibility study for the establishment of an integrated timber-processing industrial complex, and the start of conversations with possible technical and merchandising

partners. Furthermore, parallel studies should be carried out for detailed recommendations on the better utilization of existing industries. Paper mills now operating in Indonesia should not be considered as competitive with an industrial complex, but complementary to it. They are very small for economic production of Kraft, linerboard and ordinary white paper. They could specialize in some specific product lines, such as cigarette paper and the finer grades of writing paper, where size of output and possible cost differentials would not have a serious effect on overall prices or on the country's economy. The same consideration is applicable to teak exploitation and sawmilling by Perhutani plants. Upgrading equipment and quality of production for these plants should also be an important consideration in any plan to develop timber-based industries in Indonesia. But these improvements, important as they are, should not hide the pressing need for the development of better ways for the utilization by Indonesia of her important forest resources. The integrated wood products complex offers attractive possibilities for an effective use of these resources.

## CONCLUSIONS AND RECOMMENDATIONS

11.68 In the exploitation of its timber resources, Indonesia should strive to upgrade its exports and obtain a higher value added per unit removed from its forests; maximizing of long-term benefits is an appropriate basic guideline for action. To demonstrate that it is possible to obtain greater benefits by integration of multiple types of processing into one industrial complex, a pre-feasibility study has been made. This study is based on the installation of a large complex, using 1 million $m^3$(r) of sawlogs and peelers and 0.65 million $m^3$(r) of woodpulp and primary timber waste in East Kalimantan. An internal economic rate of return of 20% in 16 years has been shown to be attainable in such a project.

11.69 The investment required for an industrial complex such as the one envisioned in this report, is in the order of US $100 million. The objective of this pre-feasibility study is to demonstrate the desirability of carrying out several more detailed feasibility studies, in which different location and capacity alternatives should be examined. But, what is important is that no time should be lost in starting these studies. In spite of the size of its forest area, Indonesia does not have an exclusive claim on potentially attractive opportunities to develop timber-based industries. And, unplanned exploitation of its resources, even if very attractive on a short-term, may prevent the country from pursuing its longer-range objectives at a later date.

11.70 Rational forest exploitation and industrialization of these resources in a really beneficial way will require close collaboration of different branches of the GOI and continued collaboration between all levels of the administration and of private enterprises active in this economic subsector.

TABLE 11.1

NUMBER AND AREA OF FOREST EXPLOITATION CONCESSION AGREEMENTS AND APPLICATIONS PENDING - INDONESIA

| Classification by Type of Enterprise | Operating units, or agreements/investment permits already approved by the Government | | | | Agreements ready for Government approval | | | | Applications presented, surveys being prepared or under way, survey report under way or draft agreement in preparation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Number | | Area (000's Ha.) | | Number | | Area (000's Ha.) | | | | | |
| | Mar. 31 1970 | Mar. 31 1971 | Mar. 31 1970 | Mar. 31 1971 | Mar. 31 1970 | Mar. 31 1971 | Mar. 31 1970 | Mar. 31 1971 | Mar. 31 1970 | Mar. 31 1971 | Mar. 31 1970 | Mar. 31 1971 |
| **Private** | | | | | | | | | | | | |
| - National enterprises | 20 | 40 | 1,294 | 3,572 | | 10 | | 743 | | 13 | | 832 |
| - Joint enterprises | 20 | 31 | 3,015 | 3,529 | | 12 | | 1,005 | | 6 | | 681 |
| - Straight foreign investment | 13 | 17 | 2,841 | 3,184 | | 1 | | 50 | | 4 | | 240 |
| - Cooperative and other | - | - | - | - | | 2 | | 335 | | 7 | | 735 |
| - To be decided | - | - | - | - | | | | - | | 39 | | |
| Sub-total | 53 | 88 | 7,150 | 10,285 | | 25 | | 2,133 | | | | |
| **Perhutani** | | | | | | | | | | | | |
| - Joint enterprise | 1 | 1 | 800 | 800 | | | 1 | 115 | | | | - |
| - Production sharing | 7 | 7 | 897 | 897 | | | | - | | | | - |
| Sub-total | 9 | 8 | 1,697 | 1,697 | | | | 115 | | | | |
| **Totals** | 62 | 96 | 8,847 | 11,982 | 26 | 25 | 2,576 | 2,248 | 61 | 69 | 6,530 | 5,582 |
| **Not listed in map** | | | | | | | | | | | | |
| - Joint enterprise | - | - | - | - | | - | | - | | 1 | | 30 |
| - To be decided | - | - | - | - | | - | | - | | 1 | | 100 |
| **Listed in map but area not given** | | | | | | | | | | | | |
| - Joint enterprise | - | - | - | - | | 1 | | 130 | | - | | - |
| - To be decided | - | - | - | - | | - | | - | | 1 | | 40 |
| GRAND TOTALS | 62 | 96 | 8,847 | 11,982 | 26 | 26 | 2,576 | 2,378 | 61 | 72 | 6,530 | 5,752 |
| **GEOGRAPHICAL DISTRIBUTION** | | | | | | | | | | | | |
| Sumatera (Sumatra) | 2,296 | 27 | | 2,296 | | 5 | | 423 | | 18 | | 1,458 |
| - Atjeh and Sumatera Utara | 295 | 7 | | 485 | | 1 | | 50 | | 3 | | 210 |
| - Riau | 1,380 | 11 | | 1,090 | | 3 | | 273 | | 6 | | 409 |
| - Sumatera Barat and Bengkulu | 381 | 2 | | 125 | | - | | - | | 3 | | 235 |
| - Sumatera Selatan, Djambi and Lampung | 240 | 7 | | 596 | | 1 | | 100 | | 6 | | 604 |
| Kalimantan (Borneo) | 8,819 | 62 | | 9,114 | | 19 | | 1,765 | | 43 | | 3,617 |
| - Kalimantan Barat | 1,080 | 8 | | 830 | | 3 | | 390 | | 3 | | 450 |
| - Kalimantan Tengah | 1,437 | 11 | | 1,587 | | 7 | | 830 | | 24 | | 2,294 |
| - Kalimantan Selantan | 215 | 4 | | 485 | | - | | - | | 3 | | 250 |
| - Kalimantan Timur | 6,087 | 39 | | 6,212 | | 9 | | 545 | | 13 | | 850 |
| Sulawesi (Celebes) | 340 | 2 | | 195 | | 1 | | 60 | | 5 | | 385 |
| Maluku (Maluccas) | 377 | 5 | | 377 | | - | | - | | 4 | | 162 |
| Irian Barat (West New Guinea) | - | - | | - | | - | | - | | 1 | | 100 |
| Djawa (Java) | | | | | | | | | | 1 | | 30 |
| Location not given | | | | | | 1 | | 130 | | 72 | | 5,739 |

TABLE 11.2

AREA OF CONCESSIONS GRANTED, DRAFTED AND APPLIED FOR BY FOREIGN ENTERPRISES OR IN JOINT VENTURES

(000's of Ha.)

| Country | Straight Foreign Investment | | | Joint Ventures or Production Sharing | | | Totals | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Agreements Approved | Agreements Drafted | Applications Pending | Agreements Approved | Agreements Drafted | Applications Pending | Agreements Approved | Agreements Drafted | Applications Pending | |
| Japan | 35 | - | 100 | 2,197 | 210 | - | 2,232 | 210 | 100 | 2,542 |
| U.S. | 745 | - | 150 | 602 | - | - | 1,347 | - | 150 | 1,497 |
| Philippines | 1,348 | - | - | 602 | 240 | - | 1,950 | 240 | - | 2,190 |
| Malaysia | 100 | - | 200 | 1,085 | 440 | 596 | 1,185 | 440 | 796 | 2,421 |
| Korea | 270 | 50 | 90 | 120 | 245 | - | 390 | 295 | 90 | 775 |
| Hong Kong | 176 | - | - | 125 | - | 85 | 301 | - | 85 | 386 |
| Singapore | 80 | - | - | 265 | - | - | 345 | - | - | 345 |
| France | 280 | - | - | - | - | - | 280 | - | - | 280 |
| Other | 150 | - | - | 125 | - | 30 | 275 | - | 30 | 305 |
| TOTALS | 3,184 | 50 | 540 | 5,121 | 1,135 | 711 | 8,305 | 1,185 | 1,251 | 10,741 |

TABLE 11.3
LOGGING AND INVESTMENT TARGETS IN CONCESSIONS
GRANTED OR READY FOR APPROVAL

| APPROVED CONCESSIONS | Log production targets (1973) 000's $m^3(r)$ | Avge. proj. 1973 yields $m^3(r)$/Ha. | Projected investments: U.S.$ million | Projected investments: Per unit 1973 output $/$m^3(r)$ | Projected investments: Per unit concession area $/Ha. |
|---|---|---|---|---|---|
| East Kalimantan | 8,000 | 1.29 | 343.8[a] | 43 | 55 |
| South Kalimantan | 500 | 1.03 | 63.4[b] | 127 | 131 |
| Central Kalimantan | 1,736 | 1.09 | 25.5 | 15 | 16 |
| West Kalimantan | 1,145 | 1.38 | 16.8 | 15 | 20 |
| Sub-total Kalimantan | 11,381 | 1.25 | 449.5 | 39[c] | 49[d] |
| Atjeh & North Sumatra | 935 | 1.93 | 15.2 | 16 | 31 |
| Riau | 1,410 | 1.29 | 22.2 | 16 | 20 |
| E. Sumatra & Bengkulu | 310 | 2.48 | 3.5 | 11 | 28 |
| S. Sumatra, Djambi | 855 | 1.43 | 20.3 | 24 | 34 |
| Sub-total Sumatra | 3,510 | 1.53 | 61.2 | 17 | 27 |
| Sulawesi | 270 | 1.38 | 3.5 | 13 | 18 |
| Maluku | 620 | 1.64 | 8.5 | 14 | 23 |
| Totals or avges. | 15,781 | 1.32 | 522.7 | 33[c] | 44[d] |
| CONCESSIONS READY FOR APPROVAL | | | | | |
| East Kalimantan | 828 | 1.52 | 16.5 | 20 | 30 |
| Central Kalimantan | 758 | 0.91 | 13.5 | 18 | 16 |
| West Kalimantan | 650 | 1.67 | 7.0 | 11 | 18 |
| Sub-total Kalimantan | 2,236 | 1.27 | 37.0 | 17 | 21 |
| Atjeh and N. Sumatra | 100 | 2.00 | 2.5 | 25 | 50 |
| Riau | 440 | 1.61 | 5.5 | 13 | 20 |
| S. Sumatra, Djambi | 100 | 1.00 | 2.0 | 20 | 20 |
| Sub-total Sumatra | 640 | 1.51 | 10.0 | 16 | 24 |
| Sulawesi | 104 | 1.73 | 1.5 | 14 | 25 |
| Totals or avges. | 2,980 | 1.25 | 48.5 | 16 | 20 |

a) Including $235m in the A. Soriano & Cia. concession.
b) Including $48m in a concession granted to Korea Development Co.
c) Averages would drop to $16 per $m^3(r)$ of annual projected output, if the two concessions mentioned above are excluded.

d) Averages would drop to $22 for Kalimantan and $23/Ha. for all of Indonesia if the Soriano and Kodeco concessions are excluded.

Table 11.4

## INDONESIA - ROUNDWOOD FOREST REMOVALS ACCORDING TO VARIOUS SOURCES

Quantities in 000's of m3(r)

| Year | FAO 1/ Excl. fuelwood Quantity | FAO 1/ Excl. fuelwood Index | Bank Negara Indonesia 2/ Excl. fuelwood Quantity | Bank Negara Indonesia 2/ Excl. fuelwood Index | Bank Negara Indonesia 2/ Totals Quantity | Bank Negara Indonesia 2/ Totals Index | C.A.F.I. 3/ Totals Quantity | C.A.F.I. 3/ Totals Index | Biro Pusat Statistik 4/ Excl. fuelwood 1960 Rp m. | Biro Pusat Statistik 4/ Excl. fuelwood Index | Biro Pusat Statistik 4/ Totals 1960 Rp m. | Biro Pusat Statistik 4/ Totals Index | Biro Pusat Statistik 5/ Excl. fuelwood Vol. Index | Biro Pusat Statistik 5/ Excl. fuelwood Index 1962 = 100 | Directorate General of Chem. Industry 6/ Excl. fuelwood Teak | Directorate General of Chem. Industry 6/ Excl. fuelwood Other | Directorate General of Chem. Industry 6/ Excl. fuelwood Total | Directorate General of Chem. Industry 6/ Excl. fuelwood Index 1963 = 97 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | 5,361 | 96 | | | | | | | 3,177 | 98 | 6,494 | 101 | 100.0 | 96 | | | | |
| 1961 | 5,474 | 99 | | | | | 40,320 | 122 | 3,316 | 102 | 6,910 | 107 | 106.4 | 102 | | | | |
| 1962 | 5,556 | 100 | 2,018 | 100 | 3,360 7/ | 100 | 32,930 | 100 | 3,241 | 100 | 6,458 | 100 | 104.0 | 100 | | | | |
| 1963 | 5,639 | 101 | 1,961 | 97 | 3,547 7/ | 106 | 34,350 | 104 | 3,200 | 99 | 6,013 | 93 | 102.6 | 99 | 490 | 1,470 | 1,960 | 197 |
| 1964 | " | 101 | 1,952 | 97 | 3,313 | 99 | 31,980 | 97 | 3,096 | 96 | 5,576 | 86 | 99.3 | 95 | 470 | 1,400 | 1,870 | 93 |
| 1965 | " | 101 | 1,770 | 88 | 2,885 | 86 | 27,750 | 84 | 2,168 | 67 | 3,361 | 52 | 69.5 | 67 | 440 | 1,240 | 1,680 | 83 |
| 1966 | " | 101 | 1,983 | 98 | 3,507 | 104 | 33,560 | 102 | 1,201 | 37 | 2,818 | 44 | 38.5 | | 425 | 1,983 | 2,408 | 119 |
| 1967 | " | 101 | 2,853 | 141 | 4,350 | 129 | 41,170 | 125 | 2,614 | 81 | 3,243 | 50 | 83.9 | 81 | 469 | 2,853 | 3,422 | 169 |
| 1968 | | | 3,828 | 190 | 5,299 | 158 | 50,240 | 153 | 3,568 | 110 | 4,249 | 66 | 114.5 | 110 | 467 | 3,828 | 4,295 | 213 |
| 1969 | | | | | | | 54,820 | 166 | | | | | | | 532 | 4,859 | 5,390 | 267 |

1/ FAO Yearbooks of Forest Products, Year 1960 through 1969
For 1950, the figure recorded was 1,391 thous. m3(r)

2/ From Bank Negara Indonesia (Unit I), Laporan Tahun Pembukuan 1968, p.135 attributed to Biro Pusat Statistik

3/ From Commercial Advisory Foundation in Indonesia (C.A.F.I), Circular Tan. No. 3, Forestry Problems and Statistical Figures in Indonesia: Djakarta, July 1970, p.5 (figure attributed to Biro Pusat Statistik).

4/ From Pendapatan Nasional Indonesia (National Income) 1960-68: Djakarta, 1970, p.73/74

5/ From Pendapatan Nasional Indonesia (National Income) 1960-1968: Djakarta, 1970, p.77

6/ From Timber Situation in Indonesia, by Dr. J.F. Wattimena, Dept. of Industry, Directorate General of Chemical Industry: Djakarta, March 1971 (WK/mt/I/71)

7/ From Bank Negara Indonesia (Unit I), Report for the Financial Years 1966-1967, p.159

Table 11.3

INDONESIA - EXPORTS OF LOGS AND T[illegible]ER PRODUCTS ACCORDING TO VARIOUS SOURCES

| Year | | Bank Indonesia 1/ Quantity (000's m.t) | Bank Indonesia 1/ Value US $ 000's | Bank Indonesia 1/ Unit Value $/m.t. | Bank Negara Indonesia 2/ Quantities (000's m.t) Teak | Bank Negara Indonesia 2/ Other | Bank Negara Indonesia 2/ Total | Directorate General of Chem. Ind. 3/ Quantities (000's m3)(r) Teak | Directorate General of Chem. Ind. 3/ Other | Directorate General of Chem. Ind. 3/ Total | FAO 4/ Quantities 000's m3(r) Roundwood | FAO 4/ Sawnwood | FAO 4/ Total(r) | Biro Pusat Statistik 5/ Quantity (000's m.t.) | Biro Pusat Statistik 5/ Value (US $ million) | Biro Pusat Statistik 5/ Unit value $/m.t. | Exports - Directorate-General of Forestry 6/ (000's m3) Logs Teak | Logs Other | Logs Total | Sawnwood Teak | Sawnwood Other | Sawnwood Total | Fuelwood 000's m3 | Total Equiv. 000's m3(r) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1960 | | | 1,889 | | .7 | | | | | | | | 100.9 | | | | | | | | | | | |
| 1961 | | | 1,328 | | | | | | | | | | | | | | | | | | | | | |
| 1962 | | | 1,022 | | | | | | | | | | | | | | 4 | 113 | 117 | 8 | 8 | 17 | 60 | 196 |
| 1963 | | | 1,511 | | 6.0 | 107.1 | 114.7 | 7.1 | 35.9 | 43.1 | | | | | | | 6 | 91 | 97 | 9 | - | 9 | - | 106 |
| 1964 | | | 1,822 | | 7.7 | 62.1 | 69.8 | 14.4 | 91.1 | 105.5 | | | | | | | 8 | 179 | 187 | 9 | - | 9 | 7 | 204 |
| 1965 | | | 2,022 | | 9.7 | 123.8 | 133.5 | 17.6 | 128.8 | 196.4 | | | | 137.5 | 2.1 | 15.3 | 14 | 263 | 277 | 11 | - | 11 | - | 290 |
| 1966 | | | 3,500 | | [illegible].8 | 192.4 | 207.2 | 25.6 | 263.3 | 288.9 | | | | 203.4 | 3.6 | 17.7 | 10 | 567 | 577 | 12 | 2 | 14 | 35 | 641 |
| 1967 | | | 6,324 | | [illegible].3 | 395.9 | 408.2 | 28.3 | 567.5 | 595.8 | 560.2 | 7.5 | 575.0 | 400.9 | 6.3 | 15.7 | | | | | | | | |
| 1968 | | | 11,102 | | [illegible].7 | 809.8 | 837.5 | 28.7 | 1,159.0 | 1,217.7 | 1,879.0 | 10.6 | 1,894.0 | 837.5 | 11.1 | 13.2 | | | | | | | | |
| 1969 | | | 25,424 | | | | | 38.5 | 3,665.4 | 3,703.9 | | | | 2,429.6 | 25.3 | 10.4 | | | | | | | | |
| 1970 | | 5,161 | 86,118 | 16.68 | | | | | | 7,200.0 | | | | 4,774.3 | 86.1 | 18.0 | | | | | | | | |
| 1970 | Jan/Mar | 1,437 | 30,576 | 21.28 | | | | | | | | | | | | | | | | | | | | |

1/ Bank Indonesia, Indonesian Financial Statistics, Monthly Bulletin: April 1971, p. 98 and 130

2/ Biro Pusat Statistik, as shown in Bank Negara Indonesia (Unit I), Yearbooks 1966/67, p.160, and 1968, p.133.

3/ Timber Situation in Indonesia, op. cit., p.1

4/ FAO, Yearbooks

5/ Biro Pusat Statistik, Monthly Statistical Bulletin: March 1971, p.96

6/ Ir. Mattimeno, op. cit., p.1 (in 000's $m^3$(r)).

TABLE 11.6

PRODUCTION OF FOREST PRODUCTS BY PERHUTANI

| Kind of Product | Production | | |
|---|---|---|---|
| | 1965 | 1966 | 1967 |
| 1. Timber/Teak (cu.m) | 452,678 | 424,595 | 468,764 |
| 2. Fire-wood (sm) | 707,470 | 667,123 | 681,184 |
| 3. Charcoal (ton) | 5,190 | 3,250 | 3,711 |
| 4. Tannin bark (ton) | 3,293 | 3,619 | 1,799 |
| 5. Pine resin (ton) | 4,066 | 5,107 | 5,032 |
| 6. Turpentine (litre) | 22,823 | 29,938 | 30,145 |
| 7. Cayu-put oil (ltr) | 39,341 | 55,825 | 43,012 |
| 8. Stock-lac (ton) | 74 | 89 | 146 |

TABLE 11.7

Part 1

INTERNATIONAL TRADE OF TIMBER AND WOOD PRODUCTS
EXPORTS (1968

QUANTITY

| COUNTRIES | (000's $m^3$) Non-coniferous Sawlogs | Sawnwood | Panels Veneer Sheet | Plywood | (000's m.t.) Wood Pulp | Paper Products Total | Newsprint | Paperboard and other |
|---|---|---|---|---|---|---|---|---|
| World | 29,006 | 6,363 | 910 | 3,785 | 15,013 | 19,946 | 9,733 | 7,598 |
| Asia | 20,329 | 2,312 | 303 | 1,853 | 4 | 463 | 36 | 259 |
| Indonesia | 1,879 | 11 | - | - | | | | |
| Malaysia | | | | | | | | |
| Sabah | 5,796 | 4 | 9 | 5 | | | | |
| Sarawak | 2,988 | 311 | 6 | 10 | | | | |
| West Malaysia | 1,730 | 799 | 5 | 45 | | 1 | | 1 |
| Philippines | 7,511 | - | 220 | 254 | | | | |
| China | 2 | 58 | | 398 | | 24 | 1 | 16 |
| Japan | 2 | 250 | 3 | 425 | 3 | 343 | 6 | 207 |
| Korea | - | - | - | 560 | | | | |
| Hong Kong | 22 | 15 | - | 5 | | 19 | 4 | 12 |
| Singapore | 16 | 556 | 60 | 69 | | 16 | 1 | 12 |

VALUE
(U.S. $ 000's)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| World | 735,292 | 386,124 | 191,003 | 601,922 | 1,772,127 | 3,411,675 | 1,285,416 | 525,562 |
| Asia | 448,825 | 121,490 | 14,362 | 256,048 | 528 | 97,296 | 2,628 | 48,372 |
| Indonesia | 53,359 | 1,633 | - | - | - | - | - | - |
| Malaysia | | | | | | | | |
| Sabah | 109,135 | 195 | 464 | 464 | - | - | - | - |
| Sarawak | 45,274 | 13,843 | 378 | 835 | - | - | - | - |
| West Malaysia | 24,850 | 34,728 | 925 | 5,615 | - | - | - | - |
| Philippines | 170,001 | 6,054 | 7,996 | 18,697 | - | - | - | - |
| China | 128 | 3,933 | - | 53,028 | - | 4,010 | 127 | 2,208 |
| Japan | 158 | 13,104 | 697 | 93,032 | 503 | 74,789 | 917 | 38,455 |
| Korea | - | - | - | 65,691 | - | - | - | - |
| Hong Kong | 580 | 2,102 | - | 423 | - | 3,822 | 574 | 2,437 |
| Singapore | 363 | 22,629 | 3,776 | - | 16 | 3,109 | 130 | 2,113 |

## INTERNATIONAL TRADE OF TIMBER AND WOOD PRODUCTS
### EXPORTS (1968)
### QUANTITY

| Countries | (000's $m^3$) Non-coniferous sawlogs | Non-coniferous sawnwood | Veneer sheets | Plywood | (000's m.t.) Wood pulp | Paper Products Total | Newsprint | Paperboard & Other |
|---|---|---|---|---|---|---|---|---|
| World | 29122 | 6222 | 935 | 3863 | 14720 | 19411 | 9539 | 7676 |
| Asia | 20278 | 850 | 45 | 163 | 1322 | 1719 | 580 | 940 |
| Indonesia | ----- | ----- | ----- | ----- | ----- | 36* | 16* | 9* |
| Malaysia | | | | | | | | |
| Sabah | 12 | 28 | ----- | ----- | ----- | 2 | 1 | 1 |
| Sarawak | 2 | ----- | ----- | 1 | ----- | 2 | 1 | 1 |
| West. Malay. | 2 | 2 | ----- | 2 | 1 | 81 | 21 | 40 |
| Philippines | ----- | ----- | ----- | ----- | 25 | 140 | 68 | 60 |
| China | 1090 | 2 | ----- | ----- | 57 | 5 | 1 | 4 |
| Japan | 14476 | 191 | 7 | 7 | 784 | 135 | 104 | 29 |
| Korea | 2436 | 1 | ----- | ----- | 146 | 33 | 21 | 7 |
| Hong Kong | 314 | 58 | ----- | 41 | ----- | 272 | 52 | 181 |
| Singapore | 1466 | 218 | ----- | 39 | 1 | 110 | 16 | 69 |

* Exporters' figures

### VALUE
### (U.S. $ 000's)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| World | 1037828 | 449156 | 199487 | 548259 | 1920795 | 3589584 | 1403455 | 1721540 |
| Asia | 593410 | 38504 | 5832 | 23979 | 165880 | 345867 | 85689 | 209593 |
| Indonesia | ----- | ----- | ----- | ----- | ----- | 9068* | 3436* | 2000* |
| Malaysia | | | | | | | | |
| Sabah | 156 | 683 | ----- | ----- | ----- | 410 | ----- | ----- |
| Sarawah | 12 | 20 | 1 | 188 | ----- | 549 | 90 | 200 |
| West. Malay. | 24 | 209 | 77 | 348 | 178 | 15800 | 131 | 235 |
| Phillippines | ----- | ----- | ----- | ----- | 2400 | ----- | 3238 | 7562 |
| China | 33799 | 449 | ----- | ----- | 5864 | 1941 | 185 | 1701 |
| Japan | 438466 | 11026 | 1756 | 1495 | 112570 | 27063 | 15726 | 10881 |
| Korea | 73974 | 254 | 89 | 53 | 23901 | 6156 | 3096 | 2197 |
| Hong Kong | 5885 | 3087 | 12 | 5854 | ----- | 44620 | 7207 | 27114 |
| Singapore | 21541 | 7245 | 81 | 4548 | 210 | 20463 | 2344 | 11878 |

Table 11.8

ESTIMATED ANNUAL REPORT AVAILABILITY FOR MAJOR FOREST PRODUCTS FROM DEVELOPING COUNTRIES (1975 and 1985)

| | Logs | Sawn-wood | Veneer & plywood | Fibreboard and par-ticle board | Pulp and pulp products |
|---|---|---|---|---|---|
| 1962 | | | | | |
| Africa | 5,030 | 680 | 170 | - | 58 |
| Asia | 5,710 | 490 | 340 | 1 | 34 |
| Latin America | 350 | 1,400 | 40 | 4 | 98 |
| Near East | 10 | 50 | 3 | - | - |
| Total | 11,100 | 2,620 | 550 | 5 | 190 |
| 1975 | | | | | |
| Africa | 5,200 | 1,040 | 670 | 20 | 280 |
| Asia | 21,500 | 2,300 | 2,000 | 20 | 40 |
| Latin America | 300 | 1,750 | 330 | 50 | 300 |
| Near East | - | - | - | - | - |
| Total | 27,000 | 5,090 | 3,000 | 90 | 620 |
| 1985 | | | | | |
| Africa | 4,700 | 1,500 | 1,250 | 50 | 940 |
| Asia | 32,000 | 3,200 | 3,000 | 40 | 70 |
| Latin America | 300 | 1,880 | 910 | 160 | 990 |
| Near East | - | - | - | - | - |
| Total | 37,000 | 6,580 | 5,160 | 250 | 2,000 |

Source: Ref. 13, p. 11

1/ Units: 000's $m^3$ for logs, sawnwood, and veneer and plywood
000's m.t. for fibreboard, particleboard, pulp and pulp products.

TABLE 11.8

ESTIMATED ANNUAL EXPORT AVAILABILITY FOR MAJOR FOREST PRODUCTS FROM DEVELOPING COUNTRIES (1975 and 1985)1/

Source: Ref. 13, page 11

1/ Units: 000's $m^3$ for logs, sawnwood, and veneer and plywood
000's m.t. for fibreboard, particleboard, pulp and pulp products.

Table 11.9

WORLD PULP MAKING CAPACITIES
(000's m.t.)

| | "Market" Unbleached Sulphate | | "Market" Bleached and Semi-bleached | | Totals[1] "Market" Paper-grade Woodpulp | | Totals[2] Paper-grade Chemical Pulps | |
|---|---|---|---|---|---|---|---|---|
| | 1969 Act. | 1972 Est. | 1969 Act. | 1972 Est. | 1969 Act. | 1972 Est. | 1969 Act. | 1972 Est. |
| North America | 1,683 | 652 | 6,141 | 7,652 | 8,319 | 9,720 | 39,009 | 43,290 |
| US | 330 | 340 | 2,200 | 2,925 | 3,165 | 3,865 | | |
| Canada | 353 | 312 | 3,941 | 4,727 | 5,154 | 5,855 | | |
| Western Europe | 1,314 | 1,177 | 3,528 | 4,400 | 9,240 | 10,027 | 14,706 | 16,948 |
| Scandinavia | 1,265 | 1,085 | 2,885 | 3,460 | 7,715 | 8,305 | | |
| Other | 49 | 92 | 643 | 940 | 1,525 | 1,722 | | |
| Latin America | 135 | 170 | 325 | 385 | 606 | 781 | 1,108 | 1,483 |
| Brazil | 0 | 0 | 225 | 170 | 370 | 395 | | |
| Other | 135 | 170 | 100 | 215 | 236 | 386 | | |
| Africa & M. East | 185 | 197 | 65 | 113 | 250 | 317 | 490 | 692 |
| Asia & Pacific | 370 | 370 | 710 | 810 | 1,292 | 1,418 | 5,414 | 6,314 |
| Japan | 300 | 300 | 700 | 800 | 1,210 | 1,330 | 4,906 | 5,781 |
| Other | 70 | 70 | 10 | 10 | 82 | 88 | 508 | 533 |
| Eastern Europe | n.a. | n.a. | | | 1,829 | 2,370 | | |
| USSR | n.a. | n.a. | | | 1,800 | 2,325 | | |
| Other | n.a. | n.a. | | | 29 | 45 | | |
| Totals | n.a. | n.a. | | | 21,536 | 24,633 | | |
| Totals, not including Eastern Europe | 2,687 | 2,566 | 10,769 | 13,360 | 19,707 | 22,263 | 60,727 | 68,727 |

1/ Including sulphite and mechanical paper-grade pulp

2/ Including unbleached sulphate and sulphite pulps
Source: Ref. 51 - pp. 31/46.

Table 11.10

TARIFFS ON MAIN WOOD PRODUCTS

| | U.S. | EEC Countries 1/ | O.K. 2/ | Japan | Other |
|---|---|---|---|---|---|
| Logs | free | free | free | free | |
| Sawnwood (rough) | | free | free | | |
| - Dipterocarpacea | 3/ | | | 10% | |
| - Other hardwoods | | | | free | |
| Sawnwood (planed & grooved) | free | 5% | 5% | | |
| Veneer | | 7% | 5% | | |
| - S.E. tropical hardwoods | 10% | | | 15% | |
| - Teak | | | | free | |
| Plywood | | 13% | 5% | | |
| - Softwood | 20% | | | 17% | |
| - S.E. Asia hardwood | 20% | | | 20% | |
| - Spanish cedar | 12.5% | | | | |
| - Other hardwood species | 7.5/10% | | | | |
| Particleboard and reconstituted wood | 6/10% | 12% | 15% | 15/20% | |
| Woodpulp | free | | | | |
| Doors | 7.5% | | | | |
| Wood furniture | 5% | | | | |
| Wood chairs | 8.5% | | | | |
| Wood furniture parts | 8.5% | | | | |

1/ Common tariff.

2/ External tarif (i.e. applicable to countries other than EFTA and the Commonwealth.

3/ Less than 1%.

Sources: IBRD, Economics Department
U.S. Tariff Commission, Tariff schedules of the U.S. annotated (1971): Washington, 1970.

Table 11.11

INVESTMENT REQUIRED
(in US$ 000's)

| | Capital Investment and Other Expenses | Redistribution of site, utilities, and other plant costs | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Electrolytic Plant | Timber Preparation | Pier | Power Plant | Water Supply | Land Improvements | Shops | Warehouses | Offices and Housing |
| Pulp mill | 12,445 | - | 6,532 | 180 | 1,727 | 938 | 143 | 369 | 84 | 168 |
| Bleaching plant | 4,548 | 2,150 | - | 280 | 1,816 | 525 | 60 | 199 | 127 | 70 |
| Electrolytic plant | 2,150 | - | - | | | | | | | |
| Paper mill | 14,450 | - | - | 300 | 2,273 | 171 | 99 | 385 | 137 | 165 |
| Sub-total pulp and paper plants | 33,593 | - | - | | | | | | | |
| Sawmill | 2,370 | - | 289 | 20 | 1,448 | 346 | 163 | 92 | 23 | 396 |
| Plywood and veneer plant | 15,908 | - | 434 | 140 | 4,521 | 415 | 434 | 568 | 59 | 1,237 |
| Parquet block plant | 986 | - | - | 20 | 127 | 15 | 19 | 31 | 7 | 79 |
| Plant for doors, joinery, etc. | 1,277 | - | - | 20 | 152 | 5 | 29 | 38 | 2 | 93 |
| Particle board plant | 3,018 | - | - | 40 | 267 | 74 | 18 | 91 | 16 | 40 |
| Timber preparation plant | 7,496 | - | - | - | - | - | - | - | - | - |
| Sub-total mechanical processing plants | 31,055 | - | - | - | - | - | - | - | - | - |
| Pier and equipment | 2,000 | - | - | - | - | - | - | - | - | - |
| Power plant and electric distribution | 12,700 | - | - | - | - | - | - | - | - | - |
| Fresh water supply and treatment | 2,560 | - | - | - | - | - | - | - | - | - |
| Land improvement | 1,000 | - | - | - | - | - | - | - | - | - |
| Machine, electrical and maintenance shops | 1,855 | - | - | - | - | - | - | - | - | - |
| Warehouses | 2,275 | - | - | - | - | - | - | - | - | - |
| Offices | 1,930 | - | - | - | - | - | - | - | - | - |
| Housing and other personnel services | 400 | - | - | - | - | - | - | - | - | 82 |
| Shipping department | - | - | 241 | 1,000 | 369 | 71 | 35 | 82 | 1,820 | - |
| Sub-total (cumulative) | 89,368 | - | - | - | - | - | - | - | - | - |
| Contingencies | 4,432 | - | - | - | - | - | - | - | - | - |
| Total fixed assets | 93,800 | - | - | - | - | - | - | - | - | - |
| Pre-operating expenses and fees | 2,070 | - | - | - | - | - | - | - | - | - |
| Interest and other financial charges | 8,130 | - | - | - | - | - | - | - | - | - |
| Total capitalized interest and expenses | 10,200 | - | - | - | - | - | - | - | - | - |
| Total project, excluding Working Capital | 104,000 | - | - | - | - | - | - | - | - | - |
| Working Capital | 13,800 | - | - | - | - | - | - | - | - | - |
| Totals | 117,800 | 2,150 | 7,496 | 2,000 | 12,700 | 2,560 | 1,000 | 1,855 | 2,275 | 2,330 |

INVESTMENT REQUIRED (Continued)
(in US$ 000's)

| Redistributed Fixed Investment | | | Capitalized Interest and Expenses | Total Inv. Excluding W.C. | W.C. | Total Inv. Including W.C. | Capacity | Unit Investment |
|---|---|---|---|---|---|---|---|---|
| Excluding Contingencies | Contingencies | Including Contingencies | | | | | | |
| 22,586 | 1,120 | 23,706 | 2,578 | 26,284 | 2,457 | 28,741 | 440 t/d | $ 65,300 t/d |
| 9,775 | 435 | 10,260 | 1,116 | 11,376 | 1,756 | 13,132 | 320 t/d | 41,100 t/d |
| | | | | | | | | 106,400 t/d |
| 17,980 | 892 | 18,872 | 2,052 | 20,924 | 2,924 | 23,848 | 300 t/d | 79,500 t/d |
| | 2,497 * | 52,858 | 5,746 * | 58,584 * | 7,137 * | 65,721 * | | 185,900 t/d 1/ |
| 5,147 | 255 | 5,402 | 587 | 5,989 | 928 | 6,917 | | |
| 23,716 | 1,176 | 24,892 | 2,707 | 27,599 | 3,960 | 31,559 | | |
| 1,284 | 64 | 1,348 | 147 | 1,495 | 605 | 2,100 | | |
| 1,616 | 80 | 1,696 | 184 | 1,880 | 270 | 2,150 | | |
| 3,564 | 177 | 3,741 | 407 | 4,148 | 802 | 4,950 | | |
| 35,327 | 4,249 * | 89,917 * | 9,778 * | 41,111 * | 6,565 * | 47,676 * | 150 M m3(r)/y | 63/M m3(r)/y 2/ |
| | 1,752 | 37,079 | 4,032 | | | | | |
| 3,700 | 183 * | 3,883 * | 422 * | 4,305 * | 98 * | | | |
| 89,368 | 4,432 | 93,600 | 10,200 | 104,000 | 13,800 | | | |

* Sub-totals

1/ The value for a similar plant based on hardwoods now under construction (with a smaller bleaching plant) is $159,500 t/d (Ref. 15- pp.14 and 19), including power plant and other services. Another pulp mill (without paper mill) would cost $112,000 t/d if it made only market bleached pulp.

2/ The value for a recent plant based on similar woods and location is also $63/M m3(r)/y (Ref. 30-pp. 10 and Annex 13).

Table 11.12

PROJECTED SALES AT FULL OPERATION RATES

| | Unit 000's | Quantity | Price $/Unit | Value $ 000's | Commissions Selling Exp. $ 000's | Net Sales $ 000's | Consolidated Net Sales Quantity | Consolidated Net Sales Value $ 000's |
|---|---|---|---|---|---|---|---|---|
| Pulp mill | m.t. | | | 12,750 | 148 | 12,602 | 13.5 | 1,472 |
| - Unbleached pulp, domestic market | " | 13.5 | 120.00 | 1,620 | 148 | 1,472 | 13.5 | 1,472 |
| - Unbleached pulp, export market | " | - | - | - | - | - | - | - |
| - Unbleached pulp, plant consumption | " | 131.4 | 80.00 | 10,512 | - | 10,512 1/ | - | - |
| - Chips, chipboard plant consumption | m3 | 77.3 | 8.00 | 618 | - | 618 1/ | - | - |
| Bleaching (and electrolytic) plants | m.t. | 82.0 | | 11,260 | 720 | 10,540 | 60.0 | 7,680 |
| - Bleached pulp, export market | " | 60.0 | 140.00 | 8,400 | 720 | 7,680 | 60.0 | 7,680 |
| - Bleached pulp, domestic market | " | - | - | - | - | - | - | - |
| - Bleached pulp, plant consumption | " | 22.0 | 130.00 | 2,860 | - | 2,860 1/ | - | - |
| Paper mill | m.t. | 78.0 | | 18,877 | 1,335 | 17,542 | 78.0 | 17,234 |
| - Linerboard, domestic market | | 11.1 | 179.80 | 1,996 | 155 | 1,841 | | |
| - Corrugated med., domestic market | | 7.4 | 176.00 | 1,302 | 102 | 1,200 | | |
| - Kraft sack, domestic market | | 29.5 | 221.00 | 6,519 | 475 | 6,044 | | |
| - Writing and printing, domestic market | | 30.0 | 302.00 | 9,060 | 603 | 8,457 | | |
| Sub-total pulp and paper | m.t. | | | 42,887 | 2,203 | 40,684 | 151.5 | 26,386 |
| Sawmill | m3(s) | 172.5 | | 8,072 | 834 | 7,238 | 154.0 | 6,591 |
| - Sawmwood, export market | | 130.9 | 50.00 | 6,505 | 719 | 5,786 | | |
| - Sawmwood, domestic market | | 23.1 | 40.00 | 920 | 115 | 805 | | |
| - Sawmwood, remanufacturing | | 18.5 | 35.00 | 647 | - | 647 1/ | | |
| Plywood and veneer plant | m3 | 225.0 | | 24,005 | 1,855 | 22,150 | 222.2 | 21,898 |
| - Plywood, export market | | 200.0 | 107.50 | 21,500 | 1,675 | 19,825 | | |
| - Plywood, domestic market | | 22.2 | 101.50 | 2,253 | 180 | 2,073 | | |
| - Plywood, remanufacturing | | 2.8 | 90.00 | 252 | - | 252 1/ | | |
| Parquet block plant | m3 | 30.0 | | 2,520 | 216 | 2,304 | 30.0 | 2,304 |
| Parquet blocks, export market | | 24.0 | 85 | 2,040 | 174 | 1,866 | | |
| Parquet blocks, domestic market | | 6.0 | 80 | 480 | 42 | 438 | | |
| Remanufacturing plant | m3 | 6.3 | | 1,216 | 80 | 1,136 | 6.3 | 1,136 |
| - Various, export market | | 6.3 | 193.0 | 1,216 | 80 | 1,136 | | |
| - Various, domestic market | | | | | | | | |
| Chipboard plant | m3 | 60.0 | | 3,564 | 358 | 3,206 | 60.0 | 3,206 |
| - Chipboard, export market | | 54.0 | 60.00 | 3,240 | 324 | 2,916 | | |
| - Chipboard, domestic market | | 6.0 | 54.00 | 324 | 34 | 290 | | |
| Sub-total mechanical wood processing industries | m3 | 493.8 | | 39,377 | 3,343 | 36,034 | 472.5 | 35,135 |
| Shipping Department revenues | | | | 4,102 | - | 4,102 | | 4,102 |
| - Charge on all shipments, pulp and paper | m.t. | 151.5 | 5.00 | 757 | | 757 | | |
| - Charge on all shipments, wood products | m3 | 722.5 | 3.00 | 2,168 | | 2,168 | | |
| - Gross profit on log exports | m3 | 250.0 | 4.71 | 1,177 | | 1,177 | | |
| Grand Total for industrial complex | | | | 86,366 | 5,546 | 80,820 | | 65,623 |

1/ Interplant transfers.

TABLE 11.11

TIMBER-BASED INDUSTRIAL COMPLEX
OPERATING COSTS AND GROSS PROFITS
(US $ 000's)

| | Direct (variable) costs | | | | | | | | | Semi-variable costs | | | Fixed costs | | | | Total Costs | Income Before taxes & Interest |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Logs, Pulpwood & Forest waste | Mill waste | Timber Intermediaries | Wood pulp | Chemicals | Other Materials & Supplies | Labor (variable) | Fuel Oil & Lubricants | Sub-total | Labor (semi-variable) | Repairs Spares & Other Supplies | Sub-total | Depreciation & Amortization | Labor (not productions) | Management & General Overhead | Sub-total | | |
| Pulpmill | 4,281 | 149 | - | - | 798 | 160 | 73 | 27 | 5,488 | 105 | 250 | 355 | 2,100 | 17 | 600 | 2,717 | 8,560 | 4,042 |
| Bleaching and electrolytic plants | - | - | - | 7,272 | 661 | 83 | 24 | 182 | 8,222 | 37 | 108 | 145 | 1,166 | 20 | 50 | 1,236 | 9,603 | 937 |
| Unbleached paper | - | - | - | 4,820 | 77 | 142 | 44 | 366 | 5,456 | 62 | 123 | 185 | | | | | | |
| White paper | - | - | - | 3,630 | 465 | 186 | 30 | 228 | 4,539 | 40 | 77 | 117 | | | | | | |
| Total paper | | | | 8,450 | 542 | 335 | 74 | 594 | 9,995 | 102 | 200 | 302 | 1,389 | 15 | 50 | 1,454 | 11,751 | 5,791 |
| Pulp and paper mills | 4,281 | 149 | - | 15,722 | 2,001 | 578 | 171 | 803 | 23,705 | 244 | 558 | 802 | 4,655 | 52 | 700 | 5,407 | 29,914 | 10,770 |
| Sawmill | 3,900 | ( 55) | - | - | - 1/ | 86 | 201 | 336 | 4,468 | 213 | 89 | 302 | 613 | 46 | 250 | 909 | 5,679 | 1,559 |
| Plywood and veneer plant | 5,850 | ( 79) | - | - | 2,025 | 675 | 805 | 990 | 10,266 | 554 | 924 | 1,478 | 2,827 | 78 | 350 | 3,255 | 14,999 | 7,151 |
| Parquet block plant | 346 | ( 18) | 525 | - | - | 240 | 34 | 10 | 1,137 | 40 | 253 | 293 | 153 | 25 | 30 | 208 | 1,638 | 666 |
| Wood remanufacturing plant | - | - | 374 | - | - 1/ | 38 | 31 | 22 | 465 | 53 | 17 | 70 | 193 | 25 | 30 | 248 | 783 | 353 |
| Chipboard plant | - | 3 | 618 | - | 660 | 120 | 16 | 30 | 1,447 | 15 | 157 | 172 | 425 | 14 | 30 | 469 | 2,088 | 1,118 |
| Mechanical wood industries | 10,096 | (149) | 1,517 | - | 2,685 | 1,159 | 1,087 | 1,388 | 17,783 | 875 | 1,440 | 2,315 | 4,211 | 188 | 690 | 5,089 | 25,187 | 10,847 |
| Shipping department | - | - | - | - | - | 1,288 | 87 | 13 | 1,388 | 33 | 75 | 108 | 267 | 24 | 300 | 591 | 2,084 | 2,018 |
| | 14,377 | - | 1,517 | 15,722 | 4,686 | 3,025 | 1,345 | 2,201 | 42,873 | 1,152 | 2,073 | 3,225 | 9,133 | 264 | 1,690 | 11,087 | 57,185 | 23,635 |

1/ Included in other materials and supplies

Table 11.14

INTERNAL ECONOMIC RETURN FOR TIMBER BASED INDUSTRIAL COMPLEX
(US $ 000's)

| | Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sales[1/] | | - | 300 | 3,072 | 16,955 | 36,470 | 61,268 | 80,820 | 80,820 | 80,820 | 80,820 | 80,820 | 80,820 | 80,820 | 80,820 | 80,820 | 80,820 | |
| Pulp and paper | | - | - | - | - | 4,474 | 22,687 | 40,684 | 40,684 | | | | | | | | | |
| Mechanical wood industries | | - | - | 2,472 | 14,455 | 28,696 | 34,431 | 36,034 | 30,034 | | | | | | | | | |
| Shipping department (revenues) | | | 300 | 600 | 2,500 | 3,300 | 3,950 | 4,102 | 4,102 | | | | | | | | | |
| Costs | | - | 711 | 4,216 | 14,310 | 29,310 | 46,227 | 57,185 | 57,185 | 57,185 | 57,185 | 57,185 | 57,185 | 57,185 | 57,185 | 57,185 | 57,185 | |
| Pulp and paper | | - | - | - | - | 6,373 | 19,831 | 29,914 | 29,914 | | | | | | | | | |
| Mechanical wood industries | | - | - | 3,394 | 12,836 | 21,143 | 24,363 | 25,187 | 25,187 | | | | | | | | | |
| Shipping department | | - | 711 | 822 | 1,474 | 1,794 | 2,033 | 2,084 | 2,084 | | | | | | | | | |
| Net income before taxes and interest | | | (411) | (1,144) | 2,645 | 7,160 | 15,041 | 23,635 | 23,635 | 26,635 | 26,635 | 26,635 | 26,635 | 26,635 | 26,635 | 26,635 | 26,635 | |
| Pulp and paper | | - | - | - | - | (1,879) | 3,056 | 10,770 | 10,770 | | | | | | | | | |
| Mechanical wood industries | | - | - | (922) | 1,619 | 7,553 | 10,068 | 10,847 | 10,847 | | | | | | | | | |
| Shipping department | | - | (411) | (222) | 1,026 | 1,506 | 1,917 | 2,018 | 2,018 | | | | | | | | | |
| Depreciation & amortization cap. exp. | | - | 267 | 687 | 3,077 | 6,736 | 9,133 | 9,133 | 9,133 | 9,133 | 9,133 | 9,133 | 9,133 | 9,133 | 9,133 | 9,133 | 9,133 | |
| Pulp and paper | | - | - | - | - | 2,633 | 4,655 | 4,655 | 4,655 | | | | | | | | | |
| Mechanical wood industries | | - | - | 420 | 2,810 | 3,786 | 4,211 | 4,211 | 4,211 | | | | | | | | | |
| Shipping department | | - | 267 | 267 | 267 | 267 | 267 | 267 | 267 | | | | | | | | | |
| Benefits | | - | (223) | (457) | 5,722 | 13,896 | 24,174 | 32,768 | 32,768 | 32,768 | 32,768 | 32,768 | 32,768 | 32,768 | 32,768 | 32,768 | 32,768 | |
| Pulp and paper | | - | - | - | - | 784 | 7,711 | 15,425 | 15,425 | | | | | | | | | |
| Mechanical wood industries | | - | (223) | (502) | 4,429 | 11,339 | 14,279 | 15,058 | | | | | | | | | | |
| Shipping department | | | | 45 | 1,293 | 1,773 | 2,184 | 2,285 | | | | | | | | | | |
| Investment costs | (1,200) | (4,605) | (14,800) | (32,200) | (32,237) | (18,958) | - | - | - | - | - | - | - | - | - | - | - | |
| Pulp and paper | (500) | (500) | (2,200) | 17,000 | (21,500) | (16,884) | - | - | - | - | - | - | - | - | - | - | - | |
| Mechanical wood industries | (500) | (2,000) | (10,600) | (15,200) | (10,737) | ( 2,074) | - | - | - | - | - | - | - | - | - | - | - | |
| Shipping department | (200) | (2,105) | ( 2,000) | - | - | - | - | - | | | | | | | | | | |
| Present value | | | | | | | | | | | | | | | | | | |
| Benefits (20%/yr) | - | - | (155) | (291) | 2,758 | 5,586 | 8,098 | 9,142 | 7,635 | 6,357 | 5,308 | 4,424 | 3,670 | 3,047 | 2,556 | 2,130 | 1,769 | 57,620 |
| Investment costs (20%/yr) | (1,200) | (3,836) | (10,271) | (18,644) | 15,538 | (7,621) | - | - | - | - | - | - | - | - | - | - | - | 57,110 |
| Benefits (at 20.5%/yr) | - | - | (154) | (261) | 2,718 | 5,475 | 7,905 | 8,880 | 7,373 | 6,328 | 5,079 | 4,227 | 3,506 | 2,916 | 2,392 | 1,999 | 1,638 | 55,594 |
| Investment costs (at 20.5%/yr). | (1,200) | (3,822) | (10,197) | (18,418) | (15,313) | (7,469) | - | - | - | - | - | - | - | - | - | - | - | 56,419 |

1/ Including inter-plant sales or transfers

TABLE 11.15

TIMBER-BASED INDUSTRIAL COMPLEX

DETERMINATION OF COSTS DURING PHASING-IN OF PLANTS
(US $ 000's)

| Years | 2 | 3 | 4 | 5 | 6 | 7/15 |
|---|---|---|---|---|---|---|
| Sales (net) - Pulp and paper mills | - | - | - | 4,474 | 22,887 | 40,684 |
| Pulp mill | - | - | - | 2,554 | 6,925 | 12,602 |
| Bleaching plant | - | - | - | 1,920 | 7,190 | 10,540 |
| Paper mill | - | - | - | - | 8,771 | 17,542 |
| Variable costs - Pulp and paper mills | - | - | - | 2,610 | 13,622 | 23,705 |
| Pulp mill | - | - | - | 1,112 | 3,016 | 5,488 |
| Bleaching plant | - | - | - | 1,498 | 5,609 | 8,222 |
| Paper mill | - | - | - | - | 4,997 | 9,995 |
| Sales (net) - Mechanical wood industries | - | 2,472 | 14,455 | 28,696 | 34,431 | 36,034 |
| Sawmill | - | 2,472 | 5,667 | 7,238 | 7,238 | 7,238 |
| Plywood plant | - | - | 8,212 | 19,162 | 22,150 | 22,150 |
| Parquetry plant | - | - | 576 | 1,728 | 2,304 | 2,304 |
| Remanufacturing | - | - | - | 568 | 1,136 | 1,136 |
| Chipboard plant | - | - | - | - | 1,603 | 3,206 |
| Variable costs - Mechanical wood industries | - | 1,526 | 7,588 | 14,434 | 17,059 | 17,783 |
| Sawmill | - | 1,526 | 3,498 | 4,468 | 4,468 | 4,468 |
| Plywood plant | - | - | 3,806 | 8,881 | 10,266 | 10,266 |
| Parquetry plant | - | - | 284 | 852 | 1,137 | 1,137 |
| Remanufacturing | - | - | - | 233 | 465 | 465 |
| Chipboard plant | - | - | - | - | 723 | 1,447 |
| Revenues - Shipping department | 300 | 600 | 2,500 | 3,300 | 3,950 | 4,102 |
| Variable costs - Shipping department | 101 | 202 | 844 | 1,114 | 1,334 | 1,385 |
| Total costs - Pulp and paper mills | - | - | - | 6,373 | 19,831 | 29,914 |
| Variable | - | - | - | 2,610 | 13,662 | 23,705 |
| Semi-variable | - | - | - | 428 | 802 | 802 |
| Fixed 1/ | - | - | - | 3,335 | 5,407 | 5,407 |
| Total costs - Mechanical wood industries | - | 3,394 | 12,836 | 21,143 | 24,363 | 25,187 |
| Variable | - | 1,526 | 7,588 | 14,434 | 17,059 | 17,783 |
| Semi-variable | - | 300 | 1,560 | 2,045 | 2,215 | 2,315 |
| Fixed 1/ | - | 1,568 | 3,688 | 4,664 | 5,089 | 5,089 |
| Total costs - Shipping department | 711 | 822 | 1,474 | 1,794 | 2,033 | 2,084 |
| Variable | 101 | 202 | 844 | 1,114 | 1,334 | 1,385 |
| Semi-variable | 60 | 70 | 90 | 100 | 108 | 108 |
| Fixed 1/ | | | | | | |

1/ Beginning in the twelfth year, depreciation reserves for some plants will cover entire value of same, and capitalized expenses during construction will be totally amortized. Fixed costs could be diminished, but it is assumed that new fixed assets will be purchased during the plant operation.

TABLE 11.16

SCHEDULE FOR PLANT START-UPS IN THE TIMBER-BASED INDUSTRIAL COMPLEX

| Plant | Years: Asking for bids on building & equipment | Years: Plant start-up |
|---|---|---|
| Pier & general land impr. | 0 | 1 1/2 |
| Saw mill, Line 1 | 0 | 2 |
| Saw mill, Line 2 | 1 | 2 1/2 |
| Plywood, Line 1 | 1/2 | 3 |
| Plywood, Line 2 | 1 | 3 1/2 |
| Parquettry plant | 2 | 3 1/2 |
| Remanufacturing | 1 1/2 | 4 |
| Chipboard plant | 2 1/2 | 5 |
| Pulp mill | 1 | 4 |
| Bleaching & electrolytic | 1 1/2 | 4 1/2 |
| Paper mill | 2 | 5 |
| Power plant | 0 | 2 |

Table 11.17

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Table 11.18

CONVERSION FACTORS

1 Ha. = 1 Hectare = 2.471 acres

1 sq. mi. = 1 square mile = 2.59 sq. Km. = 259 Ha.

1 $m^3$ = 1 cubic meter = 35.31 cu. ft. = 0.33 cord

1 $m^3$(s) = 1 $m^3$ sawnwood = 424 board feet (BF)

1 standard s.w. = 165 cu. ft. = 1980 BF.

1 BF = 1 board foot = 0.0833 cu. ft. = 0.00236 $m^3$(s)

1 estereo = 1 $m^3$(r) stacked = 0.75 $m^3$(r)

1 ton charcoal = 5 $m^3$(r)

1 $m^3$(s) = 1.82 $m^3$(r) (broadleaf) = 1.67 $m^3$(r) (coniferous)

1 FT = 1 forest ton = 50 cu. ft. = 1.415 $m^3$(r)

1 Hoppus ton = 50 Hoppus cu. ft. = 1.273 forest ton

1 standard = 4.672 $m^3$

1 MBFM = 2.36 $m^3$(s)

1 cord = 2.55 $m^3$(r) of pulpwood (another definition is 128 cu. ft. = 3.625 $m^3$)

1,000 sq. ft. ¼" thick = 0.59 $m^3$ (plywood)

1,000 sq. ft. 1/10" thick = 0.236 $m^3$ (veneer)

1,000 sq. ft. 1/16" thick = 0.147 $m^3$ (veneer)

## Appendix 11.1

## CALCULATION OF POTENTIAL MAXIMUM YIELD OF INDONESIAN TIMBER

From production forests:

Bases of calculation:

- Area total: 24 million Ha.
- Volume standing: 50 $m^3$/Ha (commercial)
- Breakage and other waste: 20%
- Cutting cycle: 50 years (an acceptable average between 30 years for a sustained yield managed forest cycle[1/], which will probably never be applied everywhere, and 60 years for normal exploitation as given in other sources[2/]). The Forestry Directorate-General apparently has often used a 35-year figure for concession agreements

$$Y = \frac{24000000 \times 50 \times 0.8}{50} = 19,200,000 \quad m^3(r)$$

From forests converted to agriculture:

Bases of calculation:

- Area: 18 million Ha
- Volume standing: 60$m^3$/Ha (although some estimates have used much larger volumes per Ha. considering that all the trees must be removed)
- Breakage and other waste: 30% (including wood removed for fuel).

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1/ Martin R. Reyes, paper on Selective Logging as a Tool for Continuous Philippine Mahogany Production, presented to a Seminar on Planning of Forestry and Forests Industries in Tropical Regions, held in Manila, November/December, 1967, organized by FAO and the German Foundation for Developing Countries: page W4 of the report on the Seminar.

2/ Ref.1, Page 54 and Ref.2 Page 3.

- Time for conversion: 70 years. In theory, the time could be much shorter, as shown by estimates that shift cultivation alone destroys up to 200,000 Ha. annually [3/]. A period of 36 years has also been estimated [4/], but the shorter periods entail large migration flows from over-populated Java, where there is little forest land left, to Kalimantan, Sumatra, and West Irian, where the largest forested areas are.

$$Y' = \frac{18,000,000 \times 60 \times 0.7}{70} = 10,800,000 \text{ m}^3(r)$$

Total medium-future potential production

$$Y + Y' = 30 \text{ million m}^3(r)$$

(This potential could be ideally realized, but any realistic projections must be based on only a fraction of this figure.)

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3/ Ref.5, Page 25.

4/ Ref.2, Page 3.

Appendix 11.2

AREAS, PRODUCTION TARGETS AND INVESTMENT ESTIMATED FOR APPROVED OR DRAFTED CONCESSION TIMBER AGREEMENTS

| Page (DOF List) | Province | Area 000's Ha. | Production Targets 000's m3(r) 1969 | 1971 | 1973 | Estimated Investment Totals (US $ million) | Per unit output $/m3(r) | Average 1973 Yield m3/Ha. |
|---|---|---|---|---|---|---|---|---|
| A 1 | East Kalimantan | 52 | 48 | 60 | 60 | 3.2 | | |
| | | 141 | 48 | 48 | 60 | 3.3 | | 0.43 |
| | | 268 | 24 | 30 | 30 | 3.3 | | 0.11 |
| | | 78 | 44 | 50 | 50 | 3.2 | | 0.64 |
| | | 94 | 30 | 40 | 40 | 3.1 | | 0.42 |
| A 2 | | 14 | 10 | 60 | 100 | 0.2 | | 7.14 |
| | | 200 | 40 | 160 | 200 | 0.6 | | 1.00 |
| | | 50 | 10 | 30 | 50 | 0.5 | | 1.00 |
| | | 100 | 20 | 100 | 150 | 0.1 | | 1.50 |
| | | 50 | 20 | 60 | 100 | 1.0 | | 2.00 |
| | | 20 | 5 | 10 | 30 | 0.5 | | 1.50 |
| | | 100 | 20 | 60 | 100 | 2.0 | | 1.00 |
| | | 100 | 20 | 65 | 100 | 2.0 | | 1.00 |
| | | 40 | 10 | 50 | 80 | 1.0 | | 2.00 |
| | | 50 | 10 | 30 | 75 | 1.0 | | 1.50 |
| | | 35 | 20 | 40 | 60 | 1.0 | | |
| | | 150 | 50 | 100 | 180 | 3.5 | | 1.20 |
| | | 50 | 20 | 40 | 65 | 1.0 | | 1.30 |
| | | 100 | 50 | 100 | 150 | 2.0 | | 1.50 |
| | | 40 | 20 | 50 | 80 | 1.0 | | 2.00 |
| | | 50 | 15 | 40 | 70 | 1.0 | | 1.40 |
| 3 | | 60 | 25 | 55 | 95 | 1.5 | | |
| 4 | | 100 | 40 | 120 | 200 | 2.0 | | 2.00 |
| | | 602 | 300 | 800 | 1,200 | 15.0 | | 1.99 |
| | | 150 | 40 | 160 | 250 | 4.0 | | 1.60 |
| | | 150 | 50 | 200 | 300 | 3.0 | | 2.00 |
| | | 100 | 100 | 160 | 200 | 2.5 | | 2.00 |
| | | 50 | 15 | 45 | 75 | 1.0 | | 1.50 |
| | | 125 | 35 | 90 | 150 | 3.0 | | 1.20 |
| | | 80 | 100 | 160 | 200 | 2.5 | | 2.50 |
| A 5 | | 800 | 100 | 700 | 1,600 | 16.0 | | 2.00 |
| | | 70 | 30 | 80 | 140 | 1.5 | | 2.00 |
| | | 250 | 100 | 250 | 400 | 5.0 | | 1.60 |
| | | 60 | 20 | 60 | 120 | 1.0 | | 2.00 |
| | | 120 | 20 | 40 | 80 | 3.0 | | 0.67 |
| A 6 | | 1,200 | 200 | 400 | 600 | 235.0 | | 0.50 |
| | | 350 | 50 | 160 | 250 | 8.0 | | |
| | | 95 | 20 | 100 | 190 | 2.8 | | |
| A 7 | | 68 | 25 | 70 | 120 | 2.5 | | |
| Sub-Totals | | 6,212 | 1,804 | | 8,000 | 343.8 | 42.97 | 1.29 |
| B | | 115 | 40 | 80 | 140 | 2.5 | | 1.22 |
| | | 80 | 15 | 30 | 50 | 4.0 | | 0.62 |
| | | 70 | 40 | 80 | 120 | 2.5 | | 1.71 |
| | | 40 | 20 | 40 | 65 | 1.0 | | 1.62 |
| | | 65 | 50 | 110 | 151 | 2.0 | | 2.32 |
| | | 45 | 50 | 100 | 150 | 1.5 | | 3.33 |
| | | 60 | 25 | 50 | 90 | 1.5 | | 1.50 |
| | | 40 | 5 | 12 | 22 | 0.5 | | 0.55 |
| | | 30 | 15 | 25 | 40 | 1.0 | | 1.33 |
| Sub-Totals | | 545 | 260 | | 828 | 16.5 | 19.93 | 1.52 |
| A 3 | Southern Kalimantan | 20 | 40 | 80 | 80 | 3.4 | | 4.00 |
| A 5 | | 115 | 20 | 60 | 100 | 2.0 | | 0.96 |
| A 6 | | 80 | 20 | 100 | 120 | 10.0 | | 1.50 |
| | | 270 | 20 | 100 | 200 | 48.0 | | 0.74 |
| Sub-Totals | | 485 | 100 | | 500 | 63.4 | 126.80 | 1.03 |
| A 1 | Central Kalimantan | 244 | 40 | 45 | 45 | 2.0 | | 0.18 |
| A 2 | | 135 | 50 | 100 | 160 | 2.0 | | 1.18 |
| | | 98 | 30 | 50 | 125 | 1.5 | | 1.28 |
| | | 200 | 30 | 50 | 150 | 3.0 | | 0.75 |
| A 3 | | 150 | 100 | 200 | 325 | 3.0 | | 2.17 |
| | | 200 | 30 | 90 | 250 | 3.0 | | 1.25 |
| | | 150 | 50 | 100 | 160 | 3.0 | | 1.07 |
| | | 120 | 40 | 80 | 140 | 2.5 | | 1.17 |
| | | 70 | 5 | 13 | 21 | 0.5 | | 0.30 |
| | | 70 | 20 | 40 | 60 | 2.0 | | 0.86 |
| A 4 | | 150 | 100 | 200 | 300 | 3.0 | | 2.00 |
| Sub-Totals | | 1,587 | 495 | | 1,736 | 25.5 | 14.69 | 1.09 |

| Page (DGF List) | Province | Area 000's Ha. | Production Targets 000's m3(r) 1965 | 1971 | 1973 | Estimated Investment Totals (US $ million) | Per unit output $/m3(r) | Average 1973 Yield m3/Ha. |
|---|---|---|---|---|---|---|---|---|
| B | | 100 | 50 | 150 | 200 | 2.5 | | 2.00 |
| | | 100 | - | - | - | - | | - |
| | | 270 | 60 | 120 | 170 | 3.0 | | 0.63 |
| | | 65 | 11 | 27 | 43 | 1.5 | | 0.67 |
| | | 80 | 50 | 100 | 200 | 2.5 | | 2.50 |
| | | 65 | 10 | 25 | 42 | 2.0 | | 0.65 |
| | | 150 | 15 | 50 | 103 | 2.0 | | 0.69 |
| Sub-Totals | | 830 | 196 | | 758 | 13.5 | 17.81 | 0.91 |
| A 2 | Kalimantan Barat | 200 | 100 | 500 | 500 | 10.0 | | 2.50 |
| | | 30 | 10 | 20 | 30 | 0.3 | | 1.00 |
| A 4 | | 70 | 15 | 90 | 150 | 1.0 | | 2.14 |
| | | 200 | 80 | 140 | 180 | 1.0 | | 0.90 |
| | | 170 | 20 | 60 | 100 | 1.0 | | 0.59 |
| | | 30 | 15 | 35 | 45 | 1.0 | | 1.50 |
| A 5 | | 90 | 15 | 50 | 90 | 1.5 | | 1.00 |
| | | 40 | 15 | 30 | 50 | 1.0 | | 1.25 |
| Sub-Totals | | 830 | 270 | | 1,145 | 16.8 | 14.67 | 1.38 |
| B | | 80 | 40 | 160 | 200 | 1.0 | | 2.50 |
| | | 60 | 10 | 40 | 60 | 1.0 | | 1.00 |
| | | 250 | 100 | 200 | 390 | 5.0 | | 1.56 |
| Sub-Totals | | 390 | 150 | | 650 | 7.0 | 10.77 | 1.67 |
| TOTALS - KALIMANTAN | | | | | | | | |
| Granted | | 9,114 | 2,609 | | 11,381 | 449.5 | 39.50 | 1.25 |
| Drafted | | 1,765 | 606 | | 2,236 | 37.0 | 16.55 | 1.27 |
| | | 10,879 | 3,275 | | 13,617 | 486.5 | 35.73 | 1.25 |
| | Atjeh & Sumatra Utara | | | | | | | |
| A 2 | | 60 | 40 | 80 | 120 | 1.5 | | 2.00 |
| A 3 | | 70 | 30 | 70 | 110 | 2.5 | | 1.57 |
| | | 75 | 30 | 80 | 160 | 2.5 | | 2.13 |
| A 4 | | 85 | 30 | 75 | 135 | 1.5 | | 1.59 |
| A 5 | | 60 | 10 | 45 | 60 | 1.5 | | 1.00 |
| A 6 | | 35 | 20 | 60 | 100 | 3.2 | | 2.86 |
| A 7 | | 100 | 60 | 150 | 250 | 2.5 | | 2.50 |
| Sub-Totals | | 485 | 220 | | 935 | 15.2 | 16.26 | 1.93 |
| B | | 50 | 30 | 60 | 100 | 2.5 | | 2.00 |
| Sub-Totals | | 50 | 30 | | 100 | 2.5 | 25.00 | 2.00 |
| | Riau | | | | | | | |
| A 2 | | 100 | 30 | 50 | 70 | 1.0 | | 0.70 |
| | | 100 | 20 | 60 | 100 | 2.0 | | 1.00 |
| A 3 | | 100 | 20 | 60 | 100 | 2.5 | | 1.00 |
| | | 80 | 20 | 40 | 80 | 1.5 | | 1.00 |
| | | 100 | 30 | 60 | 100 | 2.5 | | 1.00 |
| A 4 | | 100 | 50 | 200 | 280 | 1.0 | | 2.80 |
| | | 30 | 10 | 35 | 40 | 1.0 | | 1.33 |
| A 6 | | 100 | 20 | 80 | 150 | 0.7 | | 1.50 |
| | | 80 | 20 | 80 | 150 | 1.0 | | 1.87 |
| | | 200 | 30 | 110 | 200 | 6.0 | | 1.00 |
| | | 100 | 40 | 100 | 140 | 3.0 | | 1.40 |
| Sub-Totals | | 1,090 | 290 | | 1,410 | 22.2 | 15.74 | 1.29 |
| B | | 80 | 50 | 100 | 200 | 1.0 | | 2.50 |
| | | 65 | 20 | 40 | 65 | 1.5 | | 1.00 |
| | | 128 | 50 | 100 | 175 | 3.0 | | 1.37 |
| Sub-Totals | | 273 | 120 | | 440 | 5.5 | 12.50 | 1.61 |

| Page (DGF List) | Province | Area 000's Ha. | Production Targets 000's m3(r) 1969 | 1971 | 1973 | Estimated Investment Totals (US $ million) | Per unit output $/m3(r) | Average 1973 Yield m3/Ha |
|---|---|---|---|---|---|---|---|---|
| A 3 | Sumatra Barat & Bengkulu | 90 | 50 | 150 | 240 | 2.5 | | 2.67 |
| A 4 | | 35 | 20 | 40 | 70 | 1.0 | | 2.00 |
| Sub Totals | | 125 | 70 | | 310 | 3.5 | 11.29 | 2.48 |
| A 2 | Sumatra Selatan Djambi & Lampung | 55 | 10 | 45 | 70 | 1.0 | | 1.28 |
| A 5 | | 35 | 10 | 20 | 55 | 8.0 | | 1.57 |
| A 6 | | 100 | 20 | 80 | 150 | 0.8 | | 1.50 |
| | | 150 | 50 | 150 | 200 | 3.0 | | 1.33 |
| | | 76 | 20 | 50 | 80 | 3.0 | | 1.05 |
| A 7 | | 100 | 25 | 100 | 200 | 2.5 | | 2.00 |
| | | 80 | 20 | 60 | 100 | 2.0 | | 1.25 |
| Sub-Totals | | 596 | 155 | | 855 | 20.3 | 23.74 | 1.43 |
| B | | 100 | 20 | 60 | 100 | 2.0 | | 1.00 |
| Sub-Totals | | 100 | 20 | | 100 | 2.0 | 20.00 | 1.00 |
| TOTALS - SUMATRA | | | | | | | | |
| - Granted | | 2,296 | 735 | | 3,510 | 61.2 | 17.43 | 1.53 |
| - Drafted | | 423 | 190 | | 640 | 10.0 | 15.62 | 1.51 |
| | | 2,719 | 925 | | 4,150 | 71.2 | 17.16 | 1.53 |
| A 3 | Sulawesi | 70 | 15 | 50 | 70 | 1.5 | | 1.00 |
| A 4 | | 125 | 40 | 100 | 200 | 2.0 | | 1.60 |
| Sub-Totals | | 195 | 55 | | 270 | 3.5 | 12.96 | 1.38 |
| B | | 60 | 20 | 45 | 104 | 1.5 | | 1.73 |
| Sub-Totals | | 60 | 20 | | 104 | 1.5 | 14.42 | 1.73 |
| A 1 | Maluku | 65 | 20 | 40 | 60 | 1.5 | | 0.92 |
| A 2 | | 40 | 10 | 30 | 60 | 1.0 | | 1.50 |
| A 4 | | 100 | 50 | 120 | 150 | 2.0 | | 1.50 |
| | | 90 | 75 | 125 | 200 | 2.0 | | 2.22 |
| | | 82 | 25 | 75 | 150 | 2.0 | | 1.83 |
| Sub-Totals | | 377 | 180 | | 620 | 8.5 | 13.71 | 1.64 |
| UNDEFINED | | | | | | | | |
| B | | 130 | | | | | | |
| TOTAL - OTHER ISLANDS | | | | | | | | |
| - Granted | | 572 | 235 | | 890 | 12.0 | 13.48 | 1.56 |
| - Drafted (except undefined loc.) | | 60 | 20 | | 104 | 1.5 | 14.92 | 1.73 |
| | | 632 | 255 | | 994 | 13.5 | 13.58 | 1.57 |

## APPENDIX 11.3

## TYPICAL LOGGING TERMS IN SOME IMPORTANT CONCESSIONS

| Concessionaire | Concession Terms | | | | Unit Yield m3/Ha (1) | | Annual agreed log output (000's m3) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Date | Term Yrs. | Forest Area 000's Ha. | Investment $ million | Min. | Max. | Minimum (m) By the 3rd. Yr. | Minimum (m) After 5 yrs. | Maximum After 5 yrs. |
| Korea Development Co. | Feb. 2, 1968 | 20[d] | 270 | | 32 | 120 | 80 | 200 | 740[o] |
| Sealog, Hong Kong | May 8, 1968 | 30[c] | 200[a] | n.s. | 66 | 120 | 60[b] | 300[b] | 550[o] |
| I.T.C.I. (De Long, USA) | July 11, 1968 | 20[d] | 602[e] | 7.5 | 87 | 120 | n.s. | 1200[e] | 1650[o] |
| Georgia Pacific Int'l Corp. | Aug. 28, 1969 | 20[in] | 350 | 3.0 | 62 | 120 | 160[f] | 500[f] | 960[o] |
| Weyerhaeuser Int'l Inc. | Dec. 6, 1969 | 20[d] | 95 | n.s. | 46 | 88 | 60 | 100 | 190 |
| Soriano (Philippines) | Dec. 4, 1969 | 30[d] | 1200[(g)] | 52.7 | 22 | 120 | 200 | 600[h] | 3300[o] |
| Perhutani - IFORECO (Japan) | (k) | 20[j] | 700 | 36.6 | 31 | 72 | 445 | 500 | 1160 |

a) Plus 50,000 Ha. of open land for agricultural purposes. The 250,000 Ha. to be chosen from total 360,000 Ha. survey area

b) Round measure of exportable logs

c) Can be extended to 40 yrs.

d) Can be extendedan indefinite number of times provided each extension does not leave an unexpired term longer than 20 (or 30) years.

e) As amended on Jan. 16, 1969, the original figures having been 400,000 Ha. and 500,000 $m^3$.

f) No fixed term is explicitly mentioned for the production of 500,000 $m^3$ but from the context it should be the fifth year; all figures are, however, weakened by saying that company will make its best efforts to reach them.

g) This area can be reduced to 350,000 Ha. if the concessionaire finds that establishing a pulp and paper plant is not physically or economically feasible.

h) During the fifth year, increased to 1,000,000 $m^3$ by the end of the 10th year, and to 2,000,000 $m^3$ by end of 14th year.

i) It is not specifically mentioned, but arises from text of term extensions

j) Automatically extended to 30 years upon establishment of pulp and paper industry. Further extensions possible if Ministry of Agriculture thinks them necessary.

k) Signature expected before end of 1971

l) Estimated unit yield x concession areas x 0.8 - 35. Unit yield to be calculated using Hoppus system for trees 50 cm ø or more at 20 cm above surface (Circular 461/A-1/00 of Feb. 2, 1970).

m) Defined as either marketable or exportable logs

n) May be extended "if not contrary, to public interest" Regulation No. 21 (1970)

o) Not included in agreement but based on yields of 120 $m^3$/Ha

n.s. = not specified

APPENDIX 11.4

PROJECTED PROCESSING FACILITIES IN SOME IMPORTANT CONCESSIONS

| Concessionaire | Sawmilling | | | | Plywood | | | Pulp and/or Paper | | | Total Processing | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | After Years | Investment ($ million) | % of Log Extraction | Potential Capacity 000's m3(r) | After Years | Investment ($ million) | Potential Capacity 000's m3(r) | After Years | Investment ($ million) | Potential Capacity 000's m3(r) | After Years | Investment ($ million) | % of Log Extraction | Volume of Log Input 000's m3(r) |
| Sealog, Hong Kong | 2 | n.s. | 41% | 25 | n.s. | n.s. | n.s. | - | - | - | 5 | 6.0 1/ | n.s. | n.s. |
| I.T.C.I | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | - | - | - | 5 | 7.5 | n.s. | n.s. |
| Georgia Pacific | 3 | 2.0 | 20% | 70 | 5 | 3.0 | n.s. | - | - | - | n.s. | 10.0 | n.s. | n.s. |
| Weyerhaeuser | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | n.s. | - | - | - | 6 | 2.8 1/ | 60% | 60/114 |
| Soriano | 3 | n.s. | 13%/16% | 50/100 | | | | 12 | 34.1 | 350 tpd | 5 | 1.1 | 300% 3/ | 600 |
| | 9 | n.s. | 17% | 150 | 10 | n.s. | 150 | 14 | 135.0 | 350 tpd | 10 | 40.0 | 55% 4/ | 1800 |
| | 12 | n.s. | 17% | 150 | 13 | n.s. | 150 | 16 | | 300 tpd | 15 | 141.5 | | |
| Perhutani-INDECO | 3 | 0.5 | n.s. | n.s. | 6 | 1.9 | n.s. | 9 | 39.9 | n.s. | n.s. | n.s. | n.s. | n.s. |
| | 6 | 0.5 | n.s. | n.s. | 12 12/ | 0.7 | n.s. | 12 2/ | 10.0 | | | | | |

1/ Industry logging
2/ Between the 11th and 15th. year
3/ Based on the minimum projected output. Sawmills and plywood alone would use 110% of minimum
4/ Based on maximum output (Appendix 11.3)

n.s. = not specified

Apprendix 11.5

# C I R C U L A R

No. : 461/A-1/DD/70
Attachment : 1 (one)
Subject : Guide-Line on Implementation of Forestry Concession

February 2, 1970

Forwarded to :
All Forestry Concession Holders throughout Indonesia.

Copies to :

1. All Governors/Provincial Regional Chiefs,
2. All Directorate Chiefs of General Directorate of Forestry,
3. All Chiefs of Provincial Forestry Service,
4. B. P. U. Perhutani.

1. Please be informed that by means of forestry exploitations, as the material in the Forestry Basic Law, the way to earn income from forests in Indonesia for the public and the State has become widely opened, due to the likelihood of employing large-scale capital, whether domestic or foreign. However, should such exploitations be abused or miscarried or the operators fail to abide by provisions incorporated in the agreements at the moment of acquisition of forestry concession, entry of large capital can easily destroy safety or conservation of our forests. Emergence of this factor stems from non application of the sustained yield principles, underlined in Article 13 of the 1967 Forestry Basic Law as the only means of forestry exploitations to be carried out; in the end such mismanagement becomes detrimental to the public and the relevant area.

2. Basis of forestry exploitations originates from a detailed operational planning for a certain period as well as their systematic application of the rules. These plans actually were promised by the forestry concession holders in their "agreements" with the Department of Agriculture and yet in practice so far no forestry companies have substantiated them, although they have long cleared the forests, indeed, they have repeatedly exported their operational products.

3. Through this letter therefore we order forestry concession holders to settle immediately what had been promised in the Agreement and application letter, namely :

   a. To draw-up the annual operational plan or forest clearance scheme for 1969 and 1970 to ascertain the stipulated target. These plans should have been confirmed 2 months prior to the start of tree cutting campaign. The cutting cycle we temporarily set at 35 years for selective cut, in the sense of cutting trees exclusively of 50 cms. or more in diameter (at a height of 20 cms above the surface roots) with the factor of 20% grade reduction so that the annual allowable cut is equivalent to 1/35 X 80% X volume total of Ø 50 cms and above;

   b. Start immediately drafting of the Five Year Operational Plan, namely, from 1969 to 1973 (inclusive), stating order of steps (including: designation of forest sections to be cleared in the next 5 years, construction of infra-structure, employment of labor force, heavy equipment for logging, etc) to assure ease of targetted production. These plans should have been confirmed one year after issuance of the decree granting the forestry concession;

   c. Start immediately with the Forestry Exploitation Plan or Timber Management Plan, encompassing all activities in the whole forestry concession area for the entire duration of the cycle or rotation to achieve the sustained growth principles. This plan within a period of three years since issuance of the decree on granting forestry concession, we should have confirmed.

4. Pending subsequent instructions on drawing up of the aforementioned operational plans, temporarily employ the outline attached to this letter. Furthermore, temporarily we stipulate that the annual plan be confirmed by Chief of Provincial Forestry service, the Five Year Plan be confirmed by the Chief of the Forestry Exploitation Directorate, while the Forestry Exploitation Plan, we ourselves confirm.

5. It is necessary for us to emphasize that sanctions which threaten holders of forestry concessions at the moment of acquisition of such right are as follows : a. Revocation of forestry concession :

a. 1. If the holder itself does not carry out forestry exploitation;
a. 2. If the holder fails to pay license fee and royalty;
a. 3. If the holder does not carry out forest care and forest security (consisting of: re-forestation, prevention of erosion, flood and fire, maintenance of springs, nature protection, hunting control).
a. 4. If the holders do not start operations positively and seriously at the latest 180 days since issuance of decree on forestry concession.

b. Reduction of areal extent :

b. 1. If the holder fails to build the needed infrastructure to discharge forestry exploitations;
b. 2. If the holder does not found a wood processing industry (at the very least to install a saw-mill to saw unexported stumps).
b. 3. If the holder doesnot operate according to the afore-mentioned operational plans.

6. We wish to emphasize again that forestry exploitations are not an easy and simple matter, not forestry exploitations exclusively, but complex operations, not easy to be studied and understood by non-specialists but the complexity is highly essential to assure efficient forest utilization. Without plan based on forestry exploitation knowledge, the target outline at the moment of application of forestry concession cannot be achieved or be ascertained as its achievement.

7. Finally, we hope the Governors, Chiefs of Provincial Forestry Service and Chief of Forestry Exploitation Directorate to watch steps or activities of forestry concession holders on matters as stated above, for our common interest; namely, to distribute forestry products for public prosperity and for the safety or restoration of forests whose lumber are cut on a large scale. We have the obligation to leave to the future generations our healthy forests of high economic value.

DIRECTOR GENERAL OF FORESTRY

Signed,

(SOEDJARWO).

OUTLINE OF LOGGING PLANNING.

A. ONE YEAR LOGGING PLAN.

I. Target of production.

1. Cutting areas with estimated production in m3
2. Volume per tree species.

II. Standing Stock Survey.

III. Road Location and Construction in the Cutting Areas.

1. Constructed.
2. To be constructed.
3. Volume in m3 per km road.

IV. Operation Plan.

1. Base camp.
2. Equirement.
3. L a o u r.
4. Skidding and Yarding.
5. Hauling.
6. Long Yard.

V. Long Pond.

VI. E x p o r t.

VII. Sawmilling.

VIII. Statisticts and Location map of the Cutting Area and the Roadsis be Built.

Note: The cutting cycle is for the being fixed at 35 year hence the yearly cutting area is aproximate 1/35 of the whole consession area with 1/35 of the total volume of the standing stock.

B. FIVE YEAR LOGGING PLAN

The same outline as for the "One Year Logging Plan"

C. TIMBER MANAGEMENT PLAN

I. Summary of Plan.

1. Resources data and allowable cut.
2. a. Permanent forest.
   b. Disposible forest.
   Volume and classes of Timber species.
3. Silvicultural system approved to be practiced.

II. Management Plan.

1. Statement of General Policy.
2. Land Description.
   A. Londtion.
   B. Boundery of license area
   C. Sub Bounderies.
      a. Blocks.
      b. Compartment.
   D. Relation of working circle to other license areas.
3. Forest description of concession area, of each block and of each compartment.
   A. Areas by types and by size classes.
   B. Stocking and thrift.
4. Management objectives.
   A. Business and community support.
   B. Silvicultural treatment in unevenaged Dipterocarp forest.
5. Coordination with other uses (water supply and control; Soil conservation; grazing; wildlife and recreation; etc).
6. Regulation.
   A. Growth and mortality.
   B. Period of adjustment.
   C. Cutting cycle.
   D. Grazing stock objectives.
      a. Residual stands.
      b. Future crop from seed reproduction.
   E. Calculation of allowable cut.
   F. Tree marking rules.
7. Plan of extraction.
   A. Logging plan.
   B. Logging method and equipments (Selective logging, modified selective logging, leaving of seed trees).

8. Utilization policy.

   A. Disposition of cuts.
      1. For manufacturing plants of licenses.
      2. For other plants or domestic use.
      3. For export.

   B. Minimum size of logs and quality requirements.

9. Forest development and protection.

   A. Transportation; road construction and maintenance.
   B. Timber stand improvement.
   C. Planting.
   D. Control of forest destruction, illegal acupation and timber trespass, Protection measures.
      a. Concession guard force
      b. Resettlement
      c. Other measures.
   E. Insect and desease control, if serious in the locality.

10. Cooperation.

   A. With local, district and regional forestry office.
   B. With municipality and province.
   C. With private landowners.

11. Date revision is proposed (at least after 10 years).

12. Management plan maintenance.

III. Suporting data (which bear directly on plan).

1. History.
2. Physiography; (topography, soil, climate).
3. Economy; (population, industries, trade, etc.)
4. Detailed forest data by blocks, (from timber inventory data) if complete inventory detail not yet available, at least data from area planned for five year operation may be used)

   A. Permanent or public forest.
      a. Virgin forest operable.
         1. Stand and stock tables.
         2. Reproduction.
         3. Total number of trees and volume by block, of 10 cm diameter classes from 50 cm and up.

      b. Logged over.
         1. Size class distribution of healthy residuals 29 cm and over diameter.
         2. Reproduction.
         3. Growth mortality and predicted yield for the second cutting cycle.

   B. Alienable and disposable forest.

5. Regulation calculations.
6. Control records.
7. List of references.
8. Maps.
   A. Whole license area showing blocks and compartments areas in ha and total exploitable volume, boundery line of permanent forest, logged over and non timberred areas, etc.
   B. Logging plan, showing transportation system.
   C. Timber stand, improvement and planting.
9. Pertinents illustration (optional).
   A. Graphs or curves on growth and size class distribution.
   B. Pictures.

Appendix 11.6

DECREE OF MINISTER OF AGRICULTURE
NO. KEP. 31/1968

ON

FIXATION OF THE AMOUNT OF FOREST LICENCE
FEE AND ROYALTIES,

MINISTER OF AGRICULTURE.

Considering : a. that to accelerate the forest undertaking and forest products trading for national economic development, it is necessary to immediately reorder the collections on the forest undertaking and forest products.

b. That for the said reason, it is regarded necessary to fix the amount of Forest Licence Fee and Royalties throughout Indonesia.

With a view to: 1. Government Regulation No. 22 Year 1967 (O.G. year 1967 No. 36) re Forest Lincence Fee and Royalties, article 5;
2. Act No. 5 year 1967 re Basic Provisions on Forestry;
3. Act No. 18 year 1965 re Mainpoints on Regional Administration;
4. Decree of Minister of Agriculture No. Kep. 31/12/1966;
5. Decree of Minister of Agriculture No. Kep. 18/3/1967.

H A S  D E C I D E D :

To lay down : Regulation on the amount of Forest Licence Fee and Royalties as follows :

FIRSTLY : a. Holders of Forest undertaking Right shall be charged with Licence Fee and Royalties as referred to in the appendix of this Decree.

b. Holders of Forest Products Collecting Right and all forest products taken out from the state forest which are intended to be traded shall be charged with Royalties as referred to in the appendix of this Decree.

SECONDLY : In order that everybody may know, this Decree shall be inserted in the BERITA NEGARA of the Republic of Indonesia.

THIRDLY : This Decree is effective as from the date of the sanctioning.

Sanctioned in Djakarta
on January 20, 1968.
MINISTER OF AGRICULTURE,

W. S.

SUTIYPTO S.H.
ARMY MAJOR GENERAL.

LEAF OF APPENDIX TO DECREE OF MINISTER OF AGRICULTURE
DATED JAN. 20, 1968, NO. KEP. 31/1968

ON

LICENCE FEE AND ROYALTIES

I. LICENCE FEE:

For each ha. per year US. $. 0.05

Rules :

Payment will be made of the date of the issuance of the granting of Licence Fee and paid all at the same time for the period of the Forest Licence Right.

## II. ROYALTIES

| Kinds / Group | Permanent Royalties in US.$./m3. |
|---|---|
| Djati (Tectona grandis) | US. $. 7.00 |
| <u>Class I</u> | |
| Balau/Damar Laut (Shorea dam Hopea spp) | |
| Bangkirai (Shorea Laevifolia) | |
| Merbau (Instsia spp) | |
| Ulin (Eusideroxylon Zwageri) | US. $. 3.00 |
| Giam (Coryiobian spp) | |
| Pooti (Hopea spp) | |
| Lara (metrosiderros spp) | |
| Cafassa/Bitti/Leban (Vitex spp) | |
| <u>Class II</u> | |
| Merawan/Tjengal (Hopea spp) | |
| Rengas burung (Melanorrhoes) | |
| Belangeran (Shorea belangeran) | US. $. 2,50 |
| Kulim (Scoredocarpus borneensis) | |
| Mengkulang (Heritiera spp) | |
| Punak (Tetra merista glabra) | |
| <u>Class III</u>/Kapur (Dryobalanops spp) | |
| → Keruing (Dipterocarpus spp) | US. $. 2.00 |
| Kasai (Pasestia spp) | |
| Rengas (Gluta spp) | |
| Resak (Vatica spp) | |
| <u>Class III/IV</u> | |
| Bintangur (Calophyyum spp) | US. $. 1,50 |
| Medang (Lauraceae spp) | |
| Njatoh (Sapotaceae spp) | |
| <u>Class IV</u> | |
| Suren (Toona sowani Merr) | US. $. 1.00 |
| Cemangang (Gonystylon arborescens) | |
| Meranti (Anisoptera spp) | |
| Kenari (Canarium spp) | |
| Bajur (Phoenixparmen spp) | |
| → Ramin (Gonystylus spp) | |
| <u>Class V/VI</u> | |
| Tjempaka (Albasia Moluccana) | US. $. 0,80 |
| Bungur (Beccia ambigua) | |
| Durian (Durio spp) | |
| Tekin/Kalo[illegible] (Dyeberg[illegible]) | |
| <u>Class V.</u> | |
| Pulai (Alstonia Scholaris) | US. $. 0,50 |
| Terentang (Campnosperma spp) | |
| Djelutung (Dyera spp) | |
| Perupuk (Octomeles sumatrana) | |
| Kalumpajan (Anthocephalus spp) | |
| → Meranti Merah (shorea spp) | US. $. 1,50 |
| Meranti putih ( " ) | US. $. 1,50 |
| Meranti Kuning ( " ) | US. $. 1,50 |
| Durian (Durio spp) | US. $. 2,50 |
| Tuman (Diospyros Macrantha) | US. $. 1.--- |
| Kapur (Dryobalanops spp) | US. $. 3.---/pon |
| Sonokeling (Dalbergia latifolia) | US. $. 2,— |
| Other Fancy wood | US. $. 2,— |

## Appendix 11.7

### ROUND WOOD PRODUCTION
(000's of m3(r)

| | Sawlogs | | | | Total Industrial | | | | Fuelwood | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coniferous | | Non-coniferous | | Coniferous | | Non-coniferous | | Coniferous | | Non-coniferous | |
| | 1967 | 1968 | 1967 | 1968 | 1967 | 1968 | 1967 | 1968 | 1967 | 1968 | 1967 | 1968 |
| World | 514,767 | 531,734 | 190,277 | 193,303 | 850,226 | 869,530 | 314,590 | 319,317 | 155,878 | 156,660 | 734,693 | 740,319 |
| Asia | 46,109 | 44,401 | 55,604 | 59,691 | 64,354 | 62,015 | 78,970 | 82,325 | 55,999 | | 196,360 | 200,863 |
| Indonesia | 76 | | 4,065 | 4,500 | 76 | | 5,563 | | - | | 79,232 | |
| Malaysia | | | | | | | | | | | | |
| - Sabah and Sarawak | 1 | 1 | 9,273 | 10,125 | 1 | 1 | 9,329 | 10,125 | | | 64 | 65 |
| - West Malaysia | 14 | 15 | 4,185 | 5,064 | 14 | 15 | 4,303 | 5,161 | | | 505 | 609 |
| Philippines | 230 | 250 | 9,954 | 11,087 | 230 | 250 | 9,954 | 11,087 | | | 110 | 98 |
| Thailand | - | - | 2,330 | 2,576 | - | - | 2,349 | 2,582 | | | 2,166 | 2,132 |
| Japan | 27,377 | 25,309 | 6,887 | 7,483 | 33,316 | 30,119 | 18,497 | 18,050 | 53 | 52 | 7,408 | 6,281 |
| India | 1,125 | | 4,801 | | 1,137 | | 5,562 | | 35 | | 12,725 | |
| Pakistan | - | - | 763 | | - | - | 884 | | | | 6,428 | |
| China, mainland | 12,400 | 12,700 | 7,600 | 7,800 | 23,010 | 23,550 | 14,090 | 14,450 | | | 66,000 | 72,000 |
| China, Taiwan | 643 | 670 | 58 | 60 | 723 | 760 | 338 | 358 | | | 210 | 210 |
| Hong Kong | - | - | - | - | - | - | - | - | | | - | - |
| Singapore | - | - | - | - | - | - | - | - | | | - | - |
| Korea | | | | | | | | | | | | |
| Brazil | 8,900 | 9,530 | 8,000 | 8,220 | 9,900 | 10,530 | 10,050 | 10,320 | 10,500 | 11,000 | 129,500 | 131,000 |
| Australia | 1,703 | 1,612 | 7,446 | 7,452 | 2,183 | 9,084 | 9,145 | 9,179 | 453 | 453 | 2,670 | 2,550 |
| New Zealand | 4,710 | 5,352 | 107 | 116 | 6,151 | 6,754 | 139 | 136 | | | 57 | 57 |

## Appendix 11.8

## PRODUCTION OF SAWNWOOD AND PANELS

| | Coniferous | | Non-coniferous | | Veneer | | Plywood | | Particleboard and Fiberboard | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1967 | 1968 | 1967 | 1968 | 1967 | 1968 | 1967 | 1968 | 1967 | 1968 |
| World | 289,844 | 301,293 | 87,665 | 87,625 | 401 | 449 | 26,348 | 28,060 | 13,529 | 15,628 |
| Asia | 41,823 | | 24,082 | 24,861 | | | 5,455 | 6,812 | 876 | 941 |
| Indonesia | 16 | | 1,765 | | | | | | 1 | 1 |
| Malaysia | | | | | | | | | | |
| - Sabah and Sarawak | - | | 799 | 713 | 12 | 15 | 3 | 4 | - | - |
| - West Malaysia | 17 | 54 | 1,709 | 2,000 | | | 55 | 100 | 1 | 1 |
| Philippines | 110 | 120 | 1,189 | 1,022 | 225 | 267 | 285 | 299 | 52 | |
| Thailand | - | - | 1,210 | 1,340 | 7 | 8 | 28 | 31 | 6 | |
| Japan | 30,139 | 30,940 | 7,867 | 8,076 | 151 | | 3,778 | 4,742 | 501 | 566 |
| India | 680 | | 710 | | | | 112 | | 21 | |
| Pakistan | - | - | 446 | | - | - | 5 | | 3 | |
| China, mainland | 7,700 | 8,000 | 4,800 | 5,000 | | | 120 | 130 | 130 | 140 |
| China, Taiwan | 390 | 400 | 152 | 164 | 1 | 2 | 334 | 390 | 55 | |
| Hong Kong | | | | | | | | | | |
| Singapore | - | - | 528 | 642 | | | 76 | 56 | - | - |
| Korea | 618 | | 686 | | - | - | 440 | 703 | 20 | 21 |
| Brazil | 3,618 | 3,900 | 3,000 | 3,100 | 292 | | 77 | 148 | 100 | 145 |
| Australia | 768 | 707 | 2,451 | 2,472 | 29 | | 98 | 100 | 262 | 291 |
| New Zealand | 1,539 | 1,673 | 54 | 57 | 7 | | 18 | 21 | 43 | 51 |

Appendix 11.9

TABLE OF MATERIALS FLOW VARIABLES
TIMBER BASED INDUSTRIAL COMPLEX

$F_1$ = Merchantable sawlogs and peeler logs = 1000 $m^3$ (r)

$F_2$ = Primary waste = $x_{21} F_1$ = 0.45 x 1000 = 450$m^3$ (r)

$F_3$ = Pulpwood = $x_{31} F_1$ = 0.2 x 1000 = 200$m^3$ (r)

$W_1 = x_1 (F_1 + F_2 + F_3) = x_1^1 (F_1 + F_3) + x_1^{11} F_2$

= 0.035 x 1650 = 57.7 m.t.

A = Total to yard = $F_1 + F_2 + F_3 - W_1$ = 1650 $m^3$ (r)
(Bark is not counted in the round volumetric measure).

$A_2 = F_1$ = 1000 $m^3$ (r)

$A_3 = F_2 + F_3$ = 650 $m^3$ (r)

$L_1$ = Peeler logs = 450 $m^3$ (r)

$L_2$ = Sawlogs = 300 $m^3$ (r)

$S_1$ = Sale of logs (mainly for export) = $A_2 - L_1 - L_2$ = 250 $m^3$ (r)

$P_1$ = Veneer and plywood production = $x_{41} L_1$ = 0.5 x 450 = 225$m^3$
= 381 M sq.ft. (¼" basis).

$P_2$ = Sawnwood production = $x_{52} L_2$ = 0.575 x 300 = 172.5$m^3$ (s)

$W_2$ = "Solid" or "chipping" residues from sawmilling = $x_6 P_2$ =
= $0.32 \times 172.5 = 55.1\ m^3$

$W_3$ = "Solid" residues from plywood plant = $x_6 P_1 = 0.35 \times 225 = 78.7 m^3$

$W_4$ = Sawdust and other "non-chipping" residues from sawmilling = $L_2 - P_2 - W_2$
= $300 - 172.5 - 55.1 = 72.4\ m^3$

$W_5$ = Sawdust, etc. from plywood plant = $L_1 - P_1 - W_3$
= $450 - 225 - 78.7 = 146.3 m^3$

$P_3$ = Production of joinery, doors and other wood elements = $x_8 (B_1 + B_2 + B_3)$
= $0.701\ (2.8 + 3.5 + 2.7) = 6.3 m^3$

$S_9$ = Sales of joinery, doors and other elements = $P_3 = 6.3 m^3$

$W_6$ = Sawdust and other waste from wood elements plant = $B_1 + B_2 + B_3 - P_3$ =
= $9.0 - 6.3 = 2.7 m^3$

$B_1$ = 300 (1000 daily) x 2 x 8 x 2 = 9600 sq. ft (1/8" basis) = 4800 sq. ft. ¼"
= $2.8\ m^3$

$B_2$ = "Solid" residues from plywood plant fed to wood elements plant =
= $2.7 m^3$ (estimate)

$B_3$ = 2 x 1/6 x (2 x 8 + 3 x 2) x 200 (670 daily) = 1467 BF = 3.462m3
= 3.5m3

$S_2$ = Sales of veneer and plywood = $P_1 - B_1$ = 225 - 2.8 = 222.2m3 = 376.6 sq. ft.
(¼" basis)

$S_3$ = Sales of sawnwood = $P_2 - B_3 - B_5 = 172.5 - 3.5 - 15.0 = 154.0\ m^3(s)$

$B_4 = W_3 - B_2 = 78.7 - 2.7 = 76.0m^3$

$C_1$ = Primary waste and pulpwood diverted to parquet blocks plant

$= x_9 P_4 - B_5 = 1.783 \times 30 - 15.0 = 38.4m3$

$P_4$ = Production of parquet blocks = 30.0m3

$B_5$ = 15.2m3 (estimate)

$S_4 = P_4 = 30.0\ m^3$

$W_6$ = Sawdust waste from parquet plant = $x_{10} P_4 = 0.2 \times 30.0 = 6.0m^3$

$C_2 = A_3 - C_1 = 650.0 - 38.4 = 611.6m3$

$W_7$ = "Chipping" waste from parquet plant = $C_1 + B_5 - P_4 - W_6 = 38.4 + 15.0$

$- 30.0 - 6.0 = 17.4m^3$

$C_3 = C_2 + W_2 + W_7 + W_8 = 611.6 + 55.1 + 17.4 + 76.0 = 760.1m3$

$W_8 = B_4$

$W_9$ = Sawdust from chipping mills = $x_{11} C_3 = 0.05 \times 760.1 = 38.0m3$

$P_5$ = Chip production = $C_3 - W_9 = 760.1 - 38.3 = 722.1m3$

$D_1$ = Chip feed to pulp mill ($m^3$) = $P_5 - D_2$ = 722.1 - 77.3 = 644.8 $m^3$

$D_2$ = Chip feed to chipwood plant = $x_{12} P_6$ = 1.289 x 60.0 = 77.3 $m^3$

$P_6$ = Production of chipboard = 60.0 $m^3$

$S_6 = P_6$

$W_{10}$ = Waste from chipboard manufacture = $D_2 - P_6$ = 17.3 $m^3$

$P_7$ = Unbleached pulp production (m.t.) = $x_{13} D_1$ = 0.22 x 644.8 = 145.1 m.t.

$S_8$ = Sales of paper, total = $S_9 + S_{10}$ = 30.0 + 48.0 = 78.0 m.t.

$S_7$ = Sales of bleached pulp = 60.0 m.t.

$S_9$ = Sales of bleached paper = 30.0 m.t.

$S_{10}$ = Sales of unbleached kraft paper and containerboard = $S_{11} + S_{12}$ = 48.0 m.t.

$S_{11}$ = Sales of kraft paper and linerboard = 29.5 + 0.6 x 18.5 = 40.6 m.t.

$S'_{11}$ = Sales of kraft sack paper = 29.5 m.t.

$S'_{12}$ = Sales of containerboard = 18.5 m.t.

$S_{12}$ = Sales of corrugating medium = 0.4 x 18.5 = 7.4 m.t.

$F_5$ = Feed of purchased unbleached softwood long-fiber pulp to paper mill
= $x_{14} S_{11}$ = 0.27 x 40.6 = 10.9 m.t.

$D_4$ = Feed of own unbleached pulp to paper mill
= $x_{15} S_{10} - F_5$ = 1.07 x 48.0 - 10.9 = 51.4 - 10.9 = 40.5 m.t.

$D_5$ = Feed of bleached pulp from own mill = $x_{16} S_9 - F_6$ = 0.88 x 30 - 0.2 $D_5$
= 26.4 + 1.2 = 22.0 m.t.

$F_6$ = Feed of purchased bleachedpulp = $x_{19} D_5$ = 0.2 $D_5$ = 4.4 m.t.

$P_9$ = Production of bleached pulp = $D_5 + x_{18} S_7$ = 22.0 + 1.01 x 60.0 = 82.6

$D_3$ = Feed of own unbleached pulp to bleaching plant = $x_{17} P_9$ = 1.1 x 82.6
= 90.9 m.t.

$D_6$ = Surplus unbleached pulp = $P_7 - D_3 - D_4$ = 145.1 - 90.9 - 40.5 = 13.7 m.t.

$S_5$ = Sales of unbleached pulp = $D_6 x_{18}$ = 13.5 m.t.

$F_8$ = Binding agents for particle board manufacture = $x_{21} D_2^1$ = 0.09 x 77.3 x 0.7
= 4870 kg

$F_7$ = Binding agents and other chemicals for veneer and plywood production
= $x_{20}$.

$F_9$ = Chemical feed to bleaching plant =

$F_{10}$ = Chemical feed to paper mill

$F_{11}$ = Chemical feed to kraft pulp mill

## Technical Coefficients for Materials Flow Tables

| | |
|---|---|
| $x_2 = 0.45$ | (1) - III p.29 |
| | (11) - p.61 |
| $x_3 = 0.16$ | (1) - III p.29 |
| 0.20 | Adopted |
| $x_2 + x_3 = 1.00$ | (11) - p.61 |
| $x_1 = 0.064 m^3/m^3$ | (1) - 111 p.29 |
| $x'_1$ = 225 lbs. dry bark/cord pulpwood = 4.0 kg. dry/$m^3$ (r) | (12) p.140 |
| = 1225 lbs. 80% wet bark/cord pulpwood | |
| $x_1$ = 0.035 t.m./$m^3$ (r) (dry basis) | Adopted |
| $x_4 = 0.45 - 0.50$ | (13) p.112 |
| = 0.50 | (1) - 111 p.29 |
| = 0.45 - 0.52 | (2) - 110 |
| = 60000 m ¼" sq. ft./40 580 timber tons = | |
| = 35 400 $m^3$/56800 $m^3$ = 0.62 | (3) - An 24 |
| = 0.50 | Adopted |
| $x_5 = 0.617$ | (3) - An. 24 |
| = 0.50 | (1) - III p.29 |

| | |
|---|---|
| = 0.563/.632 (European sawmilling industry) | (13) - p.95 |
| = 1/182 = 0.55 | (6) - p.211 |
| = 0.575 | Adopted |
| $x_6$ = 0.4 | (1) - III p.29 |
| = 0.388 | (13) - p.94 |
| = 0.215 | (8) - p.117 |
| = 0.32 | Adopted |
| $x_6$ = 0.35 | Adopted |
| $x_7$ = 0.04 | (1) - III p.29 |
| $x_8$ = (1 - 0.299) = 0.701 | (8) - p.364 |
| $x_9$ = 7.4/4.15 = 1.783 | (7) - p.12 |
| $x_{10}$ = 0.2 (estimated) | |
| $x_{11}$ = 0.05 | Adopted |
| = 0.05/0.06 | (18) - p 117 |
| $x_{12}$ = 1 (1 - 0.224) = 1.289 | (8) - p.248 |

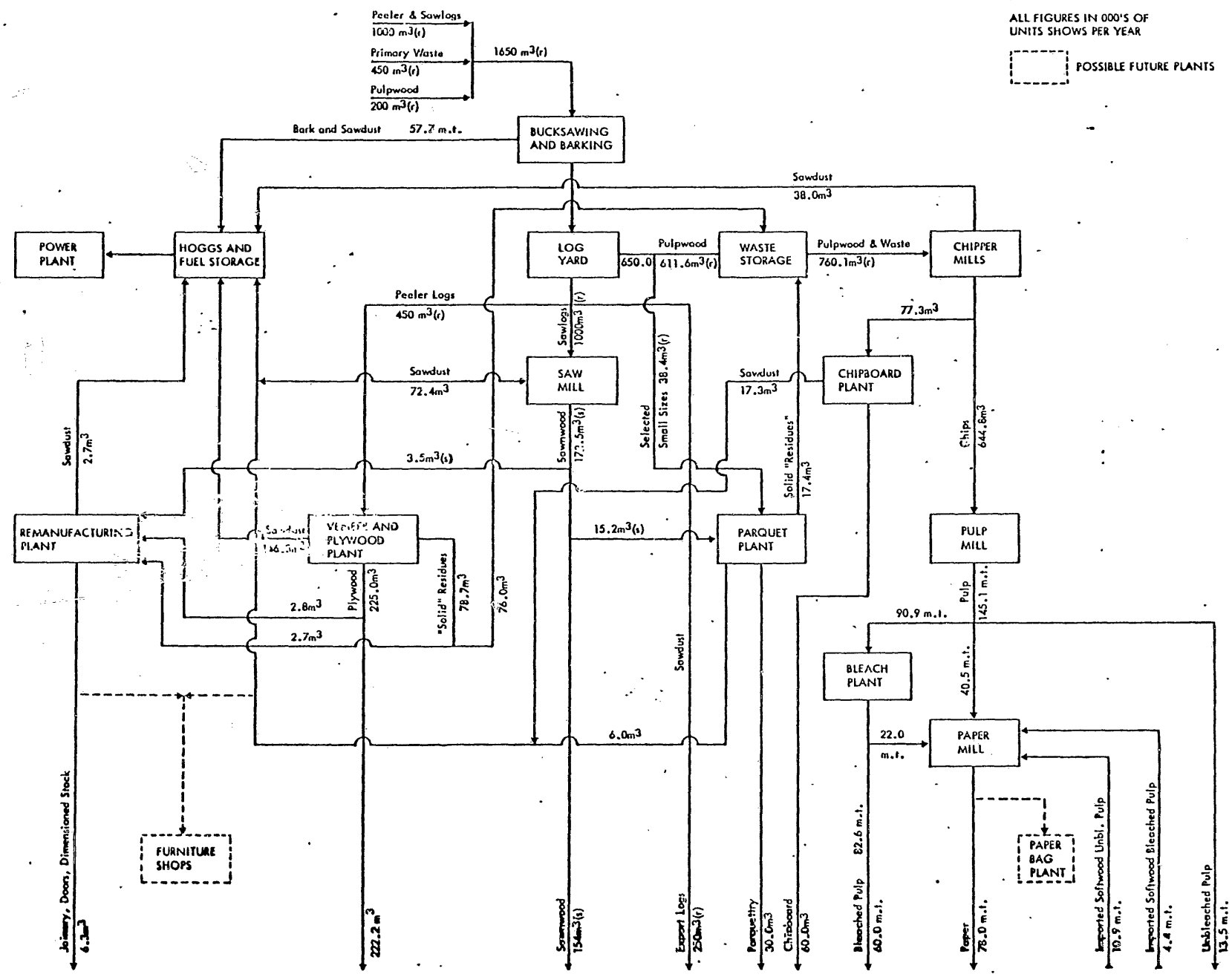
| | | |
|---|---|---|
| $x_{13}$ = 1 ÷ (1.72 cords chips/ton wood pulp) = 1/4.39 = 0.228 | (1) - | p.49 |
| = 1/4.8= 0.208 | (6) - | p.211 |
| = 1 ÷ (6.4/1.6) = 0.25 | (14) - | p.20 |
| = 0.225 | Adopted | |
| $x_{14}$ = 0.27 | (1) - | p.49 |
| = 0.31 | (14) - | Ap. 5-6 |
| = 0.267 | (15) - | p.15 |
| = 0.27 | Adopted | |
| $x_{15}$ = 1.07 | (1) - | p.49 |
| 1.04 | (14) - | Ap. 5 |
| 1.07 | Adopted | |
| $x_{16}$ = 0.257 | (14) - | Ap. 5 |
| 0.25 | Adopted | |
| $x_{17}$ = 1.10 | (1) - | p.49 |
| = 1.094 | (14) - | Ap. 5 |
| = 1.10 | Adopted | |

| | |
|---|---|
| $x_{18} = 1.01$ | (14) - Ap. 5 |
| $x_{19} = 0.11$ | (15) - p.16 |
| $= 0.257$ | (14) - Ap. 5 - 5 |
| $= 0.20$ | Adopted |
| $x_{20} = 0.08/0.10$ | (17) - Paper 3.7 p.1 |

# INDUSTRIAL TIMBER INDUSTRIES COMPLEX

## FLOW SHEET

GRAPH NO. 11.01




IBRD - 6101

# CHAPTER XII

## THE MINERAL INDUSTRY

12.1 Mineral resources of Indonesia are far from being extensively exploited. Most of the present production comes from deposits which have been known for over 50 years, others have yet to be developed. Under the present mineral development program, many of these deposits have been taken up by foreign companies, and plans for their development are under way. To date, two new mineral discoveries have reportedly been made (INCO's low grade sulfide ore body and Kennecott ore body). Within the next five years, foreign investment in mineral development will amount to an estimated $750 million. Earnings from mineral exports are expected to double within the next ten years.

12.2 Foreign technological and financial ability as well as proprietory "know how" are needed to develop some of the complex mineral deposits. In these as well as other mineral deposits, the best return on investment is in the sale of the mineral. Although most of the existing agreements are called "Contract of Work" they are essentially "Lease" type wherein the Government receives only royalty and tax revenue. Therefore, in the interest of receiving the largest return from its natural resources, the Government may wish to review its policy of agreements and consider other types of contracts such as "Participation" or "Partnership," or a true "Contract of Work" whereby sharing some of the financial responsibility, or financing of a project, the Government will receive a greater return from its natural resources. These points are developed later in this chapter.

12.3 The discussion starts with a consideration of the operation of the state enterprises in the mineral field; certain problems are identified and suggestions are made for improvements and for additional assistance. Special attention is then directed to the potential for development of coal at Bukit Asam, and a number of alternatives are briefly presented. Finally, an analysis of the Ombilin coal project is undertaken and present plans for the contract of work and for the development of the project are assessed. It is suggested that an alternative capital development plan is likely to be superior to the one now contemplated.

### TIN MINING AND THE OPERATIONS OF P. N. TAMBANG TIMAH

12.4 Tin mining perhaps has the longest history in the country. Since 1816 tin has been mined on the island of Bangka. Today, tin is being mined onshore as well as offshore on the islands of Bangka, Bilitung, and Singkep. Timah has a total offshore concession area of 33,000 square kilometers. The present tin production comes from about

130 workings (both onshore and offshore) from the islands of Bangka, Bilitung, and Singkep. Offshore, various size dredges are used, and they account for the majority of production. Land operations include open-pit and hydraulic mining of surface and near surface alluvial placer type deposits. Small amounts of primary ore are being mined. Exploration is underway to evaluate the feasibility of mining the lower-grade, primary deposits.

Production and Costs

12.5 There are a total of 34 sea and land dredges ranging in capacity from 5 to 18 cubic feet. Their ages range from 1925 to 1970. Most of the offshore dredges are of the 14 to 18 cubic feet capacity. The maximum mining depth of the dredges is 40 meters, and this can only be done with the 18 cubic foot dredge. The smaller dredges can only mine to a depth of 30 meters. Dredges account for 60 percent of the production, and the land operations account for the remaining 40 percent. Production costs of dredging are about $0.18 per cubic meter and hydraulic mining costs about $0.67 per cubic meter. The ore is processed on the dredges by washing followed by three stages of jigging. The concentrate, containing 50 percent tin, is transported to the island for further concentration at central washing plants where tabling, magnetic, and high-intensity separators produce a 68-72 percent tin concentrate. The ore dredged contains about 0.3 kilograms of tin per cubic meter. It ranges in size from 48 mesh to about 200. Recovery of tin ore is only up to 150 mesh, and the remainder is lost in slimes. An estimated 20 percent of the contained tin in the ore is lost in the slimes (-150 mesh). At present there is a study underway to improve the recovery and cut down on the loss of tin in the slimes.

12.6 Timah estimates that it will produce 19,552,000 kilos of tin metal in 1971. In 1970 Timah had 28,000 people on its payroll, most of whom were laborers whose average wage was about $1 per day. However, there are welfare benefits such as family allowances, food, fuel, housing allowances, etc., the cost of which well exceeds the $1 a day wage.

12.7 Currently, Timah is undergoing a large exploration program to locate and evaluate new offshore tin reserves. The aim of this exploration program is to establish proven offshore ore reserves until the year 2000. The exploration program, which started in April, 1970, will take an estimated eight years to complete. The total cost of this exploration program is expected to be $5.7 million; $4.6 million will be financed by Timah and $1.1 million through technical aid of the Dutch Government. The Dutch firm of Sesco N. V., Coastal Engineering Survey Consultants has been contracted to do the initial exploration.

Table 12.1 Tin Production in 1967-1970
(Kilograms of Tin Metal)

| Source of Ore | 1967 | 1968 | 1969 | 1970 |
|---|---|---|---|---|
| Bangka Island | | | | |
| Dredges | 3,918,700 | 4,980,100 | 4,572,500 | 5,223,500 |
| Hydraulic mining | 3,466,500 | 4,321,900 | 5,456,000 | 5,249,700 |
| Primary ore | 375,100 | 502,000 | 328,000 | 314,400 |
| Dismantable dredges | 467,900 | 555,700 | 558,700 | 616,700 |
| Slag (recirculated) | 270,600 | 890,100 | 873,900 | 827,300 |
| Miscellaneous | 163,900 | 439,100 | 484,200 | 902,000 |
| Subtotal | 8,662,700 | 11,688,900 | 12,273,300 | 13,133,600 |
| Bilitung | | | | |
| Dredges | 3,289,935 | 2,889,888 | 2,880,865 | 3,169,208 |
| Hydraulic mining | 1,043,027 | 1,194,699 | 1,279,541 | 1,334,355 |
| Dismantable dredges | 21,641 | 70,555 | 53,204 | 93,994 |
| Miscellaneous | 154,258 | 453,525 | 434,528 | 515,466 |
| Subtotal | 4,508,861 | 4,608,667 | 4,648,138 | 5,113,023 |
| Singkep | | | | |
| Dredges | 363,582 | 275,654 | 428,474 | 774,946 |
| Hydraulic mining | 276,802 | 279,122 | 363,061 | 403,935 |
| Miscellaneous | 15,127 | 41,760 | 321,455 | 174,856 |
| Subtotal | 655,511 | 596,536 | 1,112,990 | 1,353,737 |
| TOTAL | 13,827,072 | 16,894,103 | 18,034,428 | 19,600,360 |

The exploration program will be done in four major steps, reconnaissance surveys, scout surveys, detail survey, and drilling for reserves. The 33,000 square kilometers of offshore concession will be delineated into areas of possible interest, special interest, and those deemed most promising. Drilling will be used to evaluate these areas and to determine the extent of ore reserves. About 3,000 drill holes are expected to be completed during the entire project.

12.8 The cut-off grade for offshore reserves is 0.2 kilograms of tin per cubic meter of ore and 0.3 kilograms per cubic meter of ore for the land deposits. Based on these grades, Timah has sufficient proven reserves for the next twenty years at the current level of production. Reserves are reported on the basis of contained tin, not on the volume of ore. The 1969 reserves were as follows:

Possible Plus Proven Ore Reserves, 1970
(metric tons of tin)

| | |
|---|---|
| Bangka Island | 375,000 |
| Bilitung Island | 170,000 |
| Singkep | 23,000 |
| | 568,000 |

In 1970 an additional 30,000 metric tons of tin were added to the reserves, and 19,000 tons were mined; thus, the current reserves of possible and proven ore is 579,000 metric tons of tin. An estimated 60 percent of this is proven ore.

12.9 The three main mining areas of Bangka, Bilitung and Singkep are managed independently of each other. Therefore, the Djakarta office receives three sets of production costs. These are adjusted for accounting purposes. There is insufficient information on hand to account for the rationale of the cost figure adjustment by the Djakarta office; however, the adjustment of these costs has a significant impact on the reported profit and taxes.

Direct and Indirect Mining Production Costs
As Reported by the Field Operations (1970)

| | Bangka | Bilitung | Singkep | |
|---|---|---|---|---|
| General Cost 1/ | $ 4,952,000 | $12,045,000 | $3,337,000 | $20,334,000 |
| Hydraulic Mining | 5,148,000 | 2,710,000 | 550,000-- | |
| Dredging 2/ | 4,107,000 | 3,739,000 | 1,062,000-- | -18,774,000 |
| Other mines 3/ | 714,000 | 541,000 | 203,000-- | |
| Depreciation | 5,043,000 | 279,000 | 555,000 | 5,877,000 4/ |
| | $19,964,000 | $19,314,000 | $5,707,000 | $44,985,000 5/ |

12.10 In their end of the year statement, Djakarta adjusted the field operations direct and indirect mining production costs to $23,998,000 6/, and added $10,735,000 for other operational costs which were as follows:

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1/ Includes direct and indirect cost of field management, personnel, social allowances, exploration, telephone, travel, road building, warehouse, electrical costs, transportation of ore, etc.

2/ Includes dismountable dredges.

3/ Includes contractors.

4/ Depreciation taken by field offices.

5/ Exchange rates used: 1968: 258 Rupiah to $1
1969: 328 Rupiah to $1
1970: 382 Rupiah to $1
These rates are based on cost data from Timah where Rupiah figures were converted to dollars. Some differences may result due to rounding.

6/ This amount includes the depreciation schedule set up by Djakarta of $4,590,000 for Bangka, $2,398,000 for Bilitung, and $653,000 for Singkep.

| | |
|---|---|
| Export tax | $ 6,507,000 |
| General sales tax 1/ | 2,169,000 |
| Djakarta operating costs | 915,000 |
| Smelting costs 2/ | 898,000 |
| Local tax | 202,000 |
| Miscellaneous | 44,000 |
| Total | $10,735,000 |

Including mining costs, and other indirect operational expenses, Timah reported a total production cost of $43,733,000 in 1970.

12.11 The difference between the field operation costs and Djakarta adjusted costs is in excess of $10 million. Since analysis of costs received from Timah were not made until after the Mission was completed, no reasonable explanation can be given for such a large variation. If the field operation costs are valid, the striking point is the large indirect cost as contrasted to direct mining cost. This condition is incongruous with normal mining operations where general or indirect costs are usually less than one-third of direct mining costs.

12.12 Most of the difficulties in tin smelting operations are caused by the rebellious nature of highly heated tin metal. In as much as the smelter has only one ore to deal with, the metallurgy of tin should be comparatively simple. Its reduction is generally accomplished by the use of carbonaceous materials. However, at temperatures of 1200° to 1300° C. several problems occur: oxides of other metals that may be present are also reduced, these in turn may produce troublesome tin alloys, and unless carefully regulated, furnace linings are attached. Siliceous acid linings cause tin silicates to be formed; basic linings of lime or magnesia result in losses as stannates, and a considerable amount of tin invariably combines with silica in the flux, and goes into the slag if an acid slag is used. If basic slag is used, the tin oxide will act as acid and also enter the slag. Tin in the slags may run 10 to 25 percent tin. The slag with high tin content (10-25 percent) is recycled into the same or another furnace for the recovery of any additional tin. In addition, at elevated temperatures tin is more fluid than mercury is at ordinary temperatures, and it escapes into the most minute openings as well as soaking into the porous refractory linings. Although there are a number of smelting processes, the most conventional way of smelting tin is in reverberatory

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1/ Includes transportation and toll smelting charges at Panang.

2/ Includes depreciation of $530,000.

furnaces followed by refining through heat reatment or an electrolytic process. The heat treatment is the most widely used.

12.13 The Timah smelter is a departure from the conventional type in that instead of reverberatory shaft furnaces, they have a rotating furnace. The initial design capacity of the smelter was for 25,000 metric tons of metal. Current indications are that it has a maximum capacity of only 13,500 metric tons of metal. The smelter produced 5,994 metric tons of metal in 1969, and 5,190 metric tons in 1970. Smelting costs per kilo of metal produced in 1969 were 0.22 cents and in 1970 they were 0.23 cents. This is based on operating costs which include depreciation. At present, it is less expensive for Timah to have their concentrates smelted on toll basis at Eastern Smelting Company Ltd. at Penang in Malaya than in their own smelter. This suggests the need to reexamine the operation of the smelter to upgrade performance and to make whatever technical changes are necessary.

Marketing

12.14 Tin is one of the four commodities the world market prices of which are presently subject to control by an international commodity agreement, which includes provisions for a buffer stock. The first International Tin Agreement (I.T.A.) of 1932 was extended in 1936 and remained in effect until 1942. At that time a governmental body of allied countries took over the control of production, distribution, and prices during World War II and the immediate postwar period through 1949. The first postwar I.T.A. agreement entered into force in 1956 for a five-year term, and a second and third agreement succeeded in 1961 and 1966. The third agreement will end on July 1, 1971. The main objective of the agreement is to stabilize the prices of tin. This is done by exportation quotas imposed on producing countries and deliveries to a buffer stock. The exportation quotas are linked to the accumulation of tin stocks. Under the agreement, the I.T.A. buffer stock manager must offer tin for sale, if he has tin available, when the price is at or above a pre-set ceiling. When the price is below the ceiling price, he must buy tin if he has funds. In October, 1970, the floor and ceiling prices for the new agreement beginning in 1971 were tentatively established by I.T.A. They are as follows:

| | Old (per ton of metal) | New (per ton of metal) |
|---|---|---|
| Floor Price | 1,250 Pounds Sterling | 1,350 Pounds Sterling |
| Ceiling Price | 1,605 " " | 1,650 " " 1/ |

1/ This is about $3.96 per kilo.

The current price of tin is 1,469 pounds Sterling per ton of metal with no restrictions on exports.

12.15 Some of the marketing problems facing Indonesian tin are the practically stagnant world demand for tin; producer reactions in response to changes in demand, which may lead to unbalance in supply and demand; and strategic stock pile purchases and sales of the centrally planned countries as well as changes in their trade pattern. Since 1968, when the last shipment of Timah concentrate was shipped to Europe for smelting, there has been some shift in the marketing of Indonesian tin; Japan is now a more favorable place to market their product. The United States, however, is still the main market, having imported about 5,000 tons in 1970. Timah markets its product directly to large U.S. Steel producers. Most of the contracts are for one year and are flexible in the amounts delivered.

12.16 Based on tin consumption in the last 20 years, the trend indicates a consumption of about 190,000 tons of tin metal in the year 2000 1/ In 1969 the consumption was about 162,000 tons. If the historical trend is accurate, this will mean an increase in the world tin consumption of about 1,000 tons per annum for the next thirty years, or a trend rising less than 1% per year. This is a contrast to the demand forecasts for most other metals. Six countries, including Indonesia, account for about 90 percent of the total mine production and exportation of tin. Malaysia and Thailand have been increasing their production at a more accelerated rate than Indonesia. Eventually, there may be a limitation on how much tin can be produced for exportation by Indonesia.

12.17 In 1970 Timah reported the following income:

| | |
|---|---|
| Sale of Tin | $64,995,000 |
| Interest from investments and other income | 121,000 |
| Total | $65,116,000 |
| Reported Operating Costs | $43,733,000 |
| Profit before Taxes | $21,383,000 |

Based on a 45 percent corporate tax, Timah's tax obligation for 1970 was $9,622,000. But, by virtue of a re-investment privilege, Timah actually paid only $2,178,000 in taxes in 1970. Since the taxes are pre-paid, and since auditing is about two years behind as well as subject to negotiations, Timah may even get back some money from the 1970 taxes they have already paid.

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1/ U. S. Bureau of Mines, Mineral Facts and Problems Bulletin No. 650.

Rehabilitation of Operational Equipment

12.18 Timah's rehabilitation program is a key to future success and it is not moving along as rapidly as originally planned. Of the total request for $47 million of aid, only $7 to $8 million have been committed to date by the donor nations. For obvious reasons, the "know how" for the rehabilitation of equipment, particularly the dredges, lies in the countries where they were purchased. Most of the equipment in question came from the Netherlands, United Kingdom, and the United States. Time schedules have been set up for the rehabilitation of Timah dredges and other equipment; but the rate at which aid has been received has already delayed the program about two years.

12.19 At the present rate of progress, the five-year, $49 million rehabilitation program scheduled will never be realized. To date, only one dredge has been rehabilitated. Since Timah has not found the flow of foreign aid rapid enough for its planned rehabilitation, they are using internal funds for rehabilitation and expansion.

Conclusions

12.20 Assuming that the Field Operations reported cost of production was true ($44,996,000), with the "other operational" expenses ($10,735,000), plus taxes ($4,223,000)1/ the total operating cost would be $59,954,000. Based on a gross income of $65,116,000, Timah profit in 1970 would only be $5,162,000. Timah could be much more profitable. It is evident that the high overhead costs and the employment of 28,000 people would have to be reduced to increase the profitability of the operation. It appears that profitability might be increased by $10 million if the overhead costs could be scaled down to a more realistic level typical of this type of mining operation. It should be pointed out that this increase in profit would provide foreign exchange, a part of which could be used for other development needs, since the tax laws provide that one-quarter of profit remaining after tax shall be paid to the general development fund. Not only would a more efficient operation increase profitability, but world tin market conditions may develop that would make it necessary to operate more efficiently.

12.21 Administrative efficiency and technical competency need to be developed to cope with operations problems of Timah. The smelting operations are particularly in need of technical assistance. It is suggested that assistance in two areas (a) management and scheduling of operations, and (b) technical operation of the smelter would be desirable. Teams of experts should be deployed with Timah for at

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1/ Assuming no reinvestment privilege.

six months to make detailed analyses of the operations and to determine specific recommendations for improvement of this enterprise.

## COAL MINING AND THE OPERATIONS OF P. N. TAMBANG BATUBARA

12.22 Indonesia is rich in coal. The major coal deposits are located on the islands of Sumatra and Kalimantan. There are also deposits on the islands of Java, Sulawesi, and West Irian. The Ombilin and the Bukit Asam deposts on Sumatra and the Mahakam deposit in eastern Kalimantan are all operated by the State Enterprise P. N. Tambang Batubara. However, the present condition of the coal industry is distressing. Only two unprofitable coal mines are still in operation, Bukit Asam and Ombilin. The future development of these two mines are actively under consideration and an evaluation of the alternatives, including a consideration of the participation or role of the Government, forms the main part of this section.

### Bukit Asam

12.23 The Bukit Asam deposits, located in the foothills of the central mountain range, are about 145 kilometers southwest of Palembang, which is connected with the mine by a 160 kilometer railroad. A road that once connected these two points was completely destroyed several years ago. Mining of coal started in 1919. To date, total production from the mine has been about 19 million metric tons. All but 3 million tons came from strip mine operations. The principal coal beds are as follows:

| | Thickness (meters) |
|---|---|
| Upper Coal Bed Series | |
| Lignite coal beds, one to six in number, lenticular in occurrence, ranging from a few centimeters to 25 meters in thickness, separated by partings that range from one to 50 meters in thickness of sedimentary strata . . . . . | 85 - 150 |
| Middle Coal Bed Series | |
| Mangus ("A") Coal bed | |
| Top coal bench (A-1). . . . . | 6.5 - 8.5 |
| Parting, sedimentary strata . . . . . | 3.0 - 5.0 |
| Bottom coal bench (A-2) . . . . . | 7.0 - 10.0 |
| Interval, sedimentary strata . . . . . | 15.0 - 18.0 |
| Suban ("B") coal bed | |
| Top coal bench (b-1). . . . . | 7.0 - 9.5 |
| Parting, sedimentary strata . . . . . | 1.5 - 3.0 |
| Bottom Coal bench (B-2) . . . . . | 2.0 - 4.0 |
| Interval, sedimentary strata . . . . . | 30.0 - 35.0 |
| Petai ("C") coal bed. . . . . | 6.0 - 7.5 |
| Interval, sedimentary strata . . . . . | 250.0-250.0 |
| Lower Coal Bed Series | |
| Merapi ("D") coal bed. . . . . | 8.0 - 10.0 |

12.24 Coal is now mined at the Air Laja strip-mine area. The overburden is removed from the A-1 bed by wheel excavators and by small power shovels and tractors. The exposed coal is loaded by power shovels onto conveyors that transport the coal to a discharge station on the eastern rim of the pit. The A-2 bed is mined in a similar fashion. From this point the coal is hauled by electric locomotives in trains of small mine cars over a narrow-guage railroad track to the screening and cleaning plant, a little more than four kilometers away. Approximately 60 percent of the run of the mine coal is under 30 mm; 50 percent is under 20 mm.

12.25 The operating equipment and the plant equipment are in a deteriorated state. The ore dressing plant is over 50 years old, and there is a chronic shortage of spare parts and materials. The inefficiencies stem not only from the use of deteriorated equipment but also from techniques and operating procedures. One half of the production cost is for labor. Operating costs are about Rp. 5,600 ($14.93) per metric ton. Selling price is about Rp. 3,300 ($8.80) per metric ton. The mine had a net loss of $240,000 in 1970 on an output of 54,000 tons. Prior to 1968 the Government made up the company's losses. In 1969 the Government gave Rp. 700 million to the mine; Rp 300 million was to cover the direct cost of running the mine. The remainder was to be used as working capital. This loan was paid back in 1971. Under the present agreement between the Minister of Mines and the Minister of Finance, the State-owned railroad refunded Rp 529 million in transport charges to the coal operation in 1970 to make up the difference between production costs and selling price.

Quality of the Coal and Reserves

12.26 Though geologically very young (pliocene) the Bukit Asam coal field has attained subbituminous rank through low temperature thermal transformation from the local intrusives. Transformations, however, have not all been uniform, and the quality of coal varies from lignite (brown coal) to anthracite. The quality of the coal from the current operations at Air Laja is transitional in rank between high-volatile bituminous coal and subbituminous. Because of the various degrees of metamorphism of the coal in situ, analyses vary over an appreciable range. As a result, it is difficult to determine the exact "average" of the coal's quality. Samples taken by J. G. White Corporation (1951) and Paul Weir Company (1962) and analyzed by U. S. Bureau of Mines, and a commerical testing company in the U. S. indicate a B.t.u. range from 11,000 - 13,000, ash 3-10 percent, volatile matter 35-40, fixed carbon 44-51 and sulphur 0.35 percent. Every report written on Bukit Asam stresses the excellent quality of this deposit as a steam coal.

12.27 In the early 1950's investigations were made by the Indonesian government to determine sources of coking coal, or processes for forming metallurgical coke from semicoking coal. Between 1955 and 1957 a comprehensive study for determining the coking properties of Indonesian coals from various fields was conducted by Wedexro, Dusseldorf, Germany. Coal seams in the Bukit Asam and Ombilin fields of Sumatra, as well as in southwest Java and southeast Kalimantan, were investigated. Findings indicated that none of the coals that were investigated showed strong coking characteristics, but the coals in some of the fields had moderate or fair coking properties. They referred to Ombilin and southest Kalimantan as having more strongly coking coals than those of Bukit Asam.

12.28 Exploratory efforts have been limited to the immediate vicinity of the present operations. No exploration has attempted to fully delineate the coal field, determine the full extent of the stripable coal, or determine the amount of lignitic coal there is in the deposit. Batubara engineers indicate that in the vicinity there are "billions" of tons of low-grade stripable coal with a B.t.u. content of less than 10,000 (lignite). The estimated reserves are as shown below:

A. Recoverable Reserves by Strip Mining
(In millions of metric tons)

| Area | Coal Bed | Recoverable coal (metric tons) | Overburden Ratio 1/ | Classification of reserves |
|---|---|---|---|---|
| Air Laja | A & B | 29 | 1.82:1 | Proved |
| Kelawa | A,B,C | 8 | 2:1 | Probable |
| | | 37 | | |

B. Recoverable Reserves by Underground Methods
(In millions of metric tons)

| Area | Coal Beds | In Place | Recoverable 2/ | Classification of reserves |
|---|---|---|---|---|
| Central | A,B,C | 41 | 16 | Proved and probable |
| Southwest | A,B,C | 68 | 24 | Probable |
| Northwest | A,B,C | 133 | 49 | Proved |
| Northeast | A,B,C | 83 | 30 | Proved |
| | | 325 | 119 | |

1/ Cubic meters of overburden per metric ton of recovered coal.

2/ Conservative percentage of recovery is based on the physical mining conditions and a reasonable cost of mining methods.

Although the reserves are very large and the quality is good, there is very little present domestic demand for this coal other than the small amount consumed by the State- owned South Sumatra railroad and the thermal power plant at Bangka Island. The question is what sort of development of the mine is feasible.

Development Alternatives:

12.29 There are at least three alternatives that might be considered in further development of Bukit Asam coal, though the third is a combination of the other two: (a) develop the mine solely for export of the coal; (b) develop the mining operation to supply coal for electric power generation at the mine-head with the major consumer of the power possibly being a large aluminum smelter (in addition to the one now being considered as part of Asahan hydropower development; or (c) combine the possibilities to involve both power generation and some export. The last alternative might permit a larger output and hence lower costs than either of the other two alone. This is examined later.

12.30 All of the alternatives, to be really feasible, require a greatly enlarged output of the mine, ranging probably between 1-3 million tons annually. The fixed investment and operating costs for increasing output to these levels are estimated below. They are the basis for a later consideration of the alternatives. Obviously, if there is to be extensive export, there will be other costs involved in transport, handling, and shipping the coal. The cost estimates have been prepared based on the following assumptions regarding physical conditions:

(a) Overburden varies from outcrop to a maximum thickness of 120 feet (about 37 meters) with an average depth of 80 feet (about 24 meters).

(b) Coal seam is 5 feet thick (about 1.5 meters).

(c) A large portion of the overburden is composed of hard strata such as limestone, sandstone and cemented lime shale.

(d) Terrain varies from rolling to steeply pitching hills.

12.31 On these assumptions the fixed and operating costs, in total and per ton are estimated as follows:

Fixed Investment

| | Production (metric tons per year) 1,000,000 | 2,000,000 | 3,000,000 |
|---|---|---|---|
| Stripping machines | $11,685,000 | $15,065,000 | $18,445,000 |
| Haulage, roads, utility vehicles, buildings | 1,354,000 | 2,031,000 | 2,690,000 |
| Overburden, drilling, and blasting equipment | 290,000 | 390,000 | 490,000 |
| Drainage, refuse, bos cut, development expenses, contingencies | 1,260,000 | 1,950,000 | 2,650,000 |
| Additional contingency for installation in Indonesia | 2,000,000 | 2,000,000 | 2,000,000 |
| Total capital cost | $16,580,000 | $21,436,000 | $26,275,000 |

Operating Costs

| | Cost per Ton of Coal Based On 1,000,000 MT/y | 2,000,000 MT/y | 3,000,000 MT/y |
|---|---|---|---|
| Labor | $0.677 | $0.577 | $0.500 |
| Materials | 0.800 | 0.800 | 0.800 |
| Union Welfare | 0.400 | 0.400 | 0.400 |
| General Administration | 0.200 | 0.200 | 0.200 |
| Sales and Marketing | 0.030 | 0.030 | 0.030 |
| Insurance | 0.035 | 0.035 | 0.035 |
| Total Operating and other Costs | $2.142 1/ | $2.042 1/ | $1.965 1/ |
| Fixed cost allocation | $2.487 2/ | $1.608 2/ | $1.214 2/ |
| Total cost per ton | $4.629 | $3.650 | $3.179 |

1/ Costs do not include royalty or power costs.

2/ Based on 15% of investment. This includes return on capital, depreciation, and insurance. Current practice is to use 20% for fixed charges, which includes all above mentioned items and taxes. In this case, taxes were omitted.

Alternative I: Export as Steam Coal

12.32 Although Bukit Asam does not have the favorable metallurgical characteristics as Ombilin coal, it does have export potential as a steam coal. However, any plan of developing the coal mine to service an export market should give consideration to the conditions of the railroad and the port of loading facilities, and the additional costs that may be incurred.

12.33 All the coal from Bukit Asam is shipped out on the Southern Sumatra Railroad (a division of the State Railway Service). The eastern terminus of this railway is at Kertapati, a deep-water channel in the Musi River, which is opposite the city of Palembang. The Sumatra Railroad has been in a deplorable state concerning both its trackage and its rolling stock. Under the 1959 Development Loan Fund, the conditions of the rails and road beds were improved. The old lightweight (28-30 kilograms per meter) rails were replaced early in the 1960's with 38 kilograms-per-meter rails. These welded 85-meter sections are an improvement; however, they are medium-weight rails and are not serviceable for extensive heavy traffic or on any excessive gradients. The weight of rail required in mineral transportation with heavy rolling stock on standard track and with any gradient is between 50 to 60 kilograms per meter. The rolling stock now used for coal is composed of 50-year old steam locomotives. Most of the 500 coal carrying cars are unavailable for service. These steam locomotives are capable of moving only 450 tons on each run. Thus for any extensive tonnage there would have to be new investment in rebuilding track and replacing rolling stock.

12.34 Assuming that the port now is capable of handling one million tons a year for export and the State Railroad improves its rolling stock to accommodate this volume of coal transport to the dock without improving the rails and road bed, and charges Batubara 0.0125 cents per ton mile 1/, the additional cost per ton of coal would be $1.50.

12.35 Steam coal does not command the same price as metallurgical coal. The average price in the U.S. for bituminous coal (steam coal) in 1969 was $4.90 F.o.b. Bukit Asam may be able to command a F.o.b. price of $7.00 per ton. With a possible operating cost of $4.629 per ton plus $1.50 per ton for transportation, the total operating cost might be $6.13. Before taxes the mine might realize about $1 million profit per year. It is very unlikely that any greater tonnage could be handled without greatly increasing the costs of rehabilitation of the railroad and the port. As is shown in the section on Ombilin coal, a pipeline might be considered as an alternative to the railroad.

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1/ See Ombilin section.

12.36 The Mission did not attempt to make detailed estimates of the investment and operating costs to achieve export levels of 2-3 million tons annually, and the estimate that 1 million tons might be achieved without large new expenditures is speculative. This alternative deserves further analysis; the material and arguments presented in the case of Ombilin coal apply, in many instances, to Bukit Asam, and reference should be made to that section of this chapter. In any case, a successful export operation would undoubtedly require the technical and financial assistance and participation of a knowledgeable coal producer. Such a company could undertake the detailed economic and technical evaluations of the project.

Alternative II: Electric power generation at the mine

12.37 Among the several large coal fields of Indonesia, the Bukit Asam deposit has all of the favorable characteristics for use as direct feed fuel (as mined, no washing) for a mine-mouth-plant operation (electrical generating plant at the mine site). From what is known about the coal reserves of this deposit, there are 37 million metric tons of coal. The mine run coal as received, has a B.t.u. range of 10,000 to 12,000. It is low in ash (less than 10%) and low in sulphur (less than ½%). It is ideal coal for a steam plant. There are additional tons of proven and probable coal reserves (minable by underground methods) of 325 million metric tons of which at least 119 million metric tons are recoverable.

12.38 For the establishment of a mine-head electric power generating plant to look attractive, the costs of power by this means must be competitive with alternative sources of power, and there must be a major consumer to take the majority of power that is generated. In the analysis that follows, preliminary calculations indicate that the cost of power may well be competitive, and it is suggested that the extent of the bauxite discoveries will justify the existence of two aluminum smelters in Indonesia.

12.39 There are large bauxite deposits now being worked on Bintan Island and larger new discoveries have been made on Kalimantan. The companies involved have planned the establishment of smelters with capacities initially in the range of 200,000 tons per year, and probably expandable up to 360,000 tons. It is obvious that one of these smelters will secure its electric power needs from the Asahan hydropower potential and some steps have been taken to secure the development of hydropower facilities plus a smelter in a single package. Therefore, alternative sources of power must be considered to encourage the erection of a second aluminum reduction plant.

12.40 A 200,000 metric ton aluminum reduction plant requires about 450 megawatts of power. To generate this amount of power, it takes about two million metric tons of coal. This amount of coal can readily be supplied by Bukit Asam coal from its large reserves, possibly at a cost per kilowatt comparable to power generated at Asahan.

12.41 Between 1960 and 1967, in the United States, 56 non-Government and Government hydroelectric plants were constructed and started operating. The average investment cost per kilowatt was $300. Investment costs per kilowatt in eight U.S. non-Federal plants constructed in 1968 ranged from $90 to $422. Conditions out of the ordinary can escalate investment costs rapidly. Based on present day costs it is likely that power from Asahan will be available at around four mills per kilowatt. This is a rough judgment and is not based on specific analysis of the data.

12.42 In the United States typical capital investment for a lignite burning mine-head plant with an installed generating capacity of 240 megawatts was $29,270,000 or $122 per kilowatt of installed capacity. This includes equipment cost of $22,260,000; structures $6,810,000; and land $200,000. A plant such as this started operating in 1966. The investment for similar plants ranges from $100 per kilowatt for large plants and $155 per kilowatt for small plants.

12.43 Based on the Bukit Asam mine producing two million tons of coal a year at a production cost of $3.63 per ton as estimated earlier, a mine site thermal plant installed at $150 per kilowatt, may be able to deliver power at 4.30 mills per kilowatt.1/

| | | |
|---|---|---|
| Capacity of Thermal Plant | | 4 x 125 MW = 500 MW |
| Cost per kW installed Plant not interconnected with system | | $150 |
| Assuming a plant availability factor of 80% and a plant factor of 85% | | |
| kWh generated per annum | = | 8760 x 500,000 x .8 x .85 |
| | = | 2978 million kW |
| Assume thermal efficiency of 34% | | |
| Calorific value of coal | | 11,000 BTU per lb. |
| Cost of coal | | $3.65 per metric ton (2205 lbs.) |
| Cost of coal per million BTU | = | 15.0 US cents<br>Very cheap coal. |
| Coal per kWh generated | | 3412 BTU per kWh<br>.34 x 11,000 |
| | = | 0.91 lbs. |

1/ Estimated by C. N. White of the Bank's Public Utilities Projects Department, July 23, 1971.

| | | |
|---|---|---|
| Total quantity of coal required per annum | = | $2978 \times 10^6 \times .91$ |
| | = | 2710 million lbs |
| | | 1.23 million metric tons |
| Cost of coal per annum | = | $3.65 x 1.23 |
| | = | $4.464 million |
| Cost of coal per kWh generated | = | $\frac{4465,000,000}{2978,000,000}$ mills |
| | = | 1.50 mills |

Other costs

| | |
|---|---|
| Salaries and Wages | 1.50 US mills per kWh generated |
| Repairs and maintenance | 1.00 US mills per kWh generated (based on Malayan 1969 cost + 33%) |
| | 2.50 US mills per kWh generated |
| Coal handling & ash disposal allow | 0.1 mills per kWh |

Total Operating Costs per kWh generated

| | |
|---|---|
| Coal | 1.50 |
| Salaries and wages | 1.50 |
| Repairs and maintenance | 1.00 |
| Coal handling and ash disposal | 0.10 |
| | 4.10 US mills |

Allow for 5% of kWh generated to be used in plant
Cost per kWh delivered 4.30 US mills

12.44 The estimated cost per KWH delivered is in the competive range, but the estimates are rough and would have to be verified. At this point, it is only possible to say that this alternative should not be rejected without further study. Alternative I - development of the coal for export - may prove the more attractive, or some combination of the two may be even better, particularly if the combination could result in levels of output in the neighborhood of 3 million tons annually. Some kind of action, however, is desirable. The mine is now a drain on public funds and should not be continued in its present operation.

12.45 It is recommended that a study be made of the alternatives and that a course of action be decided upon based on the study results. The study should encompass an evaluation of potential export volumes and prices,

and an assessment of the costs of mine development, and production up to an annual tonnage of 4-5 million tons. It might also be appropriate to explore the topic with the industrial firms that could be large consumers of the power in an aluminum smelter.

## Ombilin Coal

12.46 Ombilin Coal field is about 165 kilometers by rail (about 100 miles) southeast of the city of Padang, in the northwest part of Sumatra. In 1892 a railroad was constructed to develop the mine at Sawahlunto and to connect it with the port at Padang. The existing railroad has to cross a mountain range between Kaju Tanam, which is 60 kilometers from Padang and 144 meters above sea level, and Batu Tehor, which is 94 kilometers from Padang and is 370 meters above sea level. A rack and pinion railway system is used between these two points.

12.47 There are three main coal seams; "A", "B", and "C". The coal beds dip 12-16 degrees to the east. However, both the strike and the dip vary. Most of this is due to faulting on the western side of the deposit. Almost all of the concession is underlain with coal. The principal coal areas have been named as follows:

1) Tanah Hitam
2) Sungai Durian
3) Sugar
4) Sigalut
5) Param Bamam

Coal is being mined in the Sungai Durian coal area, which covers the entire western edge of the coal field. In this area there are three seams, A, B, and C. Seam A has an average thickness of 1.50 - 2.50 meters, Seam B is 0.50 meters thick, and Seam C is 6 - 10 meters thick. The overburden is 120 meters, and the stratigraphic distance between Seam A, B, and C is 30 meters.

### Present Status of the Operation

12.48 All of the coal production comes from underground workings. The mining is done by the long wall system with face lengths of 100 to 120 meters. Sand is hydraulically pumped for back filling. Seam C is worked in benches of 2.0 to 2.5 meters in thickness. Most of the coal is mined by drilling and blasting, then transported by chain conveyors and mine cars. The major underground haulage way was abandoned following World War II, when a fire broke out in the mine. Presently, the coal is transported by narrow gauge rail and by belt conveyors around the abandoned mine area and over the hills to the screening and washing plant. Most of the operating equipment is in need of repair work or else is altogether inoperable. Both screening and washing plant as well as the power plant are over 50 years old.

12.49 The 50-year old, 6,000 K.W. power plant is delivering only 1,000 to 1,500 K.W. In 1962 a contract was signed with the Polish government to rehabilitate the mine in two stages. The first stage was to increase its output of coal to 300,000 tons per year, and 7,000 tons of equipment was delivered to the mine. Equipment for a power plant of 12,000 K.W. was also included in the shipment, but because of insufficient funds, stage one was never realized. Parts of this equipment have been used to help maintain and prolong the life of the mine. Of the Polish technicians that were sent to assist in the rehabilitation, all but one have returned home.

12.50 Of the ore available, 30 million tons have already been mined from the Sungai Durian area. The probable reserves, within the concession, are estimated to be 460 million metric tons. An estimated 117 million metric tons of coal reserve is available at depths from 0 - 350 meters below the surface, 155 million from 350 - 700 meters, and 188 million below 700 meters. The coal has a B.t.u. content ranging from 12,700 to 13,300 and is particularly desirable because the ash content is 1-3% and the sulphur content about one-half of one percent. The mine has been in production since 1892, and its best production year was 1939, when 590,743 metric tons of coal were produced. Production has been steadily declining to the present low of 63,855 metric tons. The main consumers are the railroad, which connects the mine to the port, and the cement plant at Padang. The cement plant is the larger consumer of the two. Small amounts of coal are used by the steam plant for the generation of electricity at the mine. In 1970 production costs were $11 per ton and losses of almost $200,000 were sustained. The prices received were, however, rather low.

Future Market Prospects

12.51 Ombilin coal will be developed primarily for export to Japan which is one of the world's largest consumers, as well as importers of coal. In 1970 Japan consumed 86.6 million metric tons of coal, of which 48.8 million metric tons were imported. Their main interest, as shown by some of the most recent large, long-term contract purchases, is in low-sulphur, low ash, blending coals and Ombilin fits those requirements. Geographically, Indonesia is one of the closest countries to Japan with a source of this type of coal. There is a possibility that the International Nickel Company might use the matt method for reduction of its nickel ores in Indonesia. If they do, they might use metallurgical quality coal as a reductant. The amount of coal they might need is estimated to be 200,000 metric tons a year. Ombilin may be suitable for this purpose but this potential demand is still speculative.

12.52 One of the largest exporters of coal to Japan from this part of the world is Australia. The exporting conditions which exist between Japan and Australia can be used as a guide for what might be expected in Indonesia. In 1970 Australia exported 16,470,774 metric tons of coal to

Japan. The reported average delivered price of coal imported from Australia into Japan in 1970 was $14.96 C.I.F. per metric ton. The average F.o.b. port value price was $10.60 per metric ton. However, the individual contract prices varied depending upon the grade of coal, location, date of contract, etc. For example, in 1970, coals from Coal Cliffs Australia (21% volatile, 10% ash, 0.4% sulphur, 5-7 free swelling index) were exported at a C.I.F. price of $12.35 per metric ton. The new 1971 contract for these coals increased to $14.64 per metric ton. Coals coming from Diayon in Australia (48% volatile, 8.5% ash, and 0.75% sulphur) sold for C.I.F. $9.46 per metric ton in 1970. Both of these coals have higher ash content than Ombilin coal. In Australia some of the American companies are paying a royalty of $0.05 per metric ton of coal and a rail freight rate of $0.010 - $0.015 per metric ton mile for the transportation of coal to dockside. Vessel loading costs of Australian coal vary with individual port facilities. The cost may range from 1 to 50 cents per metric ton. In general, Ombilin coal can probably command some premium over prices listed above; a C.I.F. price in the range of $12 - $15 per metric ton, F.o.b. price in the range of $9 - $12, is probably on the conservative side.

"Basic Agreement" and Proposed "Contract of 'Work'" Agreement

12.53 Japan has already expressed a strong interest in this coal deposit by signing a "Basic Agreement" and proposing a "Contract of Work" agreement with the Indonesian Government. The "Basic Agreement" concluded on April 29, 1970 between P. N. Tambang Batubara, Marubeni-Iida Company Ltd. of Japan, and Kaiser Steel International Mining Corporation of the U. S., was approved by the Minister of Mines of Indonesia on June 1, 1970. Marubeni and Kaiser agreed to cooperate fully in the execution of all stages of rehabilitation and development of the mine. This consisted of a detailed feasibility study including sales, marketing, construction, development, and operation work. Although the "Basic Agreement" has no date of termination other than the clause stating that Marubeni-Kaiser must give the Government the results of their feasibilities studies within approximately 12 months, the development work on the deposit cannot be started until a "Contract of Work" between the Government and Marubeni-Kaiser is agreed upon. A draft copy of this contract has already been prepared and presented to the Government for consideration.

12.54 Basically the companies have proposed that they undertake the development of the mine and that the Government assume responsibility for infrastructure. The proposed contract calls for the Government to do the following:

"For the purpose of this Agreement, the following infrastructure facilities shall be newly constructed, equipped, installed, or rehabilitated by the Government in accordance with designs and specifications

ii) Commencing with the beginning of the seventh year of the Commercial Operation Period and continuing through the sixteenth year thereof, the New Company shall pay corporation tax at a rate (before credits) of five percent (5%) of Net Taxable Income determined in accordance with Annex D hereof." 1/

"(c) No duties, taxes or levies of any kind shall be imposed on or in connection with the export of any products of the Projects." 2/

12.55 The rehabilitation of the mine to produce 3 million metric tons of coal a year for exportation to Japan would cost an estimated $30 million. This cost would be borne by the Marubeni-Kaiser group. Although there are numerous points in the proposed agreement which do not favor the Government, the most striking ones are the terms regarding the infrastructure, payment of rents, royalties, and taxes.

Alternative Ways to Develop Ombilin

12.56 Although the development by modern, efficient methods of extraction and the sale to foreign markets of the Ombilin Coal is very desirable, there are several major alternatives the Government may wish to review before proceeding with this project.

A. Evaluate the proposed "Contract of Work" agreement and the proposed share of financial responsibilities and benefits derived from this agreement.

B. Alternative contract based on "lease" type of agreement.

C. Alternative "Contract of Work" agreement where the Government is the contractor in control assuming all financial capital responsibilities based on present proposal of mine, rail and port rehabilitation and employment of foreign contractor to operate the entire venture.

D. Alternative "Contract of Work" agreement where the Government is the contractor in control assuming all financial capital responsibilities but re-evaluating the rehabilitation of the rail and port facilities

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1/ Proposed "Contract of Work" between Marubeni-Kaiser and Indonesian Government, Article 9, page 30.

2/ Op. cit., Article 17, page 43.

as shall be mutually agreed upon between the Government and the Companies:

i) Railway between the mining site and port site and its auxiliary facilities.

ii) Seaport facilities at port site being available for direct loading to ocean vessel of 100,000 DWT tons or larger.

iii) Electric power supply necessary for the full operations of the designated capacity of the Project.

iv) Telecommunications facilities among Djakarta, port site and the mining site.

v) Hospitals, schools, utilities, and other townsite facilities and roads in the mining site." 1/

Land rent, royalties, and taxes of the proposed "Contract of Work" are stipulated as follows:

"(b) The New Company shall pay the Government land rent in the amount of U. S. $0.05 per hectare per annum on the number of hectares included in the Contract Area, such payment to be made during the term of this Agreement commencing the first calendar year of the Commercial Operation Period.

(c) The New Company shall pay quarterly royalties in respect of coal from the Contract Area on the basis of the quantity mined and sold. The rate of royalty to be paid shall be U. S. $0.05 per metric ton of coal sold. Such payment shall be accompanied by a statement in reasonable detail showing the basis on which the payment has been calculated.

(d) Corporation tax shall be paid by the New Company to the government as hereinafter provided:

i) During the first six (6) years after the commencement of the Commercial Operation Period, the New Company shall be exempt from the corporation tax.

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1/ Proposed "Contract of Work" between Marubeni-Kaiser and Indonesian Government, Article 9, Page 19.

based on different concepts of coal transportation and ship loading, and employment of foreign contractor to operate the entire venture.

Alternative "A" - The Proposed Contract

12.57 The technical reports from Kaiser Steel International Mining Corporation of September 1970 indicate that extensive work needs to be done on the railroad which links the mine to the port and on the port itself. In brief, the railroad connecting the mine and the port needs extensive rehabilitation before it is capable of handling any heavy traffic of coal. The railroad is a narrow gauge (1,067 m.m., standard U. S. 1,432 m.m.) with light construction of 25-35 kilograms per meter rail. The existing car axle load is 10 metric tons, and the existing bridges are capable of handling 12½ metric tons per axle load. The common axle load for this type of light, narrow-gauge railroad is 15 metric tons per axle. Narrow-gauge railroad of this type is used for mineral transportation but with heavier weight rail, and rolling stock with 20.5 to 22.5 metric tons per axle load. Two to six loaded trains would have to be dispatched daily from the mine under the present conditions in order to move 3 million tons of coal. This would involve 75 locomotives and 450-460 cars. There are now 234 coal cars and 49 steam locomotives available. Increasing the number of rolling stock does not appear to be the solution. The main problem is the railroad bed, grade, (in certain sections) lightweight bridges, and the rail itself. Heavy traffic over the existing rails would fatigue them at an early date.

12.58 Railroad costs were estimated based on (1) upgrading of the railroad and equipment of existing line and (2) upgrading of the railroad and equipment with relocation of sections of the railroad.

Estimate Cost of Upgrading Railroad and Equipment of Existing Railroad Line 1/
(thousands of U.S. $)

| | Axle Loads (metric tons) | | | | |
|---|---|---|---|---|---|
| | 10 | 12½ | 15 | 20½ | 22½ |
| Direct cost 2/ | $44,795 | $42,722 | $34,992 | $32,259 | $31,173 |
| Indirect costs 3/ | 4,184 | 4,078 | 3,570 | 3,699 | 3,654 |
| Escalation & contingency | 10,591 | 10,252 | 8,793 | 8,456 | 8,264 |
| Total | $59,570 | $57,052 | $47,355 | $44,414 | $43,091 |

1/ Preliminary report Kaiser Steel International Corporation September 1970.

2/ Include mainline locomotives, coal cars, main track equipment, general service equipment, shops & fuel stations, signalling & communications, mainline and sidings trackwork, existing bridges, relocation of line, tunnels, mainline & sidings earthwork.

3/ Include export fees, field supervision, project manager, engineers & procurement.

Estimated Cost of Upgrading Railroad and Equipment
With Relocated Section of Railroad 1/
(thousands of U.S. $)

| | Axle Loads (metric tons) | | | | |
|---|---|---|---|---|---|
| | 10 | 12½ | 15 | 20½ | 22½ |
| Direct cost 2/ | $45,599 | $41,773 | $40,465 | $40,589 | $40,778 |
| Indirect costs 3/ | 5,242 | 5,047 | 5,123 | 5,295 | 5,341 |
| Escalation & contingency | 13,338 | 59,649 | 12,580 | 12,752 | 59,004 |
| Total | $64,177 | $59,469 | $58,168 | $58,752 | $59,123 |

Note: Above figures are preliminary only and do not include taxes, duties, currency conversion costs, interest during construction or financing charges.

12.59 Assuming that condition two (upgrading of the railroad and equipment with relocation of sections of the railroad) is more sound because of the need to do away with the rack and pinion section, and maintaining axle loads at 12½ pounds, since this is the maximum load for the existing bridges, the investment for this rehabilitation as proposed is $59,469,000. For the purpose of determining costs of transportation of coal from the mine to the port on this rehabilitated railroad, the fixed charges on the investment are taken at 15 percent. 4/ Based on this, the fixed charge would be $2.97 per metric ton, or $0.0180 per metric ton per kilometer. Although direct operating costs for the railroad are not available, it is estimated that maintenance, labor and supplies will amount to about $0.48 per ton, (present freight cost from the mine to Pa.lang is $1.78 per ton of coal includes loading and unloading charges), or $0.0029 per metric ton per kilometer.

12.60 Based on an estimated investment cost of $59,496,000 for rehabilitation of the railroad, and assuming an annual capacity of 3,000,000 metric tons of coal, the total operating costs of this railroad system are estimated to be as follows:

| 100% Capacity | Operating costs per annual metric ton | Cost per metric ton per kilometer |
|---|---|---|
| Fixed charges . . . . . | $2.97 | $0.0180 |
| Operation and Maintenance . . . . . | 0.48 | 0.0029 |
| Total | $3.45 | $0.0209 |

1/, 2/, and 3/ References same as for previous table.

4/ Includes return on capital, depreciation, and insurance.

12.61 The Kaiser Report also outlines the scope and capital investment necessary for the location, development and erection of the port and coal loading facilities at the port. The harbor at Padang cannot be used for various reasons. There is a good natural harbor south of Padang, and new port facilities need to be erected. The investment cost of these facilities is estimated as follows:

| | |
|---|---|
| Civil works (access track, excavation, etc.) | $ 4,243,000 |
| Material handling (R.R. unloading stackers, feeders, conveyors, shiploaders, etc.) | 7,026,000 |
| Utilities (electric power, distribution, water, sewage, communication, etc.) | 1,834,000 |
| Marine structures (moorings, dolphins, wharf, shiploader quadrant rails, etc.) | 3,225,000 |
| Buildings and general services | 690,000 |
| Marine services (tugboats, navigational aids, etc.) | 1,360,000 |
| Other miscellaneous | 940,000 |
| Total direct cost | $19,318,000 |
| Indirect costs | $ 2,413,000 |
| Escalation and contingency | 5,767,000 |
| Total | $27,498,000 |

Assuming a direct cost of loading at 15 cents per metric ton and a fixed cost of $1.37 1/ the total operating cost of the port might be $1.52 per metric ton.

12.62 Based on the royalty and rent payments in the proposed "Contract of Work" and possible income from rail and port infrastructure the Government's income, with generous estimates for the operation of the railroad and the port, would be as follows:

| | Income for Government for first six years |
|---|---|
| Rent 20,000 hectares at $0.05 per hectare | $ 1,000 |
| Royalty 3 million metric tons at $0.05 per ton | 150,000 |
| Income from railroad | 3,900,000 |
| Income from port | 450,000 |
| Total | $4,501,000 |

12.63 Taking into account the capital investment fixed charges plus the assumed operating costs, the annual expenditure may be something of this magnitude:

---

1/ Based on 15% of investment.

| | Infrastructure operating costs |
|---|---|
| Rail transportation 3,000,000 metric tons at $3.45 per ton. . . . . | $10,350,000 |
| Ship loading 3,000,000 metric tons at $1.52 per ton. . . . . | 4,560,000 |
| Total | $14,910,000 |

Therefore, it appears that under the present terms of the proposed agreement, the project is not favorable to the Indonesian Government. Under these terms the Government will lose about $10 million a year. It is understood that the Government is not in fact considering undertaking responsibility for rehabilitating the railroad and building the port. The analysis above clearly indicates the wisdom of this decision, and has been presented to show just how bad a deal the proposed contract is. On the other hand the potential profits to the private companies are substantial.

12.64 Based on the terms of the proposed contract, Marubeni-Kaiser would invest $30 million to rehabilitate the mine and produce 3 million metric tons of coal a year. Their annual income from the mining and selling of coal might be as follows:

| | Operating cost per metric ton of coal |
|---|---|
| Fixed costs. . . . . | $1.50 1/ |
| Direct operating costs of mining (exclusive of royalties and rent). . . . | 2.72 2/ |
| Royalty. . . . . | 0.05 |
| Railroad transportation . . . . . | 1.78 |
| Vessel loading cost. . . . . | 0.30 |
| Total F.o.b. cost | $6.35 |
| Possible F.o.b. price per ton. . . . . | $9.00 |
| Profit per ton . . . . . | 2.65 |
| Annual profit. . . . . | $7,950,000 |

1/ Based on 15% of investment.

2/ Based on cheap mining of deep coal in the U. S. Cost includes labor, materials, power, union welfare, general administration, sales and marketing, and insurance.

This is a very conservative estimate of profit because the assumed selling price of $9 per ton is low. In all probability the profit level could be much higher.

Alternative "B" - A New Agreement

12.65 The proposed agreement reads more like a "Lease" or "Concessionary" agreement than a "Contract of Work." In concessionary or lease agreements, the leasee is generally responsible for the infrastructure. Therefore, if the "royalty" concept is pursued by the Marubeni-Kaiser group, the infrastructure responsibility should be re-evaluated. This type of agreement may have its advantage in that no large government funds are tied up and yet there is an income from the deposit, not only as royalty but in taxes and export duties as well. 1/ Government income from royalty and taxes in a lease type agreement might be between $1 - 2 million per year. Although this return might be raised by higher taxes and royalty payments, it would still be relatively modest.

Alternative "C" - Government Assumption of Responsibility

12.66 If the Government were to assume all of the financial responsibility of rehabilitating the mine and railroad, erecting a new port facility, and employ a foreign contractor to operate the project on a royalty payment, the annual revenue from this type of venture, producing 3,000,000 metric tons of coal might be as follows:

| | Capital cost |
|---|---|
| Rehabilitation of mine | $ 30,000,000 |
| Rehabilitation of railroad | 59,496,000 |
| Port facilities cost | 27,498,000 |
| Total investment cost | $116,994,000 |

| | | |
|---|---|---|
| Fixed costs | $5.85 | 2/ |
| Direct operating costs of mining (exclusive of royalties and rent) | 2.72 | 3/ |
| Railroad operating costs (assumed) | 0.48 | |
| Port and loading costs (assumed) | 0.15 | |
| Total | $9.20 | |
| Employment of foreign contractor to operate entire system | 0.25 | |
| Total | $9.45 | |

1/ Providing some of the provisions of the contract are changed.
2/ Based on 15% of investment.
3/ Based on cheap mining or deep coal in U. S. Cost includes labor, materials, power, union welfare, general administration, sales and marketing and insurance.

At a possible F.o.b. price of $9.00 per ton, the project is unprofitable. At a higher F.o.b. price ($12 per metric ton) it becomes a profitable operation. However, a $7.6 million a year return on a 100 million dollar investment does not appear desirable. The profit might be higher if the selling price is higher. That is a distinct possibility since it is understood that the Ombilin coal is greatly desired (because of its low ash content) by one of the companies to mix with other coal that has a high ash content. Consequently the Ombilin coal may well command a premium.

12.67 It is also recognized that the Government prefers to conserve its funds for development and hence to have private investors assume as much of the investment burden (including infrastructure) as is possible. Nevertheless, if a particular project looks highly profitable, such that the return would not only repay the debt but also involve a surplus above debt repayment, it would be prudent for the Government to consider undertaking such a project on its own account or to participate actively to some degree. It appears that with some modifications the Ombilin coal project might be such a case.

Alternative "D" - Installation of a Pipeline

12.68 The railroad and port facilities' capital costs are the major problem in the development of this deposit, and consideration should be given to other ways of shipping a low-value commodity such as coal. It is suggested that a pipeline might be substituted for the railroad and for part of port expenses.

12.69 The use and development of a coal slurry pipeline is not new; in fact at the present time more emphasis is being placed on pipelines in coal transport. One of the earliest coal pipelines in the United States was completed in 1950 and was used to deliver 1.3 million tons of coal a year to a power plant 108 miles (about 168 kilometers) away through a 10-inch line. Another pipeline, just recently put into service, delivers coal to a thermal plant with an installed capacity of 1,500 megawatts. This pipeline is 273 miles long (about 440 kilometers), 18 inches wide (about 46 centimeters), and can deliver 660 tons of coal per hour. The pipeline route descends from an elevation of 6,300 feet (about 1,909 meters) to 780 feet (about 215 meters), and the maximum gradient of the pipeline is 16 percent. These are more severe conditions than are required for Ombilin.

12.70 The coal is normally prepared by crushing in rod mills to approximately the following sizes:

| | |
|---|---|
| plus 14 mesh | 2% |
| 14 mesh by 325 mesh | 82% |
| minus 325 mesh | 16% |

This is mixed with water, and by gravity and pumps, the mixture is transported to the power plant. The ratio of water to coal can vary from up to 70 percent coal to 30 percent water; however, the slurry is generally monitored, and water can be added or extracted as is necessary along the way.

12.71 Generally speaking, in transportation of large tonnages, if the railraod freight is beyong 0.005 cents per metric ton over an existing line, there is a good chance that a slurry pipeline can be competitive. The investment in coal pipeline facilities is made up of (a) slurry preparation plant, (b) terminal facilities at distribution end of the line, and (c) pipeline and pumps. The investment in a slurry preparation plant is a function of capacity, and varies between $1.00 - $1.50 per ton. The investment in terminal facilities, and tank storage is also dependent upon capacity. The investment in pipeline and pumps is related to the pipeline length and diameter. It is estimated in the range from $0.025 to $0.035 per metric ton mile for a 10 - 14 inch diameter pipe. An investment in a 10 inch or a 14 inch line 100 miles long, (about 165 kilometers) with an annual capacity of 3 million metric tons of coal in Indonesia, would be approximately as follows:

| | |
|---|---|
| Slurry preparation plant. . . . . | $ 4,000,000 |
| Terminal facilities (400,000 tons storage). . . . . | 2,000,000 |
| Pipeline and pumps 100 x 3,000,000 metric tons at $0.03 per ton mile . | 9,000,000 |
| Subtotal . . . . . | $15,000,000 |
| Added contingency for installation in Indonesia. . . . . | 2,000,000 |
| Total . . . . . | $17,000,000 |

12.72 This total amounts to $12 per metric ton of annual capacity. Taking fixed charges on the investment at 15 percent, this would amount to $0.850 per metric ton, or $0.00850 per metric ton mile. The cost of operation and maintenance, including labor supplies, is estimated to be from $0.0010 to $0.0015 per metric ton mile. Thus the total cost per ton would be $0.970 or $0.00970 per metric ton mile. No allowances were made for any savings which could be incurred from having the pipeline follow parallel to existing railroad grades, or for the fact that the pipeline may cut the distance between the mine and the port.

12.73 Although it is customary to think of ports as having docks, deep-water harbors, and ship loading facilities when large tonnages of

mineral transport are being considered, there are some new and somewhat radical systems now being devised and used, particularly for large bulk mineral cargos. One of the new systems provides for slurry loading of ships. An ideal situation is created by this method, if a coal slurry pipeline is used to transport the coal to dockside at Ombilin. This system has the potential for reducing the cost of loading and discharging of bulk minerals by up to 90 percent in certain cases.

12.74 The substitution of a pipeline for the railroad and the port would apparently cut fixed investment costs by a factor of two or more, and would similarly lower the operating costs of the system. Although the Mission did not undertake a detailed evaluation of the system, a preliminary analysis strongly suggests that this solution is superior to the railroad-port combination. The financial flows and costs are as estimated below, for a conservatively estimated selling price.

| | Operating costs per metric ton |
|---|---|
| Fixed cost | $2.50 1/ |
| Direct operating costs of mining | 2.72 2/ |
| Pipeline transportation costs | 0.97 |
| Port facilities cost | 0.06 |
| Total | $6.25 |
| Employment of foreign contractor to operate entire system | $0.20 3/ |
| Total | $6.45 |
| Possible F.o.b. price per ton | $9.00 |
| Profit per ton | $2.55 |
| Annual profit | $7,650,000 |

Conclusions

12.75 Based on some elementary cost calculations, it appears that the project as proposed in the "Contract of Work" is not a financially favorable one for the government, nor are other stipulations in the agreement desirable for the Government to enter into. The proposed

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1/ Based on 15% of investment.

2/ Based on cheap mining of deep coal in the U. S. Cost include labor, materials, power, union welfare, general administration, sales and marketing and insurance.

3/ The price was dropped since no railroad operation is involved.

agreement is not a "Contract of Work" but a "lease" agreement which leaves the Government with the part of the project development which is the highest in capital investment and gives the lowest dollar return.

12.76 It appears that not all alternatives have been given full consideration with respect to choosing an investment configuration that would yield the highest rate of return. Nor has the project considered the technological developments which can greatly reduce the capital investment. In these circumstances the Government may wish to consider the following actions:

(a) Refuse the terms of the proposed "Contract of Work" agreement.

(b) Decide what type of agreement it wishes to enter into relative to this deposit and renegotiate with the Marubeni-Kaiser group.

(c) If Marubeni-Kaiser desire to invest 30 million dollars, that could become part of the total investment of the project and would share proportionally in the profits on the sale of coal.

(d) Undertake new feasibility studies on the most economical methods to develop and rehabilitate the mine, and transport of coal to vessels. Since such proficiency is not available in Indonesia, a competent independent firm could be contracted to make these studies.

## OTHER MINERALS & THE OPERATIONS OF P. N. ANEKA TAMBANG

12.77 Aside from petroleum, tin, and coal, the development and management of most of the other minerals in the country is carried out by the Aneka Tambang. The principal minerals now being exploited are: silver, gold, diamonds, iron, nickel, and bauxite.

### Gold, Silver and Diamond Operations

12.78 Gold and silver are mined at two mines, Tjikotok and Tjirotok, seventeen kilometers apart in the Province of West-Java. The total concession covers about 4,574 hectares. Four kilometers from Tjikotok is the processing plant. The ore deposits in Tjikotok consist of three veins averaging 1.5 to 8 meters in width with a dissemination of native gold and silver in quartz gangue. The average content of ore is 3.5 grams of gold and 650 grams of silver per metric ton of ore. The Tjirotok veins contain not only gold-silver but lead and zinc as well. The average content of the ore is: gold, 8 grams per metric ton; silver, 350 grams per metric ton; lead, 2.3 percent per metric ton; and zinc, 1-1.5 percent per metric ton.

12.79 Production from the mines is about 40,000 metric tons of ore. Current reserves are estimated to be about 400,000 tons of ore. The ore is treated with cyanide, precious metals precipitated with zinc dust and the precipitate shipped to the Logan Mulia smelter and refinery in Djakarta for further treatment. The mine is making a small profit and has a life of about ten years based on current production. The greatest problem is the appearance of lead and zinc with depth. Presently, exploratory drilling is underway to develop additional reserves. There are about 800 men employed at the mine.

12.80 Logas mine on the Sangingi River in Central Sumatra is a gold dredging operation which is about to be closed down. The average grade of about 125 milligrams of gold per cubic meter is not sufficient to make this a profitable operation.

12.81 A $400,000 diamond dredging operation in the Sinepang Empat area, 30 kilometers north of Martapura in Kalimantan, is at present unprofitable. There is, however, hand panning being done by the local people in the area who for years have had some measure of success in finding gem quality stones which find their way out of the country; therefore, no information is available on the diamond production in Indonesia.

Iron

12.82 The titaniferous iron sands which occur along the southern part of Java were considered at one time the source and basis for the building of a steel plant with an annual capacity of 100,000 tons at Tjilegon, West Java. Although there are more than 100 localities of iron ore deposits throughout the country, none have been found to be large enough, contain the proper grade and mineralogicl composition, or be in a favorably located spot for development. The best that has been done with the iron sands is the exploitation of the beach sand deposit at Tjilatjap, Central Java. This deposit contains 14.5 percent magnetically concentratable iron. There is an estimated three to four million tons of ore. Production of iron ore concentrate containing 55-58 percent iron and about 7-8 percent titonium started in May, 1971. Aneka Tambang has a contract with Japan for 300,000 tons of iron ore a year for the next ten years at a price of $5.50 F.o.b. At this price, Aneka is making a profit of $.50 per ton. Mining is done hydraulically, followed by wet magnetic separation. Concentrates are loaded into 30,000-ton ore ships by a conveyor belt. The development cost of this project was about $4 million, most of which went into the dredging, followed by blasting out a deep water channel. A larger beach sand deposit about 120 kilometers south of Tjilatjap near Jogjakarta, is under consideration for development. Preliminary exploration shows a possible deposit containing more than 40 million tons of exportable iron sands. However, harbor conditions are more difficult than those encountered at Tjilatjap.

Bauxite

12.83 Most of the present mining of bauxite is done on the island of Bintan, as well as on Buton, and there are mines on Kojang and Dondang. Mining is a simple operation of stripping, followed by washing. Most of the ore is shipped to Japan, and small amounts are exported to Western Europe. A recent 10-year contract with Japan calls for delivery of 800,000 tons of bauxite in 1969 and 1 million tons each year thereafter.

Bauxite Ore Exports

| Year | Metric Tons | Value in U. S. $ |
|---|---|---|
| 1966 | 688,385 | 3,626,373 |
| 1967 | 888,537 | 4,560,125 |
| 1968 | 847,751 | 3,881,021 |
| 1969 | 863,626 | 4,364,221 |
| 1970 | 1,182,239 | 5,894,733 1/ |

Aneka Tambang's operations employ about one thousand men. The cost of producing a metric ton of bauxite is about $3.50, and it is being sold for about $5.60 per metric ton. Discussion and feasibility studies are underway for the possibility of putting up an alumina plant. Technical aid has been requested for this project.

Nickel

12.84 Nickel, along with bauxite, are the two most profitable minerals for Aneka Tambang. Mining of nickel by the State Enterprise is being done in the southeastern peninsula of Sulawesi, at Pomalaa, Tandjung Pakar, and Batukilat fields as well as on the island of Haniang. Nickel ores occur in vast quantities in Indonesia. These ores are nickel-bearing laterites which are derived from the weathering of peridotite in serpentine masses of rock. Weathering process removes the aluminum and calcium of the rock while iron, chromium, nickel, and cobalt are concentrated in the weathered soil, particularly at the interface of the unweathered and weathered rock. The existance of these deposits have been known for a long time; however, they have defied economic metallurgical recovery because the nickel-bearing minterals are silicates. Recently there has been an increasing interest in these deposits. Semi-mechanized, selective strip mining and manual pick and shovel are used to mine the nickel ores of various grades, and these are blended together to produce export quality ore. The present agreement with the Japanese group of Sunideco, calls for the nickel plus cobalt content of the ore to be no lower than 2.4 percent.

1/ No information is available why the published value & reported selling price are not the same.

Nickel ore Exports of Indonesia 1965-1968

| Year | Loaded Weight In Metric Tons 1/ | Value in U.S. $ |
|---|---|---|
| 1966 | 133,650 | 1,190,315 |
| 1967 | 145,881 | 1,394,896 |
| 1968 | 240,542 | 2,367,142 |
| 1969 | 257,761 | 3,344,874 |
| 1970 | 538,453 | 8,315,266 |

There are about 3,000,000 tons of this high-grade nickel-cobalt ore left. This year Aneka Tambang expects to ship out 800,000 tons of ore and one million thereafter. At this rate, the high-grade will be exhausted in about three years' time. Although the concession has been drilled by Aneka Tambang, the low-grade (1.8 percent nickel-cobalt) ore reserves were not made available.

12.85 Aneka Tambang is proposing the construction of a ferr-nickel plant at the mine site that would utilize the low-grade nickel-cobalt ores and have an annual capacity of 4,000 metric tons of contained nickel in ferro-nickel. The cost of the plant is about $25 million and the proposed plan for financing is $12 million out of Aneka Tambang's profits, with the remainder to be borrowed from the local banks. The planned capacity of this plant is somewhat small for most efficient production. Smelting is done in blast furnaces, rotary kilns and most often in electric ore furnaces. Technology of smelting is complex and know-how plus experience in the erection and operation of the plant are essential. Neither of these are present in Indonesia; yet the $25 million project of a ferro-nickel plant is scheduled for construction. A review of these plans might be prudent.

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1/ Includes Moisture.