STUDY ON THE DEVELOPMENT PLAN

OF

THE KINGDOM OF SAUDI ARABIA

JULY 1972

OVERSEAS TECHNICAL COOPERATION AGENCY

JAPAN

The views expressed in the Report are those of the survey team and do not necessarily represent those of the Japanese Government.

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Saudi Arabian Currency

SR = Saudi Rial

	SR/US $	¥/SR
1959 - 1971 12.23	4.50	80.0
1971 12.23 -	4.14	74.3

Calendar

Saudi Arabian official calendar is Islamic calendar (Anno Hijra = A.H.) and fiscal year begins on the first day of July of A.H. In this report, the year expressed originally in A.H. is converted into Gregorian year; for example, 1392 A.H. is expressed as 1972, and fiscal year 1391/1392 is expressed as 1971/1972.

The year originally expressed in Gregorian is expressed as 1972 A.D.

Preface

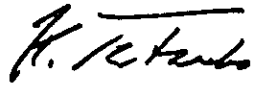
This study was carried out based on the Pre-Overseas Investment Basic Study budget allocation in the fiscal 1971 budget of the Ministry of Foreign Affairs, Government of Japan, which had the Overseas Technical Cooperation Agency, commission the work to the International Development Center of Japan.

The study has its origin in an agreement reached during discussions between officials of the Government of Saudi Arabia and the Japanese Arabian Gulf Economic Mission headed by Sohei Nakayama, which visited Saudi Arabia in January, 1971, to promote economic cooperation between both countries. The agreement was that Japanese cooperation should be provided to Saudi Arabia in connection with the latter's Five Year Development Plan.

However, for Japanese agencies to provide cooperation, they must be provided with information and knowledge about social and economic conditions in Saudi Arabia, and for that it is essential for Japan to study and understand the development plan, and also the economic and social conditions behind it.

The purpose of this study is to execute such an investigation and determine the areas where Japanese cooperation could be effectively provided. The study team spent a total of five weeks in two visits to Saudi Arabia and were cordially received and given much information by government officials and other people. The original report, in Japanese, was submitted to the Ministry of Foreign Affairs. In this English version, the lengthy descriptive parts about Saudi Arabian national affairs and its Five Year Development Plan are briefly epitomized.

July 1972



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SUMMARY

SUMMARY

1. Saudi Arabia is mostly arid desert. From antiquity, and up to very-recently, the natives of Saudi Arabia have lead severely restricted lives, primarily as nomads practicing shifting agriculture, and until recent times had never been united. It was only in 1932 when the present King's father united many tribes and declared the foundation of the nation that the modern era of Saudi Arabian history began.

2. Since 1938, the American oil companies which obtained oil concessions in 1933, have discovered and developed many huge oil fields. With the remarkable increase of Saudi Arabian income gained from the oil industry, social development investments--in education, urban development, transportation and communication systems, water resources and irrigation works, etc.--have been rapidly increased. Channeling income from oil to social development has stimulated private economic activities, causing the gross domestic product to reach a level approximately double earnings from oil, and the gross domestic product growing at a rate almost equal to the 10% p.a. growth rate of oil production.

3. To give the Government's development investments order and rationality as a whole, a Five Year Development Plan had been in preparation since early 1960, but due to lack of basic statistical data, its attempts to implement the plan were delayed and at last they were begun in September, 1970, by the Central Planning Organization which was established in 1965.

4. The plan has three main goals:

   1. To increase the gross domestic product at the rate of 9.8% annually;
   2. To develop human resources to contribute to national economic progress, and

3. To reduce economic dependence on income from oil, and to diversify the sources of the gross domestic product.

This plan is based on the assumption that the oil production would grow 9.1% p.a., and the government is prepared to disburse 431 billion Rials of financial money. Although manpower development is given high priority, in the future, the shortage of technical school and college graduates and skilled laborers is anticipated to become larger than at present if the plan is carried out to the letter. Further, construction of the infrastructures, such as roads, communication networks and urban facilities, are expected to require large financial investments. Mining industries, which are expected to be the mainstay in Saudi-Arabia's drive for reducing dependence on income from oil, development of natural gas and mineral resources and large-scale industry based upon them, is to be by a public corporation, PETROMIN, while manufacturing industries producing for the domestic market are to be managed by private companies. As the former depends mainly on overseas markets, PETROMIN welcomes jointventures with foreign companies. The private industries are left to their own free will, and the investments are not planned beforehand. Besides, many enterprises feel necessary to obtain technical and managerial know-how of foreign enterprises.

5. Saudi Arabia has a high income; although the country does not want other countries' financial aid for their social development, it does need technical assistance from foreign countries, for manpower development and, in fact all other pertinent areas. Many Western countries have provided technical assistance, in many ways, such as receiving students and trainees, and dispatching engineers and specialists.

Compared with Western countries, Japan has hardly made any contribution to Saudi Arabia's development efforts, having received only total 27 trainees and dispatched 7 engineers for a short stay, in addition to having dispatched a five-man geological survey team. This poor accomplishment is thought

to be due to a lack of intercourse between the agencies concerned in each of the two countries. Moreover, technical and economic cooperation by the Japanese governmental agencies must follow the rigid principle that action can be taken only following receipt of a explicit request from the counterpart government. Moreover, the Japanese government is not empowered to provide services for remunerations, because they are considered to be private contracts.

6. Since last year, negotiations between the two countries of an economic cooperation agreement has been underway, and there is an atmosphere of seeking to deepen mutual understanding. In this connection, we should like to suggest that the agencies concerned should first recognize the realities of Saudi Arabia, and then make clear the significance of cooperative services to its social and economic development, and then to take the attitude of wanting to positively cooperate rather than passively wait for a request for cooperation.

The importance of Saudi Arabia, which possesses one-fourth of the world's proved oil reserved, will further increase in the future. It is of great significance not only to this country but also to the world economy that Saudi Arabia will strive to decrease its dependence on income from oil by diversifying its economy. Moreover, the income obtained from oil will accumulate more rapidly in the future, and effective utilization of this income for establishment of the nation's economy will a significant issue. For Japan, which will be obliged to greatly depend on Saudi Arabia's oil resources in the future, it is a matter of international responsibility to help them find alternative sources of income in advance of the depletion of the oil resources.

7. The areas for which Saudi Arabia is specifically expecting Japanese assistance are manpower development and industrialization.

The Overseas Technical Cooperation Agency should make arrangements with Saudi Arabian agencies on the plan for inviting trainees to Japan, and carry out the training programs to satisfy their needs. Furthermore, the OTCA should cooperate to improve the training courses of Saudi Arabian vocational training centers. Also, it should provide services, such as by dispatching of engineers, and supplying of various kinds of information, data and materials to the Industrial Studies and Development Center.

In addition, intercourse between the Chambers of Commerce and Industry of both countries should be promoted in order to encourage Japan's direct private investments in the establishment of private manufacturing industry.

In PETROMIN's exploration and exploitation of mineral resources, and establishment of industries utilizing the natural gas, Japanese assistance could have great influence on the results of PETRAMIN's efforts. Especially for the latter issue, in its planning, Japanese industry concerned should carefully review and comparison the two possibilities of building a plant in Japan using expensive naphtha as the raw material or building it in the oil producing countries where cheep natural gas is available.

STUDY ON THE DEVELOPMENT PLAN OF THE KINGDOM OF SAUDI ARABIA

I. A BRIEF SURVEY OF THE KINGDOM OF SAUDI ARABIA

1. Geography and History

Saudi Arabia extends over 2,200,000 sq km of area, including most of the vast boot-shaped Arabian Peninsula--1,100 km wide, 2,000 km long and 2,500,000 sq km in area, - from latitude 16° to 30° and longitude 37° to 56°. The ground elevation increases from the level land along the Arabian Sea westward to heights of 1,000 to 2,000 m, suddenly forms a precipice and drops to the level of the Red Sea. Between the Red Sea and the precipice lies a strip of level land, less than 100 km wide. This precipice, gentle in the northern part, holds a basin at the foot of the mountains. Only the Assir area, the southern part of the mountaineous area along the Red Sea, which ranges over 2,000 m high, has 200 to 500 mm of annual rainfall and is covered with vegetation. The rest of the area, however, receives an average of about 100 mm. It has no river except for wadies which appears only following rains. Only the brown land of rocks, soil and sand is visible from the sky; greenery can be spotted to a very limited extent.

There are rocky deserts, particularly in the west, and arid grounds covered with soil in addition to the deserts of sand dunes. These sand dune areas, which cannot support any form of life, cover 25% (about 500,000 sq km) of the whole land: in the south lies Rub al Khali, the well-known desert which covers about 20% (about 400,000 sq km) of the entire land; in the northern center, lies Nefud; and in the east, connecting both points, lies Dhahra which is long and slender and curves arclike toward the east. The low ground toward the Arabian Gulf, east to Dhahra, is called the Hasa area; the central inland area is called the Nejd area; and the low ground along the Red Sea is called the Hijaz area. The land, except for the Assir area, mostly has no rain and high temperatures during summer; in the Nejd area, temperature

climbs to 45-50 degrees C during the day. From autumn to spring little rain falls and grass grows, sparsely, on the arid ground; inland, at daybreak in winter, the temperature drops almost to zero.

The origin of Arabic people is said to have been in what is present-day Yemen. In the Hijaz area which connects Yemen and the area around the Meditterranean Sea and the Dead Sea, which has been a well spring of culture from antiquity, and where the traffic has been heavy, has long been inhabited, and commercial and agricultural activities have been carried out since long ago. In the vast wilds inland, however, the limited nomadic life based on tribal units and the half-agricultural and half-nomadic life in the vicinity of the wadies and oases has changed little since the beginning of history. In the seventh century, Muhammed, a merchant of Mecca in Hijaz, inspired by God, founded the Islam faith. It is historically well-known that this Islam grew within one century to be the Saracen Empire; however, two generations after Muhammed died, the center of the Empire shifted to the area around of today's Syria and Iraq. The Arabian Peninsula, therefore, has remained in the world of the tribal nomadic life and of everlasting conflict among tribes, and has had to wait till the twentieth century for a unified national society to be established. A small population and the difficulty in moving across the forbidding land are considered to be reasons why the foundation of a unified society has been delayed so long.

Since the middle of the sixteenth century, the Empire of Osman Turkey has occupied parts of the Arabian Peninsula such as Hijaz, Assir, and a part of Hasa (Hofuf), except for the inland area, Nejid. In this Nejid, in the middle of the eighteenth century, Muhammad ibn Abudull Wahhab preached that the people "Return to the Koran," and started a religious revival which was patronized by the Patriach Saud Family in Dariyaih (Riyadh area). The teachings emphasize strict

adherence in practice to the precepts of the Koran. Inspired with Wahhabism, the Saud Royal Family, who had conquered Neji and ruled over it for a while and expanded its influence to Mecca, was crushed by the invasion of Egyptian armies. Its second dynasty, which was revived afterwards, however, suffered from continuous struggles and was finally occupied as far as Riyadh by the revolt of the Rashd Family. As a result, the Saud Family fled to Kuwait. In 1901, Abdul Aziz, Prince of the Saud Family, who regained Rihadh dramatically by leading a group of twenty soldiers, attacked those tribes which refused to worship Wahhab, conquered Nejid, forbade skirmishes among tribes, and moreover conquered Hasa. Further, he won over the Hashimite Family and conqured Hijaz and declared the foundation of the Kingdom of Saudi Arabia, that was unified in 1932. In 1933, for the first time, an American oil company sought permission to obtain oil concessions. As a result, the Arabian-American Oil Company, (ARAMCO), was formed. After the discovery of the Dammam oil field in 1938, the Abqaiq and Abu Hadriya oil fields were discovered in 1940. Development of oil resources, although temporarily halted due to World War II, proceeded rapidly especially after 1950. Today, Saudi Arabia is the third largest oil producer; and the government is rapidly proceeding with social and economic development programs, by using the national income from oil.

2. Society, Legislation and Administration

In Hijaz area, which had had contact with foreign countries from early times and where such cities as Mecca, Medina and Jeddah had been founded, cultural influential, including Egyptian and Turkish elements, has been felt from the early period. The Nejid area, birthplace of the Saud Family, however, rarely had contact with the outer world; there, the tribal society, leading a primitive half-nomadic and half-agricultural life, has been changed little over the past millenium.

King Abdul Aziz, who conquered the Hijaz area in 1924 and united the whole land, well aware of Saudi Arabia's position as a newly born country, strove to modernize his nation, gradually set up administrative offices, and made every effort in initiating the construction of cities and roads and in introducing an educational system and modern medical care.

For this newly-unified nation, which was reformed from a pre-modern society under an ideology of Wahhab's teaching, it is, needless to say, difficult to reform drastically the ruling principle and social customs rooted in preachings and in the commandments observed for so long in the past. At present, the political system consists of the ideology of Islam, of the ruling principle of Sheikh or the customary head of large tribes, and of the legalized system of modern administration.

In the world of Islam, the Koran is not only a canon and moral doctrine but also Constitution, civil law, criminal law and commercial law all in one. Since such a theocracy, that the King in Saudi Arabia is not only the king but also the priest of Wahhabism, is adopted, the Koran takes the role of Law. As there is no other Constitution, the judicial system is entirely administered by the Order provided by the Koran. It is natural, however, that the mechanism of modern society based on scientific technology and its consequent complex economic activities could not be adequately governed by regulations dating from more than a thousand years ago. Concerning the organization of administration, the set-up of various government organizations, and the restriction of economic activities, new special laws are being made public in considerable number.

The present administrative establishment is adopting the modern system of having a Cabinet; however, since there is no national assembly, the Cabinet has the powers of administration, legislation and compilation of the budget. At present, the King also holds the portfolio for the Prime Minister; the

cabinet is organized by the King who selects members from the royal family and the ranks of capable officials. Positions of government officials in the administrative offices are being filled gradually by men who have studied abroad or have graduated from Riyadh University. Most positions which require specialized knowledge and experience are still occupied by foreigners.

As the higher education expands, the people's political consciousness is expected to grow and to be quite influential on the future's political form. But for now, most people are satisfied with the King's outstanding ability and the political economic development under his reign; and the State is politically stable.

3. Social and Economic Development

Among the Middle Eastern countries, Saudi Arabia has been the least developed country in social and econimic aspects. In regard to education, transportation, communications, and share of manufacturing industries in the gross national product, Saudi Arabia is still less developed than such Middle Eastern countries as Iran, Iraq, Lebanon, and the United Arab Republic. Her recent economic growth has been, however, steady and rapid. It is a noteworthy characteristic of the Saudi Arabian economy that this growth has been based on sound fiscal policies and that in the immediate furture no fiscal problems are anticipated. The engine of her social and economic development is, of course, the increase in production of crude oil, and the consequent increase in government revenue gained from royalties and foreign oil companies' income tax payments. By 1970 crude oil production had grown to seven times that of 1950, while the government revenue increased by about 20 times during that same 20-year period.

Based on this government revenue from oil, investments in education, medical care and other parts of the nation's social infrastructure have been promoted since the reigns of King Abdual Aziz and King Saud, and these investments have been further stimulated since Faisal became King.

(1) Education

Before the war, modern education (elementary level) was introduced to this country by King Abdul Aziz, but it was not until in 1953, when the Ministry of Education was established, that a significant advance was made in creating a national education system. In 1958, intermediate schools and secondary schools were founded. In 1957, a department of liberal arts was established in Riyadh University and departments of science, of commerce and pharmacy were added in 1958, 1959 and 1960 respectively. Although the opportunity to obtain an education had been available only to men, education for women was initiated in 1960. In 1964, a vocational training center was established under the guidance of International Labor Organization. Thereafter industrial schools at the secondary school level were also founded. In Riyadh University, departments of education and medicine were established in 1967 and 1969 respectively.

(2) Medical care system

There was no modern health and medical care system in Saudi Arabia before the foundation of the Kingdom. King Abdul Aziz introduced an government medical care system, and the Ministry of Health was established in 1951. In 1963, a World Health Organization survey mission for health and medical care which was sent to Saudi Arabia led to the government's improving hospital facilities and health service systems, training of health technicians, and establishing of a central health research institute.

Construction of these hospitals, which includes planning, medical acquisition of equipment and supplies, and training of medical technicians in addition to construction of the hospitals, was open to international bidding and purchases of medical equipment and drugs also was by international bidding. In 1969, the number of government-owned and -managed hospitals was 47; they had 6,800 beds. Further, the number of provincial clinics amounted to 190. The total number of doctors was 770 including 95 Saudi Arabians. In addition to these state-operated medical facilities, there are 18 private hospitals. Because the department of medicine in Riyadh University was founded as recently as 1969, education of Saudi Arabian doctors has to mainly depend on training abroad.

(3) Social welfare

A basic teaching of Islam is to help people who are poor or in distress. With regard to modern social security and social welfare services this was given concrete expression by utilizing the services of experts from UNICEF and by constructing seventeen Community Development Centers which provide social security, education and health services in towns and villeges.

(4) Urban development

Although in major cities construction of facilities for electric power, water supply and drainage systems has proceeded since immediately after World War II, using the income from petroleum, urban development programs on the basis of urban planning have been begun only since 1967, using master plans made by foreign consulting companies. In major cities such as Riyadh, Jaddah and Dammam, city streets have been widened and paved, street lamps have been installed, roadside trees have been planted, and old houses have been replaced by new modern

buildings. In provincial cities, however, although water, electricity, telephone system, and some modern buildings can be found, all-round urban development plans are not in evidence.

(5) Transportation

A) Roads

In a country as vast as Saudi Arabia and one with scattered villages and towns, two characteristics which long hindered unification of the nation, improvement of transportation and communication systems are crucial for political, social and industrial development.

Motor vehicles were introduced before the war, but paving of the roads connecting cities and neighboring major villages was not started until after Wrold War II. In 1963 the total length of paved roads was 3,900 km. Roads connecting major cities such as Jeddah and Riyadh (900 km) and between Riyadh and Dammam (600 km) were then still unpaved. It therefore took several days to drive between these major cities. In 1963, King Faisal invited an United Nations Technical Assistance Operations survey team which proposed a master plan of construction of 7,700 km of trunk roads connecting major cities throughout the country. Based on this master plan, construction of modern highways was initiated in 1964 by ten firms including European, American and Arabian consulting firms and domestic construction firms. Each year, more than 1,000 km was constructed and one billion rials were invested.

B) Ports

In 1948 a pier for foreign freighters was constructed in Jeddah, and the Arabian-American Oil Company constructed a port for crude oil in Ras Tanura and a dry cargo pier in Dammam, which was later turned over to the Government. Since 1960, experts of port planning and management were

called in under United Nations technical assistance arrangements to provide instruction in modern techniques of harbor management, and the Government has enlarged harbor facilities in Port Jeddah and Port Dammam. New port construction in Jeddah has almost been finished as of this writing and the cargo-handling there is 1.7 million tons per year. In Port Dammam, a new pier with a capacity of 1 million tons per year has been completed and the port's capacity is now being increased to 2 million tons per year.

Besides the ports above mentioned, ports in Jizan and Yanbo are being reconstructed as secondary international ports. The first stage of construction in Jizan (three 4,000-ton berths) has been completed.

C) Air transportation

Saudi Arabia's Government started domestic air services with the cooperation of the United States in 1947. In the 1950s air service between major cities such as Jeddah, Riyadh and Dammam (Dhahran) was established. Since 1961, experts from the International Civil Aviation Organization were requested to make recommendations for the improvement of airport facilities, airport management and meteorological observation. In 1963, the Government established Saudi Arabian Air Lines on the basis of a master plan made by the ICAO. Operation of planes, provision and maintenance services were contracted to TWA and Lockheed respectively. Since then number of airports and airplanes has been increased, and 24 major cities are now connected by air plane service.

D) Railways

The "Pilgrim's Railway" (from Damascus to Medina) which was destroyed by the armed force commanded by Lawrence in World War I, has not been reconstructed yet. The 570-km railway connecting Port Dammam and Riyadh,

which was constructed by the Arabian-American Oil Company and transfered to the Government, now operates one round trip a day.

(6) Communication

Although a postal service system has been established and post offices are found in each city, all mail must be sent to postal boxes because of lack of a complete address system including street names and house numbers. Mail service is sometimes delayed.

With regard to the telephone service system, the Government introduced automatic switching facilities in major cities on the basis of the recommendation of experts from the International Telecommunication Union. The number of telephones in the 14 major cities, however, is still only 25,000. Since the number of available lines for long distance calls is quite limited now, it is troublesome to communicate with foreign countries or between major domestic cities by telephone.

(7) Public information

In the early 1960s there was only one radio broadcasting station (50 KW), two newspapers and several weekly magazines for commercial information in Jeddah. In 1963, the Ministry of Information was established to promote Government-operated broadcasting and to subsidize private newspapers. At present, there are four radio stations each with power of 350 KW, five TV channels (black and white), five private newspapers in Jeddah and fifteen monthly and weekly magazines.

(8) Water Resources

Reconnaissance surveys for water resources, which are of crucial importance in agricultural and social-economic development of this country, were done by Food and Agricultural Organization experts in 1962. These

surveys indicated that there are more underground water resources in Saudi Arabia than had been though to exist and that their effective use could double agricultural production. Encouraged by this survey finding, the Government started, in 1965, research on water resources and agricultural development. The country was divided into eight districts for as many research projects and a contract for a survey for each district was offered for international bidding. By 1971, the projects for seven districts (all but Rub al Khali District) had been finished by three consulting groups from the United States, France and Italy. The Ministry of Agriculture and Water Resources started to train water resource researchers and well drilling technicians in order to develop water resources and to sink deep wells. Water resources in Riyadh depends on these deep wells. In recent years, construction of sea-water desalination facilities has been promoted for coastal cities and a desalination plant had been constructed in conjunction with an electric power plant in Jeddah.

(9) Agriculture

On the basis of a provisional survey on the national level, the FAO implemented an irrigation project for construction of a dam at Wadi Jizan in the southwest and constructed an experimental station in Qatif in the east. Under UNDP supervision, in the Wadi Jizan irrigation project, construction of a dam was completed in early 1971 and as of this writing, an irrigation system is being planned. In an agricultural development program in Hasa Oasis region, improvement of an irrigation and drainage system has been almost completed, by foreign consulting groups and construction companies. In this district, Braunschweig University, of West Germany, and the University of Wales, of England, are undertaking soil and water research and research for livestock

production respectively. Taiwan also contracted to do research on rice production in this district. In Haradh region where water resources are abundant, a project to settle the nomadic Bedouins, who are scattered in this area, was started under King Faisal's initiative. Digging of wells, and provision of a water supply and drainage system for this district, have almost been completed.

Besides the projects mentioned above, surveys of actual agricultural conditions, training for mechanization of agriculture, establishment of an agricultural credit bank and establishment of agricultural experimental stations are being promoted in major agricultural regions such as Oasis, Kharj, Assir. Increases in agricultural production, however, have not been satisfactory so far. Although there has been no improvement in Saudi Arabia's self-sufficiency in foodstuffs (about 50%), poultry raising in the western and eastern regions has grown rapidly in recent years, and production of vegetables and fruits has been improved to the extent that part of production is being exported to neighboring countries. On the contrary, demand for dates, a major traditional foodstuff, has shown a tendency to decline because of improvement of the quality of the diet of the people of this country. Recent trends in agricultural production and imports are shown in Table 2.

Although Saudi Arabia is inhabited by many nomads, among whom traditional, marginal livestock production prevails, considerable quantities of animals for food have been imported in recent years. These imports have fluctuated widely due to changes in climatic conditions. As most settled farmers are still engaged both in livestock production and in farming, the Government is promoting livestock by a breeding program and by encouraging the growth of fodder production. The number

of livestock, and amounts of livestock producted and imported, are shown in Table 3.

(10) Mining and Manufacturing

A) Petroleum industry

The petroleum industry has been developed by foreign petroleum companies which were given concessions. The most important engine of social and economic development of this country has been the Government revenue obtained from the foreign petroleum companies which consist of royalty (12.5% of announced price) and income tax. Concessions, which cover the entire area where the possibility of discovery of oil deposits exists, were given to ARAMCO* in 1932 and a concession for all offshore areas was also given to it later. The success of ARAMCO in discovering and exploiting oil fields and increasing production is shown in Table 1.

Besides ARAMCO, a concession in the neutral zone between Kuwait, where Saudi Arabia and Kuwait have a fifty-fifty interest, was awarded in 1949 to Getty Oil, which discovered the Wafra oil field. In 1957, a concession in the offshore area of the neutral zone was given to the Arabian Oil Company, a Japanese company, which discovered the Khafji oil field.
In the case of the Arabian Oil Company, both the Saudi Arabian Government and the Kuwait Government invested in it, each to the extent of 10% of the total equity capital. ARAMCO ships most of its crude oil and oil products from the refinery (500,000 bbl/day) in Ras Tanura and also ships some crude oil to Mediterranean coast through the TAP line (500,000 bbl/day).

Crude oil production in 1971 was 4.74 million bbl/day, which is next that of the U.S.A. and the Soviet Union.

* (The capital structure of ARAMCO since 1948 has been SOCAL 30%, Texaco 30%, Esso 30%, and Mobil 10%)

As far as proved oil reserves are concerned, Saudi Arabia has 135 billion bbl which is a quarter of the total world oil reserves. The most rapid increase in crude oil production is expected to be seen in this country. Production of 10 million bbl/day is expected to be reached by 1980.

B) PETROMIN

PETROMIN was established in 1962 as a government-owned company for developing petroleum, natural gas and other mineral resources and their related industries. PETROMIN monopolizes the domestic market for oil products and has constructed an oil refinery in Jeddah for domestic demand. It also established several joint ventures with foreign enterprises; these ventures include a drilling company, a geophysical survey company, marine construction company and a company manufacturing fertilizer from natural gas.

Some oil-well drilling concessions which had been given to ARAMCO have been transfered to PETROMIN, in accordance with the concession agreement. PETROMIN's policy is to develop those areas in cooperation with foreign oil companies. In 1965, the ERAP Group and in 1967, the Sun Oil Group signed cooperative agreements with PETROMIN for oil exploration and development in areas along the Red Sea coast. In 1967 ENI and Phillips signed with similar agreements for a 80,000-km area in Rub al Khali. None of these however have been successful in discovering an oil field so far. Regarding the utilization of natural gas, PETROMIN and domestic capital jointly established a fertilizer company, SAFCO, and a plant with daily capacity of 600 tons of ammonia and 1,100 tons of urea was constructed in 1969.

Although mineral resources are not yet fully developed, PETROMIN has already entered the steel industry, one of the mineral-resources-related industries.

A rolling mill was blown in in Jeddah in October, 1967. Present capacity of this mill is 45,000 tons of bar steel per year on a three-shifts basis, but because of a shortage of skilled labor, 15,000 tons are now being produced in one-shift operation. Billet is now being imported.

C) Mining

As the western part of Saudi Arabia is formed of Pre-Cambrian shield, which consists of metamorphic and igneous rocks, various sorts of mineral deposits are expected to be found. Since the beginning of the 1960s, the Government has contracted with geological survey institutes in the United States, France and Japan for investigations of geological features and mineral deposits and deposits of copper, gold, silver, lead, zinc, iron, phosphorus etc., have been found in several districts in the western mountainous region. Programs to develop these deposits, however, have not yet been started. To cope with the problems of marketing these mineral resources, PETROMIN is expecting to enter into joint-ventures with foreign companies.

D) Manufacturing

As mentioned above, the Government founded PETROMIN to operate large-scale export-oriented industries, based on oil, gas and mineral resources. Regarding other domestic market-oriented, import-substituting small and medium scale industries, the Government allows private sector freedom to take the main role.

Although before the war there was no major manufacturing industry in this country, most inhabitants of which lead nomadic lives, several manufacturing enterprises financed by private capital have been established after Western culture and technology were introduced after the World War II.

In 1962, when it was proposed that PETROMIN be established, the Regulation for the Protection and Encouragement of National Industries was promulgated to encourage the development of manufacturing industries in the private sector. This law exempted machinery, equipment and raw materials for manufacturing from import duties. To promote foreign investment, the Foreign Capital Investment Code was promulgated in 1964. This exempts joint ventures in which Saudi capital occupies more than 25% of the total investment from corporate income tax for five years after the initiation of operation*.

To acquire the privileges of these two acts, it is necessary to apply to and receive approval from the Ministry of Commerce and Industry. The list of businesses approved by the ministry by the end of 1970 is shown in Table 4. The number of businesses (number of plants) was 271 which includes the plants which had not yet started operation but excludes plants which had terminated operation. This table also excludes the businesses owned by PETROMIN or by petroleum companies.

Among the industries in the list, the cement industry is largest. Cement factories were established in Jeddah in 1958, in Hofuf in 1961 and in Riyadh in 1966. All three factories have been expanded several times and production capacity of each factory is more than 1,000 ton/day at the present stage. Also, the soft drink industry, brick industry and concrete block industry, which includes many smaller scale firms, and the furniture (wood and steel) and fixture industries are prominent.

In the fishery processing industry, one company has a monopoly in lobsters trapped in the Arabian Gulf and exports them in frozen form. Major products of the

* Income tax for both Saudi subjects and corporations is almost nominal.

textile industry are carpets and towels. The basic chemical industry produces oxygen, nitrogen and acetylene gas, among other products. In the metal product manufacturing industry, major products are sheet metal, kitchen utensils and desert coolers (simple coolers which use only water and fans).

The number of newly manufacturing firms is increasing. Of the firms in the table, 130 were approved during the three years from 1968 to 1970. Major business categories which were approved in a recent three-year period are biscuits, chocolate, ice cream, soft drinks, poultry feed, towels, sewing, casting, turning, aluminum window frames, steel furniture, beds, kraft paper bags, toilet tissue, printing, plastic processing, foam rubber, soap, drugs, asbestos pipe, polyvinyl chloride pipe, aluminum, copper home utensils, desert coolers, nails, bolts, plaster, ropes and electric wire.

Among these lines of businesses, foreign capital was introduced in relatively large scale undertakings such as soap, drugs, asbesto pipe, polyvinyl chloride pipe and soft drinks. At the end of 1971, the number of joint ventures provided with foreign capital was 36 and there were 30 companies which were fully owned by foreign corporations. The among of foreign capital invested in these 66 firms was 38.3 million rials.

Summarizing the above, a list of relatively large scale firms operating or under construction at this writing is shown in Table 5 (excluding oil refineries of foreign petroleum companies).

(11) Economy, National Income and Public Finance

The economic development of this country has been promoted through the Government expenditures which have been supported mainly by the revenue from petroleum. Changes in the national budget of Saudi Arabia are shown

in Table 6. It can be seen that the share and amount of development-related budget allocations have been increasing rapidly. Distribution of the project budget by sector in a recent five-year period is shown in Table 7.

In regard to public finance, the Government has been maintaining the principle of a balanced budget. Eighty-five percent of the total revenue from petroleum is in foreign currencies. Economic development of this country clearly depends on the revenue from petroleum and the increasing public finance based on that revenue. Although most consumer goods and durables must be supplied by imports, the balance of the foreign account has been sound. Due to Saudi Arabia's provision of aid for two Arabian countries after the 1967 Suez War, the financial condition of this country faced some difficulty during the past three years and an income tax was imposed in September, 1970. In fiscal 1971, however, this income tax was eliminated because of a sharp increase in the revenue from petroleum after the Teheran Agreement in February, 1971. Foreign currency reserves, which had decreased during the three-year period, started to increase in fiscal 1971.

In spite of the insufficiency of basic statistics, the Ministry of Finance and Economy estimated the gross domestic product by industrial sectors in a recent ten-years period, as shown in Table 10. It can be seem from the table that as characteristics of the economy of Saudi Arabia half of the GDP comes from the petroleum industry, almost 20% is generated through the public sector, only 30 percent is generated by private industries excluding petroleum, and the share of manufacturing industries is as low as 2%.

Finally, it should be mentioned that the average annual rate of increase of the price index in this country has been about 2% and the average annual rate of

growth of the real gross national product has been 7.5% which is a sound pace, in the past seven years.

II. FIVE YEAR DEVELOPMENT INTRODUCTION

Although task for formulation of an all-round, long-term economic development plan was started when King Faisal assumed power, it was however, almost impossible to make a comprehensive plan due to lack of basic relevent statistics. In 1965, the Central Planning Organization (CPO) was established, to execute basic research on the economy of the country and to formulate the five-year development plan. In 1968, after a contract was signed with Stanford Research Institute, full-scale research on basic economic conditions was implemented and full scale preparations for formulating the five-year plan were started.

After analyzing past performance of the economy, the CPO announced the guidelines of the plan in September 1969, and it was intended to begin execution of the plan in fiscal 1970.

On the basis of these guidelines, specific goals were determined and feasible projects were examined by each ministry. All projects were arranged by CPO and total expenditures required were calculated. The five-year plan was thus established.

The major characteristics of the plan are as follows:

(1) In a global framework, the projected rate of growth by sector and therefore the total rate of growth of the gross domestic product were presented in the first part, and then, on a sector-by sector basis, goals, projects required to attain those goals, and government expenditures required are presented.

(2) Inter-relationships among the figures in various sectors in the plan are not clear from the viewpoint of econometrical explanation. This may be expected as a result of lack of demographic and basic economic statistics and quantitative indication of the relations between sectors

were not available. Therefore this development plan should not be considered to be similar to economic development plans made by developed countries, and it should be understood that the development in each sector during this five-year period is still in a preparatory stage.

(3) Although economic diversification and departure from the petroleum monoculture economy are mentioned in the foreword of the plan, the major characteristic of the plan is its emphasis on public investment based on the revenue from petroleum. Formation of the basic agricultural structure has been encouraged but the increase in production is expected to be only 4.6% p.a. Even if supposed a high rate of growth expected of mining and manufacturing, the share of this sector in the gross domestic product in 1975 is expected to be only 3.5%. Among the projects in mining and manufacturing, major projects by PETROMIN depend on cooperation of foreign companies as partners. In regard to private industry's activities of this sector, the Industrial Studies and Development Center (ISDC) provided a list of expected industries which are open to private interests, and this list is no more than a guideline for the private sector. It will be a crucial problem whether the private sector can promote these industries by their own effort.

(4) Projections of government revenue, which are the basis of the plan, are computed based on the projection of a 9.1% increase in petroleum revenue. Judging from the later changes in financial terms of petroleum concession agreements, it is clear that the actual revenue from petroleum will be more than expected and there will be no financial problem in executing the plan. Rather than financial constraints, then, the possible constraint which may occur is that posed by the administrative abilities of plan execution. In this respect, reform of the administrative system and completion of statistics are included in the plan.

(5) It is especially evident in the plan that development of human resources will crucially influence the future development of this country. For each sector, plans of training for required number of technicians and workers are mentioned. There is one chapter particularly concerned with manpower development plan and which analyzes in detail projected supply and demand of manpower. According to this projection, if each sector develops as set forth in the plan, the gap between supply and demand of manpower will further widen even if the education and training program is accomplished, and this program shows the highest rate of increase in the government expenditure. This dramatizes the urgent nature of the problem of human resource development.

The planned annual growth rates of value added by sector is summarized in Table 13 and the amount of government expediture required is shown in Table 14.

1. Administrative System

To improve efficiency in administration, an administrative reform plan will be promoted, which includes both centralization of some functions and decentralization of other functions by transferring authorities to local level. First, a High Committee for Administrative Reform is to be created and a general plan for improving the organization of government is to be formulated, and second, a Public Works Department is to be established. Third, the Central Budget Department is to be strengthened and the department of budget and accounting of each ministry is to be improved. Fourth, the General Personnel Bureau is to be strengthened and conditions of employment in the public services improved; fifth, central purchasing and contracting is to be promoted. Sixth, administrative training is to be extended, and seventh, administration at the regional and district level is to be strengthened and more government functions are to be decentralized to the local level. As the specific

plans, first, improvement of statistics such as census information; second, mapping of the country, and third, several surveys and research by CPO, are mentioned in the plan.

2. Manpower Development , Education and Vocational Training

A) Manpower Development

Recognizing that the most important constraint on Saudi Arabia's development is manpower resources, this problem is analyzed by projecting demand for and supply of manpower resources. For the demand, the required manpower at the end of the five year plan is estimated assuming that all projects in the plan are to be accomplished. For supply, available manpower supply is computed by adding the amount of manpower presently available and amount of manpower expected to be supplied from the education projects in the plan, and adjusting these figures by taking account of improved quality due to training in vocational training centers and other governmental institutes. The results are shown in Table 15. This Table shows that the gap between demand and supply of manpower will be further widened as the projects in the plan are achieved and suggests that foreigners must be employed to fill the gap. On the basis of this computation, promotion of education by the Ministry of Education, improvement of vocational training by the Ministry of Labor, and support for other training systems by the government and private sector are considered to be crucially important in order to attain effective mobilization of domestic manpower resources in the economic development process.

(1) Education

i. General Education

Boys: At the end of the plan, it is expected that at least 90% of six-year-olds will have enrolled in primary schools, 85% of graduates of primary schools will have enrolled in intermediate schools and 50% of graduates of intermediate schools are expected to enroll in secondary schools. To achieve this goal, the number of schools and classes will be increased and teacher training institutions will be improved and expanded. Vocational education at the secondary school level will be also increased, by increasing the number of industrial schools from four to ten. In addition, three commercial schools and four agricultural technical school will be founded by the end of the plan period.

Girls: The number of primary schools for girls will have been increased from 347 to 959 and 17.4% of graduates of these primary schools will have enrolled in intermediate schools by the final year of the plan period. The number of students in secondary schools for girls will be also expanded from 350 to 4,900. To satisfy the need for women teachers, a woman teacher's college will be established.

ii. High Education

University of Rivadh: It is planned to provide capacity for enrolling 50% of the general secondary school graduates and to strengthen all present eight faculties through engaging additional staff and constructing additional facilities as necessary to match enrollment increases. It is also intended to attain a student/faculty staff ratio of 10:1 by the end of the plan period, to relocate and concentrate

university facilities during the plan period and improve the facilities of the Faculty of Medicine.

College of Petroleum and Minerals: It is proposed to expand undergraduate enrollment to the level of 1,150 students by the end of the plan period, to complete the present campus development master plan and to initiate graduate studies.

College of Education, Mecca: It is expected to increase enrollment to approximately 950 students and to increase the number of trained teachers graduated annually to approximately 150 at the end of the plan period.

King Abdul Aziz University: Total enrollment is planned to be 825 students by the final year of the plan period and the Faculty of Arts and Human Sciences will be expanded from one to three departments. A Department of Accounting will be established in the Faculty of Economics and Administration. It is also planned to initate studies for eventual establishment of a Faculty of Sciences.

iii. Religious Education

It is expected to increase the number of religious institutes for education from 37 to 41 and to increase present total enrollment by 45% at the end of the plan period. In the College of Arabic Language and College of Shariah, it is planned to increase acceptance of new students to 48% and 41% of the total graduates of religious institutes respectively.

iv. Special Programs for Education

It is planned to provide additional facilities for the academic and vocational instruction of the blind, deaf and dumb and also to expand the opportunities for part-time adult education at all levels.
Extension of the literacy center system, continuation of the summer campaign program and use of educational television is also mentioned in the plan. The number of people put through these program is to be increased from 40,000 to 77,000 per annum.

When these programs are put into effect, the total enrollment by the end of the plan period of male students is to be 416,000 in primary schools, 80,000 in intermediate schools, 18,000 in secondary schools, and 2,700 in technical schools of secondary level.
The total enrollment of female students is to be 224,500 in primary schools, 23,500 in intermediate schools and 4,900 in secondary schools. In teacher training institutions, 12,500 male students and 4,900 female students will have enrolled by the final year of the plan period. In universities, there will be 9,800 students in general universities not including those studying abroad and 5,000 students in religious universities.

(2) Vocational training

To provide about 7,000 skilled and semi-skilled laborers from the existing vocational training centers during the plan period, it is planned to increase the present number of sections in the six training centers from 42 to 75. It is also proposed to establish six small vocational training centers, each of which has the capacity of graduating 100 skilled laborers annually, and three preliminary training centers for younger people.

3. Public Infomation

In order to extend shortwave and medium-wave coverage, a radio station will be established in Tabuk in the north and in Jizan in the south. The number of television stations will be increased from four to five. Transmission lines between Riyadh, Jeddah, and Qassim are to be improved. It is also planned to provide new research facilities and to improve programing and other techniques.

4. Health and Medical Care; Social Affairs

(1) Health and Medical Care

i. Administrative improvement

To make more effective use of doctors, the systems of planning, budgeting, staffing and payment will be improved.

ii. Medical supplies

It is proposed to decentralize stores to improve efficiency of medical supplies on the basis of the guidance of an expert from the WHO.

iii. Manpower development

The number of doctors will be increased from the present 1,020 to 1,600 and proportion of Saudi Arabians employed as doctors will be increased from the present 15% to 35% by the end of the plan period. The number of paramedical technicians will be also increased from the present 2,400 to 5,300 and training institutes will be extended to achieve this goal. Specialized training in preventive medicine and public health doctors (76), technicians (149) and administrators (27) is mentioned in detail in the plan.

iv. Over-all organization of health and medical care

The country will be divided into six health care regions, each of which have central hospital, a training institute, a research unit and special hospitals. Each health region will be divided into three or four health units each of which will have a local hospital and health centers. To reformulate the present health and medical care system into this new health network, improvement and expansion of existing hospitals and construction of new medical facilities are proposed in the plan.

v. Others

It is proposed to implement medical survey research, to promote preventive medical care and to improve programs of the Saudi Red Crescent Society.

To implement studies of problems of health and medical care system, such as relations between public and private medical care systems, is also proposed in the plan.

(2) Social welfare programs

It is proposed to improve social orientation institutions for juveniles, and social welfare institutions for institutional care of the aged and the disabled and also to increase social security offices in order to improve services such as relief assistance to social security beneficiaries.

It is proposed that community development centers be extended. To achieve these goals it is planned to expand training of social workers. To promote establishment of cooperatives, subsidies will be offered.

(3) Labor Affairs

To implement provisions of the new labor law of 1969, the following specific objectives are proposed: establishing a general department of labor, expanding the system of branch labor offices from the present 21 to 29, improvement of the employment opportunity program, expansion of the scope of statistical survey and finally initiation of training programs for field and office staff.

(4) Housing

In relation to housing, only indirect assistance of the government has been offered, through programs for urban development and public utilities. In the plan, however, it is proposed to establish a Department of Housing within the Ministry of Finance and National Economy. Surveys and research on housing and planning, for the purpose of establishing financial institution for housing, are to be implemented by the department during the period of the plan.

5. Public Utilities and Urban Development

(1) Electricity

i. Urban Electric Companies

The power consumption in seven major cities is expected to amout to 1.5 billion KWh at the end of the plan period.

Rapid expansion of the existing seven companies will continue to 1.6 times of the existing capacity, 250MW. In this projection, however, increases in demand for electricity due to new large-scale factories are not included.

ii. Rural Electrification

To promote rural electrification, the plan proposed to provide interest-free long-term loans for construction of generating plants in towns with population of more than 2,000. The loan period is 15 years and there is a three-year grace period.

iii. Organization for Electric Service Administration

The High Committee for Administration of Electricity will be established to issue rules and regulations, to study electric rates and technical regulations, to promote rural electrification and also to supervise the program of unifying voltage and frequency. By the end of 1975, the sevice voltage and frequency will be standardized throughout the country at 220/380 volts and 50 cycles.

(2) Water

General responsiblities for the development of water resources and the construction of a supply system lie with the Ministry of Agriculture and Water. This will complete the existing projects of drilling wells and constructing supply systems in major cities like Riyadh and Jeddah and also on-going projects of drilling 550 wells and constructing 162 supply systems in provincial towns during the plan period.

As special projects, it is proposed that dam construction at Abha in Assir district, construction of 20 desalination plants in al-Khobar, Khafji and other coastal cities and expansion of the desalination station in Jeddah will be accomplished by the end of the plan period.

Distribution systems, when completed by the Ministry of Agriculture and Water, will be operated and administered by the Ministry of Interior which will establish water administrative systems including system of collecting usage charges at the local level.

(3) Municipalities

A major program during the period will be to pave roads and by the final year of the plan period, a total of 1,270 km of roads will have been constructed in major cities and construction of an additional 550 km will have been accomplished in local towns and villages.

Municipal buildings will be completed in the eleven main cities, and a slaughter house, and a meat and vegetable market will be established in each city.

Twenty-three percent of the total budget for the program period will be spent on sewage systems. Three-fourths of this will be expended in four major cities including Riyadh and remaining one-fourth will be used for other six cities. Preparatory research will be initiated for remaining cities.

In Riyadh and other major five cities, storm water drainage systems will be constructed.

It is recognized that a regional development plan covering a wide area for long-range urban development program in the future must be intensively studied.

6. Transportation and Communications

(1) Roads

Completion of 1,195 km of main roads under construction, construction of 1,286 km of roads already designed and construction of 1,832 km of roads under design are proposed during the plan period.

The total length of road construction during the plan period therefore will amount to 4,312 km. In addition to this, study and design of 94 km of roads will be completed during the plan period.

Besides these main roads, completion of 900 km of feeder roads which connect villages with these main roads is planned, (Completion of study and design of 300 km of additional feeder roads is also proposed in the plan.) The construction of rural roads which connect neighboring villages until the construction of asphalt-top roads is carried out by the Rural Roads Division of the Ministry of Communication, and 2,000 km of them will be completed during the plan period. During this plan period, the maintenance program is expected to eliminate the backlog of work and build up an organization which, in ten years, could control all road maintenance with adequate trained Saudi Arabian personnel.

(2) Ports and Railroads

The projects at Jeddah, Dammam and Jizan will be completed by the end of the period, and these annual landing capacities will be 1,700,000 tons, 2,750,000 tons and 500,000 tons respectively. A third berth in Yanbu is also proposed to be constructed if economically feasible. It is also planned to start studying expansion of six Red Sea ports and three small scale Arabian Gulf ports for domestic transportation.

No new railroad construction is proposed in the plan.

(3) Airlines

It is proposed in the plan to improve domestic airports to introduce jet service and to upgrade control and guidance systems. Introduction of domestic jet service will be further promoted, and market development efforts will be made, as well as efforts to improve the load ratio. Concerning ground service technicians, who at present are mainly foreigners,

promotion of a training program is proposed. Large-scale substitution of foreign technicians by Saudi Arabians is not, however, expected. As far as international service is concerned, Rome and Paris will be added to cities presently served and the possiblility of absorption of pilgrims as customers will be explored.

(4) Telecommunications

It is expected that a total of 137,000 automatic telephones will have been installed and 41 telephone stations will have been constructed by the end of the plan period. Attainment of these targets, however,will not be sufficient to meet the total expected demand for services. Coaxial cable, microwave trunk routes or both connecting the western and eastern regions through Riyadh will have been completed by the end of the plan period. Regarding international telephone service, earth stations are proposed in Jeddah and Riyadh to facilitate communication with most areas outside the country via satellite, and coaxial cable and microwave channels are proposed to connect Bahra in and Kuwait with Dammam. Telex services will be introduced by completion of systems above mentioned. Although operation of this expanded telecommunications system will be entrusted to foreign companies for some time, it is planned to establish a government-operated coorporation to operate them in the future. To achieve this goal, training institutes for telecommunication technicians will be constructed in Jeddah and Riyadh.

(5) Meteorological Service

The Meteorology Department, which was recently established, will establish a domestic and international meterological observation system during the plan period. In this effort, three more surface observation stations and six upper atmosphere observation stations will be

established and modern equipment for the reception of radioteletype transmissions from international regional stations and satellites will be installed. A national Meteorological Center will be estabished and weather maps will be made by the staff of the center. Transmitting stations will be constructed in Jeddah, Riyadh and Dahran to supply services of receiving and sending of data by observation stations for the Air Force and the Ministry of Agriculture and Water. A National Meteorological School is to be established in cooperation with King Abdul Azia University in Jeddah to provide personnel requirement.

(6) Postal Service

In spite of the fact that the volume of mail is expected to continue to increase by about 10% p.a., the efficiency and reliability of the postal services are far from sufficient. Only 20 new post offices will be constructed during the plan period, but main objective of the development program is to improve inadequate administrative system and operation. Many detailed measures are proposed to achieve these objectives. These are, for example, revision of the current practice of registering governmental mail in such a way that only the most important documents are registered, strengthening relations with customs and cooperation with airline companies, mechanization of services, and especially the dispatch of trainees to England and establishing a training institute to provide short courses for postal services. However, required manpower will be introduced from neighboring Arabian countries.

7. Mining and Manufacturing Industry

Except projects by PETROMIN, projects in manufacturing rely on the activities in the private sector, and the plan consists of nothing but guidelines for programs in the private sector, which are completely different from other governmental projects. Only two construction projects, a silo and a flour

mill in Dammam, will be implemented by the government. An Industrial Bank will be established by the government at an early stage of the plan period. The Industrial Studies and Development Center, which was also founded by the government to promote industrial development in the private sector, will establish industrial estates in Riyadh, Jeddah and Dammam, study the feasibility of establishing various manufacturing industries and make rationalization guidance for management and technology of small and medium size firms.

A) Petroleum

It was already mentioned that the expected rate of growth of crude oil production is 9.1% p.a. The plan does not mention any specific project or proposal about foreign oil companies. Business activities to be undertaken by PETROMIN, however, are dealt with specifically in the plan. Domestic consumption of petroleum products is expected to be doubled (21,800,000 bbl/year) by the end of the final year of the plan period. PETROMIN will expand the existing oil refinery in Jeddah and will establish a new oil refinery with capacity of 15,000 barrel per day in Riyadh.

Completion of a lubricating oil plant under construction in Jiddah is also expected during the plan period. A tanker company with two 40,000 DWT tankers will be established to facilitate oil transportation between Ras Tannura and Jeddah.

B) Mining

The Department of Mineral Resources will coutinue to make geological maps, and will further investigate promising deposits which have been already discovered by through preliminary survey and sampling analysis. PETROMIN acquired a joint concession with a American mining company and is expecting further application of concession by foreign mining companies. It also intends to study an

all-round development plan for iron ore, rock phosphate and gypsum in northeast.

C) Manufacturing Industry

i. PETROMIN

Projects by PETROMIN are shown in Table 16. If all the projects are realized funds required will amount to 5,112 million Rials, but half of the capital requirement will be loans and remining half will provided by equity capital, half of which will private domestic capital and/or foreign capital.

ii. Private manufacturing sector

Projections have been made by ISDC of the potential growth of the private manufacturing sector based on the survey of existing firms in 1968 and on the brief feasibility studies including market projections and on the target of annual growth rate of 14% in manufacturing sector. The list of projects formulated on the basis of this estimated growth rate is shown in Table 17. The projects in the list are however considered to be a tentative plan. Some projects in the list may not be realized and some other projects which do not appear in the list may be realized by private circies.

8. Agriculture

Expected agricultural production by the end of the plan period is shown in Table 18. Production of wheat and vegetables, as well as alfalfa for livestock feed, are expected to increase. The average rate of growth of agricultural production is expected to be 4.9% p.a. including livestock and the average rate of growth of crop production will be 4.3% p.a. Increase of crop production in now under cultivation can be achieved by

increases in per-hectare yield through the following measures: (1) use of improved varieties, (2) introduction machine, (3) improvement of irrigation systems, (4) use of fertilizer, and (5) efficient rotation of crops. In the plan it is emphasized to promote autonomous activity of farmers through government support in the form of agricultural extension work and demonstration projects. To support private activities of farmers, half of the cost of purchasing machines and fertilizer will be subsidized by the government and remaining half will be available from the Agricultural Bank as loans.

To promote the new use of unused land, the government will allocate the lands to those who intend to cultivate them, after undertaking hydrological and agronomical surverys, providing specifications for well and irrigation systems and providing financing for their construction through the Agricultural Bank.

Three large-scale projects now being carried out by the government--irrigation and drainage system under construction in al Hasa, the King Faisal Settlement in Haradh, and Wadi Jizan Irrigation Project--will be completed during the plan period. Besides these large projects, the government will, first, improve and reorganize agricultural experimental stations through clarification of the specific objective of each station, second, study practical application of the results of the experimental stations work such as improvement of varieties, and third, promote extension worker training in the Ministry of Agriculture and Water.

9. Trade and Services

A planning Bureau in the Ministry of Commerce and Industry will be established in order to coordinate the activities of trade and financial services which efficiency have crucial importance for development of the economy. Major objective of the bureau are to coordinate interests of dealers in imports and domestic industrialists from the point of view of consumer protection, and of promotion of domestic industries. In the

Planning Bureau, the following measures are proposed to achieve the goal. First, the tariff system will be reviewed and improved. Second, the juridical framework for the settlement of commercial disputes will be strengthened, and third, quality control of commodities will be also strengthened.

The Planning Bureau will also promote public information for business, take part in international fairs to improve international relations and implement business training in cooperation with the Ministry of Education, ISDC and the Chamber of Commerce.

III. JAPAN'S ECONOMIC COOPERATION WITH SAUDI ARABIA

1. The Background

(1) From the viewpoint of Saudi Arabia

Saudi Arabia holds a quarter of the world's proved reserved at present and is the largest oil holder. The country provides a large part of the annual increases in the world's oil supply and her position in the over-all picture of world oil supply is increasing in importance. Judging from the importance of oil in international economy and politics, this implies that Saudi Arabia's actions potentially exert a large influence upon the world's economic and political stability. As the oil production increases, the Saudi Arabian GNP will continue to increase. The fact, however, that this future prosperity depends on the naturally limited underground resources is a fundamental matter of concern, in relation to the future, for the people of Saudi Arabia. In other words, the depletion of oil resources would mean shrinkage of the economy; if the oil resources are fully depleted, the economy would become as farren as the country's desert. However, those who have started enjoying the benevolent influence of modern civilization will never be able to withstand. It is therefore of fundamental importance that Saudi Arabia establish such GNP sources utilizing the income from oil, as long as it lasts, so that following the decline of oil production civilized living standard could be maintained even without any oil revenue. If the ratio between oil reserves and annual production will become only 30 or 40 sometime in future, when the remaining time is likely to be insufficient to accomplish this, it is likely that the Saudi Arabian government will restrict oil production so as to buy time to prepare on behalf of the generations to come, contrary to the expectation of oil-consuming countries.

It has already been mentioned that Saudi Arabia is endeavoring for development to solve the fundamental problem of obtaining sources of income other than oil, but to attain success, however, the technical cooperation of developed countries is needed. In connection with this, it seems that the Kingdom hopes to improve its cooperative relationship with Japan, which has been weaker in technical and economic cooperation relations than many other countries. King Faisal's visit to Japan for the first time in 1971, the first such visit by a Saudi Arabian ruler, and the proposal that an economic cooperation agreement be signed are results of this fundamental policy.

(2) From the viewpoint of Economic Cooperation

Japanese economic cooperation for Saudi Arabia requires somewhat different principles and methods from those used in cooperation with Southeast Asian countries. This cooperation can be characterized, in a word, as cooperation with a "rich developing country" and, moreover, the following problems can be identified. These are considered in the following paragraphs.

1. A problem of mutual attitude toward cooperation
2. A problem of the areas and measures for cooperation
3. Coordination with others' efforts for cooperation
4. Special aspects of the Kingdom of Saudi Arabia

A) The Mutual Attitude Towards the Cooperation and the Importance of Understanding Saudi Arabia's Social Situation

It is difficult to expect good results of cooperation between the two countries unless there is mutual understanding the way of thinking of each other. Especially in regard to Saudi Arabia, the following aspects should be well considered.

1. Problems of arising from the question-- unfamiliar to Japan-- of "cooperation" with a "rich developing country".

2. Problems of mentality difference which have resulted from the particular socio-psychological situations under the effort for a rapid progress to get out the traditional society, the harshness of the environment and the discipline of Islam.

First, the strong pride of Arabs has never been sullied because the country (except for some cities along the coast once occupied by Turkey, the central part has never been conquered) has never been conquered. In addition to this, this country has a strong self-confident feeling that they can do without any foreign financial assistance since they have been making all social and economic changes by using their own money, within the frame of a sound fiscal policy. Under this policy, Saudi Arabia has been easily receiving cooperation from abroad by paying for it. On the other hand, in Japan, for historical reasons economic cooperation has often implied economic aid, as when doing some one a favor. In cooperating with Saudi Arabia, however, Japan must not permit such a feeling from arising. It is, therefore, necessary to well understand the social situation prevailing in this country, and to keep in mind the significance of cooperation for Saudi Arabia's development. Further, the concept of cooperation, to Saudi Arabia, does not necessarilly mean gratuitious cooperation but is considered to include cooperation provided on the basis of a contract for the purchase of services. Because of their pride, Saudi Arabians do not persistently request cooperation, which tends to cause Japan to misunderstand true intentions. Thus, it is quite important to maintain good bilateral communications with Saudi Arabia.

B) Areas for Japan's Cooperation

Because Saudi Arabia is considered to be a "rich developing country", areas and measures for cooperation to be extended by developed countries to this country will differ from those for other developing countries. First of all,

extending loans, except for the deferment of payments in principle can not be concidered. Furthermore, grants for infrastructural projects, which are common in cooperation activities for developing countries, in principle can not be considered, because making a master plan, designing, engineering and construction are all done by international tender on commercial basis in this country.

At the present stage, what Saudi Arabia may expect from Japan are mainly the following.

1. Cooperation in the oil industry
2. Cooperation in the natural-gas-based industry
3. Cooperation in the development of mineral resources
4. Cooperation for the development of human resources
5. Cooperation in private manufacturing industries for the domestic market

Among these, activities under the fourth item, that is, the development of human resources, on a government-to-government base. Activities under the other items be carried out by private Japanese enterprises, and accordingly the Government would take an indirect role.

C) Foreign Cooperation for Saudi Arabia

Saudi Arabia, which suffers from an extreme shortage of well-trained human resources in both the public and private sectors, has to depend on the technical cooperation from abroad. Because the country has ample financial resources, it employs many foreign experts under individual contracts as well as those who are sent according to agreements with various organizations of the United Nations and European countries.

Also, because Saudi Arabia has extremely limited ability to provide advanced and professional education to its people, has been sending many people abroad to study with the aid of Government scholarships. Among the total number of foreign study scholarship recipients (1,790), by the end of 1969/1970,

430 has been sent to Islamic countries; 567 has been sent to the United States. In addition, many trainees have been sent to Islamic countries, Europe and the United States.

The United Nations has dispatched many missions for surveys in various fields, and they have submitted valuable reports. The United Nations also has been sponsoring trainees abroad, and established a special fund and provided guidance for the Wadi Jizan Irrigation Project, establishment of the faculties of technology and education in Riyadh University, and establishment and management of the Qatif Agricultural Experimental Station.

European countries and the United States are providing opportunities and scholarships for study abroad and for other trainee programs and are sending, on the basis of contracts, many specialists in many fields, through governmental and private organizations. For example, the curriculum planning in junior college of technology, the supply of teaching materials, and the training of teachers is being performed under contract by West Germany; the dispatch of professors to the medical faculty of Riyadh University and for post-graduate education is beeing done by the University of London; agricultural research in Hofuf is beeing undertaken by universities in West Germany and England; Saudi Arabian Airways is operated under contract by Trans World Airlines, of while ground maintenance work is being done by Lockheed, and investigation into geology and mineral resources is cooperated by the geological survey institutes in United States, France and Japan.

In principle the costs of this are paid by Saudi Arabia, based on contracts, even if part of the costs are paid by cooperating countries as is true in some cases.

The number of manufacturing establishments owned by foreign interests, and joint ventures with foreign capital, including foreign Arabic capital which have been approved by the end of March 1971 amounts to 66. In addition among

PETROMIN affiliates are several joint ventures with foreign enterprises. There are no joint ventures with equity participation from Japan except for the Arabian Oil Company. In short, many European nations and the United States have been cooperating with Saudi Arabia in various ways which differ in principle from the way used by Japanese Government, which requires that overseas cooperation should start with an explicit request from the developing country in question and should that costs be paid by Japan in principle. If the Japanese Government adheres to this principle and follows normal procedure, projects under consideration will be undertaken by other countries on contract basis before Japan reaches a decision.

2. Japan's Cooperation

(1) Provision of Information and Materials

Information and materials on Saudi Arabia, available in Japan, are insufficient, and in Saudi Arabia hardly any information and materials are available on the Japanese economy, industry, technology and other subjects, which might be very helpful when Saudi Arabian officials consider the cooperative projects with Japan. Saudi Arabia possesses far less information on Japan than on other countries. This is a fundamental problem of great importance either in the narrow sense of the cooperative practice or in the broad sense of future mutual cooperative relationship. Actually, according to the survey team's direct contact, Industrial Studies and Development Center (ISDC) is seeking industrial information from Japan in English especially translation of Japanese industrial standards. The faculties of Riyadh University has not yet arranged to receive published literature on a regular basis, but the Faculty of Commerce is seeking literature in English on Japan's history of economic development. It would be useful for if periodicals were to be regularly sent to those organizations, for which Japanese-origin information is of particularly high value.

As already mentioned, various kinds of projects are being implemented in Saudi Arabia, with a mixture of cooperation and commercial activities, and because of this it is necessary to establish an office in Riyadh to obtain information and convey it to the appropriate governmental offices and private organizations and companies in Japan as well as to promote bilateral communication between private industrial circles. In regard to private-base cooperation for industrial development in Saudi Arabia, first of all, it appears necessary to exchange fact-finding missions between the Chambers of Commerce and Industry of Japan and Saudi Arabia, in order for each to become familiar with the situation in the other country and to establish a channel for bilateral communication.

(2) Training in Japan

In Japan, training for persons from developing countries is provided primarily by Overseas Technical Cooperation Agency (OTCA) but also by other organizations, but from Saudi Arabia thus far only a few trainees have been accepted, except for by about 20 trained by Kokusai Denshin Denwa (International Telegraph and Telephone Corporation). The survey team found out that organizations under each ministry in Saudi Arabia want to know whether their personnel can be trained in Japan.

An invitation to nominate persons for training by the OTCA is sent annually to the Saudi Arabian Government through the Japanese Embassy. This invitation, however, is only for a few persons, is for a ready-made program and does not indicate whether the OTCA training program would be suitable for Saudi Arabia, in terms of field of specialization, standard of training, the number of members and the period. So far, therefore, Saudi Arabia has not made any nominations. So that Saudi Arabia may utilize the opportunities offered by Japan's training programs, consultation with the Saudi Arabian government would be required.

(3) Dispatch of Specialists

Specialists are dispatched on an individual and project basis. At present, in the former case, there will be dispatch of (1) statisticians and (2) specialists to the ISDC. In the future, a dispatch of specialists in economic administration for economic organizations--the Ministry of Finance and National Economy and the Central planning Organization--will be considered.

A. Statistics/Economic Administration:

To accelerate economic and technical cooperation comprehensively and effectively, it will be important to send specialists to the central economic offices and to keep informed on the fundamental economic situation in Saudi Arabia. Specifically, first, the dispatch of statisticians to the Central Department of Statistics must be considered. In addition, as far the future, the dispatch of economists to the Ministry of Finance and National Economy or the Central Planning Organization will be valuable, when the importance of economic administration increases regarding attaining the nation's long-term goal, namely, the diversification of the income resources.

B. Industrial Studies and Development Center

ISDC is the government organization which is in charge of promoting the establishment of private industries. After completing a basic survey of private industry, the ISDC is working at creating industrial estates in the surburbs of three major cities and intends to start guiding rationalization activities for small-scale factories with assistance of foreign experts.

The concrete desire of the ISDC is to secure the services of industrial economists, civil engineers, and mechanical engineers from abroad, under one- to three-year contracts. In addition, the possibility of employing specialists for the feasibility studies for establishing various industries, under

two- to three-month contracts, is being studied by the ISDC.

C. Agriculture

In the field of agricultural cooperation, it will be more realistic to contact for of specialists on project-team basis than an individual basis dispatch. But there is also the possibility of sending specialists individually to each agricultural laboratory and the experimental station. The specific request this time would be for the dispatch of a specialist in chick sexing at Qatif Argicultural Experimental Station, where he would teach techniques to Saudi Arabian.

(4) Supply of Machinery

The supply of machinery is generally supposed to be undertaken as part of project-basis cooperation. Specifically, the ISDC has inquired as to the possibility of supplying machine tools of new style in order to renew the old-fashioned machine tools in machine shops. This can be considered as one type of project for cooperation including instruction on the use of new types of machinery.

(5) Project-Basis Cooperation

A. Vocational Training Center

Technical education in Saudi Arabia is an important field which needs foreign cooperation. Industrial high schools were set up with technical cooperation from abroad; the establishment of industrial junior college has been already contracted for with West Germany. Concerning fields, the improvement of some sectors in the vocational training centers might be a suitable objective for Japan's cooperation. There are already five vocational training centers and one is under construction. Because officials of the Ministry of Labor consider that training in radio and television set repair, in the vocational training centers, should be improved, they are seeking foreign assistance to improve the quality of instruction (including the necessary materials). There is thus a good chance for

Japan to cooperate by sending supervisors, supplying teaching materials and educating instructors. If such an effort proves successful, it is possible that such cooperation may be expanded to other subjects and to even to the administration of vocational training centers.

B. Agriculture

In the field of agricultural cooperation, there are good chances to cooperate on a project contract basis for projects of various scale. The survey team feels, however, that great care is required in selection of such projects and ways to cooperate in agriculture, because agricultural projects tend to take a long time require enormous, continuous effort. Some comment through the investigation held lately are as follows:

1. Agriculture, except for Assir-Tihamat, relies on the use of underground water containing salt, and therefore on leaching of the salt; the soil is highly calcareous and has weak alkalinity. Such conditions of water and soil are rare in Japan so that direct application of techniques developed in Japan cannot be considered.

2. There are, however, still many opportunities to cooperate in research and experiments performed by agricultural experimental stations administered by the Ministry of Agriculture, which have only few years of experience and are neither sufficiently equipped nor staffed.

3. Among the large-scale projects executed by the government, the Haradh project is the newest and most important; it calls for establishment of a full-scale agricultural project where the land has never been cultivated before. It might be, however, somewhat difficult for a Japanese organization to cooperate on this project, because the project also has social aims such as the settling nomadic people, besides the above-

mentioned problems--unfamiliar to Japan--of conditions. On the other hand, if Japan was interested, it might be easier for Japan to cooperate on the Jizan project because in that area surface water is used, the soil consists of a silty alluvial layer, and because it deals with agricultural reform for the sake of already-settled farmers. The year-round climate, however, is very hot and humid. In Al Hasa, Japanese participation would depend on the nature of the research subject, because England, West Germany and Taiwan teams are already participating in research there.

The followings are several sample instances in which Japan could participate in research and experimentation activities.

In Qatif Agricultural Experimental Station, experimentation concentrates on vegetable production, especially the improvement of varieties. This specific field is one in which Japan is highly capable and Japanese specialists could contribute effectively to these efforts. It seems strange to the survey mission that the Dirab and Kharj experiment stations are not concerned with the vegetable production in spite of the importance of vegetable production near the Riyadh region. It seems that it would be valuable if a vegetable production department were to be established in either of the stations by Japanese contribution. Regarding plant breeding of wheat in Kharj, Japan may be able to supply equipment and send wheat breeding team.

The mission believes that laboratories in the Ministry of Agriculture in Riyadh should function as the central research laboratory, and toward this end, Japan may be able to contribute through provision of equipment and expert services.

In addition to these possibilities, the adoption of new techniques is with considering. Hydroponics would save irrigation water; use of the water-proof underground asphalt film method to avoid salt damage resulting from the rise of

the underground water table due to irrigation and at the same time would decrease the infiltration loss of irrigated water. A combination of hydroponics and asphalt film can also be considered. In either case, for the practical application of these techniques to Saudi Arabia, preliminary technical study with experimentation will be needed.

C. Health and Medical Care

Health and medical care can be included in cooperative projects. The present survey has yielded only a rough idea of the situation of Saudi Arabia's medical affairs, the views of those concerned with medicare administration, the procurement of equipment and drugs and the procedures of construction of hospitals. In Saudi Arabia which has ample capital resources, materials, talent and so forth are all procured by tender. Under such circumstances, the understanding of both countries on the relevant conditions is required to specify proper field for bylateral cooperation. In this regard, what should be done is to invite the proper personnels of the Ministry of Health to Visit Japan in order to learn about Japanese medical affairs.

D. Other areas

Although this survey could not cover all fields, a possibility that may also be considered is that Japan contribute to setting up laboratories or institutes for telecommunication, broadcasting and building material testing and so on.

(6) Cooperation in the Oil Industry

To establish a close relationship with Japan in the regard to the oil industry could be an important part of Saudi Arabian policy. Saudi Arabia has initiated a strong drive for equity participation in the oil industry which will lead to PETROMIN's owning 20% Saudi Arabian of oil reserves, and, eventually, direct sales of crude oil to the consuming countries. Further,

Japan seeks a stable supply of crude oil. Regarding putting these two points together, the governor of PETROMIN has said "PETROMIN wants a market and Japanese oil companies want sources. It will be very natural for both to cooperate in joint activities."

However, Japanese oil companies do not have real freedom to undertake joint integrated activity due to administrative restrictions stipulated by the Petroleum Industry Law of Japan.

Therefore, the realization of joint ventures by Japanese oil companies and oil companies in producing countries depends on the policy of Japan's Ministry of International Trade and Industry.

The Japanese Government's oil policy is based on the old pattern of world oil industry, in which the major international oil companies behaved as if they were omnipotent in selling crude oil and they appear as strong competitors of the domestic oil companies in the domestic oil products market, and, has adopted measures to protect the domestic oil refining and marketing companies from threat posed by foreign oil companies. The Ministry of International Trade and Industry is now studying the matter of changing its oil policy, in accordance with the prospects for fundamental changes in the oil supply pattern of the world.

We should recommend to the policy makers, that since their objective is to secure a long-term stable supply of oil, they should objectively observe the current and future changes in the world's oil industry and should take such positive measures to establish a stable relationship on a mutually cooperative basis with oil producing countries, especially Saudi Arabia.

(7) Direct Investment

The development of mining industries in Saudi Arabia largely depends upon the participation of foreign enterprises because they provide markets. In PETROMIN plans for establish-

ing the manufacturing industries, the same is true for technical, managerial, as well as marketing activities. Many of Saudi Arabia's private enterprises need the aid of foreign enterprises in the field of technical and managerial know-how, and therefore welcome the opportunity to form a joint venture. Outside the areas of concern of PETROMIN, hundred-percent foreign-owned enterprises are permitted, but such a company would not be eligible for a tax reduction because the domestic capital participation is less than 25% of the equity.

A) Mining Industries

Many kinds of metalic mineral deposits have been discovered in Saudi Arabia's western mountaineous area. Their development is the work of PETROMIN. Development will not be attempted, however, unless a specific export market can be identified. Therefore, PETROMIN welcomes inquiries and proposals from foreign mining companies for establishment joint ventures.

Last year, a group of Japanese mining companies proposed to undertake joint development of copper, lead and zinc ore. There has been no significant progress in negotiations, however, because of the relationship between depressed price tendency in the world copper market and the financial terms of the agreement draft proposed by Saudi Arabia. The Survey mission hopes that these negotiations are concluded in success.

B) The Petrochemical Industry

The establishment of a petrochemical industry has been Saudi Arabia's strong wish ever since the foundation of PETROMIN. This is the desire to exploit the enormous amount of natural gas found with crude oil, to increase the value added of the nation's important resources and to give added impetus to the building-up of manufacturing industries.

Manufacturing ammonia and fertilizer, which use methane from natural gas as feedstock, has been discussed since the foundation of PETROMIN because it neither requires auxiliary

materials nor produces any by-products, and because market prospects are good. PETROMIN concluded a contract with Occidental Petroleum Co. for plant operation and sales; consequently PETROMIN plant built, a fertilizer plant in Dammam and has been in operation since 1969. At the time when similar fertilizer companies were being established in Iran and Kuwait, forming the first phase of the fertilizer industry along the Arabian Gulf, no companies in Japan ventured to invest in the area. Today the fertilizer industry in Japan faces a serious depression because of excess capacity and also the low price in principal export markets such as China and India. Competition in exporting the fertilizer has come from the area along the Arabian Gulf. Since the cost of natural gas, the raw material for fertilizer in oil producing countries in the Middle East, is very low at the plant site, without any charge at the well-head, competitiveness of the same product in export markets from a plant in Japan, using expensive raw material, would be low, even if demand increases. Further, it is certain that fertilizer plants in the Middle East will be expanded in the future. The mission hopes that Japanese enterprises will be fully aware of these prospects and their long-range implications. We can foresee the same process happening with regard to the methanol industry based on methane.

PETROMIN's interest in the petrochemical industry is concentrated to a degree on the olefin series such as ethylene made from ethane, propane and butane from natural gas. The annual quantity of ethane plus ingredients contained in over 10 billion cu.m. of flared gas in Abqaiq and Ghawar oil fields is sufficient to manufacture over a million tons of ethylene.

A significant characteristic of the olefin series chemical industry is the possibility of diversification of the derivative products; this increases potential for future growth of the industry. This might be what Saudi Arabia is expecting. But, diversification of by-products requires

various auxiliary materials, and a complex marketing arrangement, which have the affect of limiting the feasibility of initiating such an industry in Saudi Arabia.

If a Japanese joint venture were to attempt to manufacture ethylene as a primary product for export taking advantage of the cheap and plentiful supply of raw material, there would be the need to transport to consuming countries (probably including Japan) by cryogenic tanker like as LNG tanker, which would incur high costs (about $30/ton for Japan).

The feasibility of manufacturing and exporting the liquified ethylene depends on the value of by-products such as propylene and butadiene. Furthermore, the gradual growth of the petrochemical industry using naphtha in Southeast Asian countries, which are considered as a potential market for petrochemical products from Saudi Arabia. They must impose high import tariff on imported chemical products if they will establish their own petrochemical industry.

Nevertheless, considering upward trend of world oil prices, effective utilization of the ample natural gas resources in the Middle East, which are being flared at present, is of great importance. It will be feasible to establish a petrochemical industry utilizing associated gas (oil well gas) in Saudi Arabia for exporting to Japan and Southeast Asia if an appropriate product pattern is chosen.

At present, the petrochemical industry in Japan faces a serious depression due to excessive capacity, and new investment is dwedling. But, for after 1975 when it is estimated that demand and supply will be balanced, it is moot whether new investment for the primary phase of the petrochemical industry should be made in Japan or in the Middle East where the raw material costs are very low. In the latter case, the Japanese Government should reduce the import duty for intermediate products. Moreover, it is necessary for both governments to take necessary measures to protect and to encourage investment, to facilitate the decision to invest

by the enterprise concerned.

C) The Iron and Steel Industry

PETROMIN is concerned with the iron and steel industry as an industry based upon mineral resources, as well as the development of iron ore. Though PETROMIN has only one rolling mill having a capacity of 45,000 tons of round bars annually, in Jeddah, its final objective is to establish an integrated iron and steel industry.

An expert on the survey team made a preliminary study of the feasibility of commercial exploitation of the largest iron ore deposits in Saudi Arabia at Wadi Sawawin. According to his report, only a part of the vast potential reserves are commercially exploitable, and, therefore, large-scale exploitation seems to be unfeasible. Domestic demand of iron will be, however, estimated about 300,000 to 500,000 tons annually within few years in the future. In addition, considering the possibility of use of natural gas which has been found in the nothern end of the Red Sea for direct reduction of iron, the possibility of exploitation of selective iron ores in the area will be worthy of consideration.

It is said that another plan to produce steel by direct reduction using natural gas and importing the scrap or iron ore, in the east part of the country, has been suggested by a foreign enterprise.

Since the establishment of an integrated iron and steel industry in Saudi Arabia is still under consideration, there may be an opportunity for the Japanese steel industry to provide know-how and cooperate.

D) Domestic-Market-Oriented Manufacturing Industries

Development of manufacturing industries which are oriented to the domestic market depends upon activities in the private. Government officials and private businessmen, however, feel that the introduction of technical and managerial know-how from abroad is essential to establish new industries.

As is mentioned above, in spite of the existence of several handicaps in Saudi Arabia in general, it is certain that some kinds of product are better produced domestically than imported. On the other hand, it is foreseeable that the specific products might be replaced by domestic ones and importers might lose their market if the product is produced domestically by someone else.

Exports from Japan to Saudi Arabia have shown rapid growth during the past few years. We should pay much attention to the growth trend of domestic manufacturing industry, especially joint ventures by European or American capital. At present, even in Japan the feeling is becoming prevailing that there is need to change the pattern of investment activities away from concentration at home land and interest in direct investment abroad is thus increasing. In this connection, Japanese business circles shoulb pay more attention to Saudi Arabia which is rapidly growing in gross domestic product and has the great potential. Japanese business circles have to learn of real situation in Saudi Arabia. A fact-finding team should be sent from Japan Chamber of Commerce and Industry, and a channel of communication between the chambers in both countries should be established. Also, a liaison office of some organization such as JETRO should be set up in Saudi Arabia to facilitate Japanese investment. Provision of technical cooperation to ISDC will also help in regard to collecting informations concerning these matters.

Table 1. Crude Oil Production and Government Revenue from Oil

Year (A.D)	Crude Oil Production (million bbl)	Government Revenue (million $)
1940	5.1	1.2
1945	21.3	4.3
1950	199.5	56.7
1955	356.4	340.8
1960	480.7	333.7
1961	540.2	377.6
1962	599.7	409.7
1963	651.9	607.7*
1964	694.3	523.2
1965	805.2	662.6
1966	950.1	789.7
1967	1,024.3	909.1
1968	1,114.2	926.8
1969	1,173.9	958.6
1970	1,386.2	1,210.0
1971	1,741.4	2,040.0 (E)

Note: * including special payment, (E): estimated

Table 2. Production and Import of Agricultural Goods
(Unit: thousand tons, (million Rials))

	Production (Value) (1969/70 Est.)	Import (Value) (1968)
Wheat	135 (97)	33 (15)
Barley	37 (22)	10 (3)
Rice	3 (2)	153 (160)
Sorgham	112 (82)	- (-)
Millet	155 (114)	3 (1)
Flour	- (-)	113 (51)
Maize	- (-)	15 (4)
Dates	250 (125)	- (-)
Vegetables	510 (181)	43 (30)
Fruit	94 (78)	72 (53)
Coffee, Tea	- (-)	13 (52)
Sugar	- (-)	91 (33)
Fats & Oils	- (-)	20 (36)
Prepared-Stuffs	- (-)	37 (81)
Alfalfa	1,760 (141)	-
Prepared Animal Foods	- (-)	5 (4)
Others *	- (-)	....(64)
Total	(701)	(587)

* including Tabacco, Salt

Table 3. Animal Breeding, Import and Production of Animal Foods

	(1969/70 Est.) Breeding (Settled) -thousand-		(1969 A.D) Import -thousand-	(Value) (Million SR)	(1969) Slaughtered -thousand- Domestic	Import	Total
Sheep	2,800	(962)	713	(53)	127	593	720
Goat	1,400	(725)	560	(44)	214	257	471
Camel	600	(102)	5	(3)	30	26	56
Cattle	270	(211)	38	(13)	20	36	56
Donkey	100	(98)	0	(0)	-	-	-
Horse	20	(1)	0.2	(0.3)	-	-	-
Poultry	7,000	(7,000)	1,602	(2)			

	Production -thousand tons-	(Value) (Million SR)	Import -thousand tons-	(Value) (Million SR)
Meat	48	(178)	12	(21)
Poultry	4	(18)	7	(21)
Fish	30	(60)	1	(1)
Dairy Products	210	(210)	25	(71)
Egg	*50	(10)	*81	(12)

Note: * unit: million eggs

Table 4. Licensed Factories Under Regulations For The Protection and Encouragement of National Industries & Foreign Capital Investment Regulations

ISDC Code	Industry	No No. of Establishment				Paid-up Capital (Million Rials)				Employees			
		W	C	E	Total	W	C	E	Total	W	C	C	Total
202	Dairy Industry	3	2	1	6	3.27	0.84	0.75	4.86	94	42	30	166
	Seafoods Preparing	-	-	1	1	-	-	7.30	7.30	-	-	446	446
	Confectionery	4	2	2	8	4.06	0.35	0.42	4.83	244	26	32	302
	Foodstuffs Industry	4	1	-	5	3.19	0.10	-	3.29	111	6	-	117
	Poultry Foods	1	-	1	2	0.81	-	0.27	1.08	12	-	14	26
214	Aerated Water & Ice	8	4	7	19	10.95	6.57	12.70	30.22	368	202	509	1,079
231	Spinning & Textile	7	0	1	8	11.05	-	0.50	11.55	400	-	18	418
243	Apparel Industry	2	1	1	4	0.38	0.07	0.10	0.55	47	17	27	91
251	A Turnery	4	9	1	14	0.49	1.41	0.20	2.10	26	114	10	150
	B Foundry	1	3	-	4	0.20	1.94	-	2.14	23	96	-	119
	C Carpentry	3	5	-	8	0.75	1.25	-	2.00	43	110	-	153
	D Smithery	2	4	-	6	0.30	1.71	-	2.01	31	120	-	151
	E Aluminium	2	5	-	7	0.27	0.78	-	1.05	30	82	-	112
260	Furniture Industry	8	16	-	24	2.08	3.68	-	5.76	183	288	-	371
272	Paper Products	5	2	4	11	5.49	1.69	1.58	8.76	145	41	41	217
280	Printing & Publishing	2	13	4	19	3.50	3.29	1.00	7.79	72	161	43	277
291	Tanning & Leather Products	2	-	-	2	0.30	-	-	0.30	28	-	-	28
300	Rubber Products Industry	2	1	1	4	1.64	0.60	0.70	2.94	136	9	9	154
319	Chemical Products Industry	8	7	4	19	10.79	8.07	7.25	26.11	185	135	117	337
331	Brick & Cement Products	21	19	12	52	15.80	11.27	8.54	35.61	566	516	440	1,522
334	Cement	1	1	1	3Δ	31.25	50.00	70.00Δ	151.25	625	150	200	975
350	Metal Products Industry	9	11	2	22	2.40	3.43	0.83	6.66	203	203	47	453
381	Ship Reparing	3	-	-	3	0.76	-	-	0.76	47	-	-	47
394	Jewelry & Goldsmithery	3	-	-	3	0.47	-	-	0.47	21	-	-	21
	Masonry	-	1	-	1	-	5.26	-	5.26	-	75	-	75
399	Others	6	7	3	16	0.83	5.23	1.25	7.31	78	137	68	283
	Total	111	114	46	271	111.03	107.54	113.39	331.96	3,718	2,531	2,531	2,051

Note: excluding PETROMIN

Source: Ministry of Commerce and Industry

Table 5. Relatively Large Scale Industrial Firms

(A) Affiliates of PETROMIN

Firm	Capital (Co-Investor)	Main Product	Capacity
	million rial		
Jeddah Refinery	70 (25% private)	Petroleum Products	12,000 b/d
Petrolube	3 (29% foreign)	Lubricating Oil	75,000 b/Y
SAFCO	100 (49% private)	Urea	1,100 T/D
Petromin Sulfur	60 (33% foreign)	Sulfur	230,000 T/Y
Petrocid	n.a. (n.a.)	Sulfuric Acid	50 T/D
Sulb	n.a. (0)	Round Bar	45,000 T/Y

(B) Private Firms (1.5 Million Rials and Over in Paid-up Capital)

Type of Industry	No. of Firm
Icecream	1
Confectionery	1
Macaroni	1
	1
Aerated Water (Drinks)	7
Carpet	1
Paper products	1
Printing & Publishing	2
Paint	1
Soap	1
Plastic sheet & Pipe	2
Caustic Soda	1
Cement Pipe Tile and Building Material	7
Asbesto Pipe	2
Cement	3
Prefabricated House	1
Electric Wire	1

Table 6. Government Budget: Estimated Revenue & Appropriations

(Million Rials)

Fiscal Year	Revenue (Oil Revenue)	Appropriations (Project Budget)
1960/61	1,786 (n.a.)	1,786 (291)
1961/62	2,166 (")	2,166 (400)
1962/63	2,452 (")	2,452 (550)
1963/64	2,686 (2,249)	2,686 (550)
1964/65	3,112 (2,570)	3,112 (762)
1965/66	3,961 (3,141)	3,961 (1,402)
1966/67	5,025 (3,944)	5,025 (1,717)
1967/68	4,937 (3,515)	4,937 (2,147)
1968/69	5,536 (4,196)	5,536 (2,220)
1969/70	5,966 (5,198)	5,596 (2,682)
1970/71	6,380 (5,629)	6,380 (2,596)
1971/72	10,782 (10,010)	10,472 (5,036)

Source: Statistical Yearbook.

Table 7. Project Budget

Item	63/64	64/65	65/66	66/67	67/68	68/69	69/70	70/71	71/72
Education	60.8	74.0	124.4	113.4	76.6	60.1	42.2	56.7	145.7
Communications	193.9	443.4	382.0	538.8	527.0	794.4	705.6		
Roads & Ports	(126.4)	(343.5)	(318.5)	(422.1)	(437.6)	(606.0)	(500.0)	568	1,039
Civil Aviation	(36.7)	(25.7)	(43.4)	(85.3)	(71.2)	(108.3)	(104.7)		
P. T. T.	(26.2)	(67.5)	(18.0)	(13.8)	(14.6)	(78.0)	(95.9)	78.6	294
Railways	(4.7)	(6.7)	(2.2)	(17.6)	(3.6)	(2.1)	(5.0)		
Municipalities	110.4	165.9	231.7	284.0	247.0	301.0	252.3	204.6	433.1
Health	16.0	23.5	31.2	28.3	21.8	14.1	13.9	15.5	29.5
Water	49.5	97.1	119.2						
Agriculture	37.1	51.9	41.1	228.0	314.2	398.8	300.0	241	705
Labour & Social Affairs	6.2	14.4	19.0	13.8	11.1	8.0	8.7		
Information	22.4	37.1	40.4	85.0	72.4	50.9	53.5		
Pilgrims & Endowment	12.2	15.6	19.4	21.7	16.4	19.0	10.7		
Finance	63.9	65.9	105.6	112.8	105.3	164.8	143.0	N.A.	N.A.
Commerce & Industry	8.8	7.9	11.1	15.8	7.5	14.4	8.7		
Petroleum & Mineral Wealth	23.3	94.6	38.2	45.7	41.7	56.2	57.7		
Interior	19.6	31.3	36.1	30.1	21.9	16.2	43.2		
Foreign Affairs		6.2	4.6	7.9	3.0	3.0	3.6		
Defence & Others	77.6	76.3	224.7	228.7	800.2	682.9	1,057.3		
Total	701.7	1,205.3	1,428.6	1,746.1	2,266.2	2,583.9	2,700.4	2,596	5,036

Source: Statistical Yearbook for 63/64 ~ 69/70, hearing from CPO for 70/71, 71/72.

Table 8. BALANCE OF PAYMENTS ESTIMATES 1964 - 1969 A.D. (Million U.S.$)

	1969	1968	1967	1966	1965	1964
Current Account:						
A. Receipts:						
1 - Exports F.O.B.	1 845	1 784	1 568	1 543	1 198	1 045
2 - Getty & Japanese Oil	54	55	50	44	44	41
3 - Pilgrimage	94	72	63	59	57	52
4 - Foreign Missions	-	-	-	6	5	5
5 - Miscellaneous	68	80	64	40	34	25
Total Receipts	2 061	1 991	1 745	1 692	1 338	1 168
B. Payments:						
1 - Imports C.I.F.	839 (1)	796 (1)	647	629	502	394
2 - Non-Monetary Gold	16	11	23	32	23	16
3 - Investment Income payments	725	698	602	606	441	385
4 - Government Expenditure abroad N.I.E.	278 (2)	270 (2)	138 (2)	81	36	70
5 - Travel & Personal Transportation N.I.E.	85	77	70	58	48	40
6 - Tapline Expenditure	23	24	23	22	22	22
7 - Others Services	154	160	152	143	136	64
Total Payments	2 120	2 036	1 655	1 571	1 208	991
Current Account Surplus (A - B)	- 59	- 45	+ 90	+121	+130	+177
CAPITAL & FINANCING ACCOUNT:						
1 - Direct Investment Liability (+ Increase - Decrease)	+ 39	+ 16	- 95	- 35	- 78	+ 11
2 - Gold & Foreign Exchange Holdings of SAMA (+ Increase - Decrease)	-121	- 56	+ 60	+113	+140	+ 95
3 - Commercial Bank's Foreign Position (+ Increase - Decrease)	+ 10	- 12	+ 19	- 15	- 27	+ 6
4 - Errors & Omission & Unidentified Private Outflow .	+ 13	+ 7	+ 76	+ 58	+ 95	+ 65
Total Capital & Financing Account	- 59	- 45	90	121	130	177

Source: SAMA (Saudi Arabian Monetary Agency).

(1) Approximate figure.

(2) Includes U.S.$ 35 Million paid to the Arab Fund in 1957, U.S.$ 140 Million in 1968 and U.S.$ 147 in 1969.

Table 9. Gold, Foreign Exchange Holdings and Investments of the SAMA

Gregorian	Foreign Exchange	Gold	Investments	Total
1965. 4. 30	2,586	350	101	2,987
1966. 4. 20	2,971	349	237	3,557
1967. 4. 10	3,463	349	414	4,226
1968. 3. 29	3,222	349	755	4,326
1969. 3. 18	2,900	574	687	4,161
1969. 3. 7	2,242	574	691	3,507
1970. 11. 30	2,342	574	787	3,703
1971. 7. 8	3,407	574	812	4,793

Table 10. (A) GROSS NATIONAL PRODUCT BY INDUSTRIAL ORIGIN*
(At current Factor Cost)

(Million Riyals)

Sector	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69
1. Agriculture, forestry, fishing	866.2	908.8	874.4	839.4	862.4	895.7	974.4
2. Mining and Quarrying:							
Crude petroleum and natural gas	4,049.2	4,068.8	4,508.8	5,441.5	6,052.2	6,772.9	7,360.6
Other Mining & Quarrying	15.5	18.4	25.1	31.7	35.4	39.8	41.7
3. Manufacturing:							
Petroleum refining	528.6	586.4	658.3	698.2	736.2	870.6	967.1
Other manufacturing	157.0	172.9	191.3	212.4	237.0	265.6	299.0
4. Construction	310.8	368.3	501.7	633.4	707.1	796.1	834.2
5. Electricity, gas, water and sanitary services	100.9	112.8	128.2	150.3	166.9	181.3	195.6
6. Transport, storage and communications	537.3	636.6	739.4	855.5	976.4	1,060.1	1,172.1
7. Wholesale and retail trade	516.0	599.7	718.0	823.2	876.3	988.9	1,175.9
8. Banking, insurance and real estate	41.8	48.2	59.1	68.3	81.9	93.0	102.7
9. Ownership of dwellings	382.0	405.0	430.0	462.0	494.0	545.0	601.0
10. Public administration and defence	659.7	771.7	853.3	900.2	1,079,5	1,096.3	1,195.1
11. Services:							
Education	180.7	230.6	261.2	304.9	379.8	413.1	426.0
Medical and health	77.8	92.7	103.3	115.3	136.0	135.4	140.2
Other services	180.2	184.3	205.4	239.3	257.5	304.3	324.6
Gross Domestic Product at Factor Cost	8,603.7	9,205.2	10,257.5	11,775.6	13,078.6	14,458.1	15,810.2
Less: Net factor income payments to the rest of the world	2,119.0	1,948.0	2,200.0	2,839.0	2,961.0	3,204.0	3,492.0
Gross National Product	6,484.7	7,257.2	8,057.5	8,936.6	10,117.6	11,254.1	12,318.2
Less: Depreciation	648.5	725.7	805.8	893.7	1,011.8	1,125.4	1,231.8
National Income	5,836.2	6,531.5	7,251.7	8,042.9	9,105.8	10,128.7	11,086.4

* Provisional estimates

Source: Central Department of Statistics, Ministry of Finance.

Table 10. (B) REAL GROSS NATIONAL PRODUCT BY INDUSTRIAL ORIGIN*
(At Constant Prices as in 1966/67)

(Million Riyals)

Sector	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69
1. Agriculture, forestry, fishing	879.2	894.7	887.4	877.4	862.4	897.4	923.9
2. Mining and Quarrying:							
Crude petroleum and natural gas	3,843.1	4,115.5	4,678.4	5,501.4	6,052.2	6,572.7	6,972.1
Other mining and quarrying	17.5	20.1	26.6	32.6	35.4	38.6	39.3
3. Manufacturing:							
Petroleum refining	553.2	594.0	662.8	689.7	736.2	872.2	961.4
Other manufacturing	157.0	172.9	191.3	212.4	237.0	265.6	299.0
4. Construction	380.6	428.8	555.2	666.3	707.1	756.7	753.8
5. Electricity, gas, water, and sanitary services	87.1	101.2	119.9	148.0	166.9	187.2	208.3
6. Transport, storage, and communications	537.3	636.6	739.4	855.5	976.4	1,060,1	1,172.1
7. Wholesale and retail trade	559.0	638.6	766.3	858.5	876.3	987.3	1,151.7
8. Banking, insurance, and real estate	47.3	52.0	63.1	70.6	81.9	89.9	95.7
9. Ownership of dwellings	413.4	429.9	447.5	471.4	494.0	534.3	577.9
10. Public administration and defence	778.9	874.9	927.5	938.7	1,079.5	1,052.1	1,099.4
11. Services:							
Education	213.3	261.5	283.9	317.9	379.8	396.4	391.9
Medical and health	91.9	105.1	112.3	120.2	136.0	129.9	129.0
Other services	191.5	192.3	211.2	243.6	257.5	291.7	307.6
Gross Domestic Product (at factor cost)	8,750.3	9,518.1	10,672.8	12,004.2	13,078.6	14,132.1	15,083.1
Less: Net factor income payments to rest of the world	2,154.8	2,014.0	2,289.2	2,894.1	2,961.0	3,132.1	3,331.3
Gross National Product	6,595.5	7,504.1	8,383.6	9,109.7	10,117.6	11,000.0	11,751.8

* Provisional estimates

Source: Central Planning Organisation / Central Department of Statistics.

Table 11. GROSS NATIONAL EXPENDITURES

(Million Riyals)

	1962/63	1963/64	1964/65	1965/66	1966/67	1967/68	1968/69
1. Consumption expenditures	3,986.5	4,264.8	4,563.5	4,940.9	5,614.2	6,019.8	6,541.5
A. Private	2,742.5	2,834.8	2,909.5	3,025.9	3,177.2	3,367.8	3,603.5
B. Government	1,244.0	1,430.0	1,654.0	1,915.0	2,437.0	2,652.0	2,938.0
2. Gross capital formation	1,075.6	1,093.7	1,499.5	1,986.8	2,418.3	2,939.7	3,252.0
A. Private	713.6	795.4	1,070.3	1,342.9	1,316.3	1,270.5	1,269.3
B. Public	462.0	414.0	640.9	986.7	1,010.7	1,273.8	1,406.0
C. Inventory change	100.0	115.7	211.7	342.8	91.3	395.4	576.7
3. Exports	4,975.0	5,528.5	6,288.5	7,266.0	7,733.5	8,485.5	9,444.4
4. Imports	1,364.1	1,567.5	1,947.6	2,254.8	2,537.9	2,806.2	3,188.8
5. GDE (1+2+3-4)	8,673.0	9,319.5	10,403.9	11,938.9	13,228.1	14,638.8	16,049.1
6. Net factor income payments abroad	2,119.0	1,948.0	2,200.0	2,839.0	2,961.0	3,204.0	3,492.0
7. GNE at market prices (5-6)	6,554.0	7,371.5	8,203.9	9,099.9	10,267.1	11,434.8	12,557.1
8. Indirect taxes	129.3	179.3	211.4	237.3	233.8	249.5	308.9
9. Subsidies	60.0	65.0	65.0	74.0	84.3	68.8	70.0
10. GNE at factor cost (7-8 + 9)	6,484.7	7,257.2	8,057.5	8,936.6	10,117.6	11,254.1	12,318.2

Source: Central Planning Organisation / Central Department of Statistics.

Table 12. COMPOSITION OF EXPORTS AND IMPORTS

(Million Riyals)

	Hijri		Gregorian	
	1386 (1966-67)	1387 (1967-68)	1968	1969
Total Exports	7,614	7,853	9,118	8,962
Crude Oil & Petroleum Products	7,596	7,833	9,097	8,941
Animals & Meat	4	5	4	4
Vegetables	4	4	4	7
Leathers	6	5	4	3
Others	4	6	9	7
Total Imports	2,258	2,212	2,578	3,377
Foodstuffs, etc.	693	666	796	926
Animals and meat	118	59	197	153
Milk and milk products	58	68	71	83
Fruits and vegetables (fresh)	63	77	73	89
Fruits and vegetables (preserved and canned)	37	30	33	49
Fats (animal and vegetable)	35	40	41	35
Wheat	34	65	17	30
Flour	45	52	51	65
Rice	106	120	134	147
Tea, coffee and cardamum	76	54	53	89
Sugar	38	8	27	25
Tobacco and tobacco products	5	6	32	75
Building Materials	305	199	260	429
Wood, timber, etc.	53	45	48	71
Cement	37	25	43	63
Iron bars and sheets	61	48	70	87
Pipes and their parts	43	40	75	105
Textiles and Clothing	148	147	153	172
Machinery, Electric Appliances and Transport Equipment	708	709	846	1,084
Cars (incl. buses, ambulances, lorries, pick-up, etc.)	171	175	186	285
Trucks and tractors	48	45	31	13
Machinery (excl. agr. and elec. machinery)	184	150	181	231
Agricultural machinery	17	23	42	65
Airconditioners and refrigerators	26	24	39	56
Batteries	9	10	9	9
Parts of cars, trucks and tractors	75	74	80	86
Radio and household elec. appl.	29	22	45	48
Electric machinery (incl. parts)	22	26	8	7
Railroad equipments	2	12	2	2
Aircraft	34	67	85	66
Ships, boats, etc.	8	6	9	10
Chemical Products	118	111	137	259
Medicines and drugs	52	42	55	74

Soaps and detergents	6	5	5	8
Perfumes and cosmetics	6	6	8	14
Miscellaneous	286	380	386	507

Source: Central Department of Statistics, Ministry of Finance.

Table 13. AVERAGE ANNUAL GROWTH RATES OF VALUE ADDED BY SECTOR FOR THE PLAN PERIOD
(Constant Prices)

SECTOR	(Percent)
Agriculture	4.6
Crude Oil & Natural Gas	9.1
Mining and Quarrying	23.3
Petroleum Refining	9.1
Manufacturing	14.0
Construction	10.4
Electricity, Gas, Water, and Sanitation	13.2
Transportation, Communications & Storage	12.9
Wholesale & Retail Trade	12.8
Banking, Insurance and Real Estate	11.0
Ownerships of Dwellings	8.6
Public Administration and Defense	5.0
Education	19.0
Health	9.5
Other Services	10.0
GROSS DOMESTIC PRODUCT	9.8

Table 14. SUMMARY OF FINANCIAL ALLOCATIONS FOR THE PLAN (SR Millions)

	Recurrent (a)	Project (b)	Total Amount	Total Percent
Administration	6,794.6	922.8	7,717.4	18.6
Defense	3,980.0	5,575.0	9,555.0	23.1
Education, Vocational Training and Cultural Affairs	6,150.2	1,277.5	7,377.7	17.8
Health and Social Affairs	1,612.9	308.2	1,921.1	4.7
Public Utilities and Urban Development	1,246.9	3,325.4	4,572.3	11.1
Transport and Communications	1,767.3	5,709.2	7.476.5	18.1
Industry	321.8	776.7	1,098.5	2.7
Agriculture	973.8	493.9	1,467.7	3.6
Trade and Services	83.5	43.8	127.3	0.3
Total	22,931.0	18,382.5	41,313.5	100.0

(a) Covers expenditures under Chapters I, II and III of the annual budget.

(b) Covers expenditures under Chapter IV of the annual budget.

Table 15. (A) MANPOWER DEMAND IN 1970 AND END OF PLAN BY SECTORS AND INDUSTRY

Sector or Nature of Activity	Estimated No. of Workers Required (thousands)	
	1970	End of Plan
Private Sector	1,040.6	1,301.8
Nomads	145.2	134.6
Settled Agriculture	331.4	348.3
Petroleum	15.0	15.7
Mining & Quarrying	13.7	20.6
Manufacturing	51.8	70.3
Construction	141.5	205.0
Electricity, Gas, etc.	12.2	19.6
Commerce	130.2	197.6
Transportation	62.1	98.2
Services	137.5	191.9
N A D	-	-
Public Sector	138.0	184.5
Petromin	2.1	5.9
Total	1,180.7	1,492.2

Table 15. (B) SUMMARY OF MANPOWER REQUIREMENTS BY EDUCATION, TRAINING, AND LEVELS OF SKILL, 1970 TO END OF PLAN

Education, Training or Level of Skill	SECTOR				Total
	Public		Private	Petromin	
	Cadre	Non-Cadre			
Managers and Administrators(a)	-	-	3,935	70	4,005
Professional	-	-	2,445	450	2,895
University Degree (b)	8,799	-	-	-	8,799
Technician: Intermediate to Secondary Certificate plus 1 to 3 years training	3,213	-	4,580	730	8,523
High School or Secondary Certificate	15,001	-	-	-	15,001
Intermediate Certificate	5,349	-	1,060(c)	300	7,709
Primary Certificate	2,606	1,100(d)	66,440(c)	-	70,146
Skilled and Semi-skilled	3,062	1,900	55,630	1,130	61,722
Unskilled	-	3,000	137,710	1,120	141,830
Drivers	-	750	-	-	750
Religious workers	-	750	-	-	750
Sub-total	39,030	7,500	271,800	3,800	322,130
Nomads	-	-	(- 10,600)	-	(-10,600)
Total, all Sectors	39,030	7,500	261,200	3,800	311,530

(a) Numbers for managers and administrators for the Private Sector and Petromin include some with university degrees.

(b) University Degree, in the case of the Public Sector, includes not only professional workers but also teachers in intermediate and secondary schools and teacher training colleges, and some managers and administrators.

(c) Clerical and Sales; Some of these will need training in addition to a basic primary or intermediate education, as discussed in the text.

(d) These are clerks in offices.

TABLE 15 (C)

SUMMARY OF MANPOWER SUPPLY-DEMAND SITUATION
BY EDUCATION, TRAINING AND LEVELS OF SKILL

Demand by Type and Sources			Supply by Sources		Remarks
Professional Workers Requiring University Degrees			*Local institutions of* higher education	6,400	*Deficiency of 4,600* has to be filled by immigration. This indicated difference between supply and demand assumes that all graduates from institutions of higher education are employable. As shown previously, 3,000 will graduate from faculties of Arabic Language or Islamic Law, and therefore, the gap to be filled by *foreigners will be of* special types, e.g. Medicine, Sciences, Engineering.
Public Sector (including managers requiring University degree)		2,200	Overseas program	1,000	
Private Sector		2,450		7,400	
Teachers and Educational Administrators requiring University degrees		6,600	Less 300 joining the private sector as managers and administrators	—300	
Petromin		450		7,100	
		11,700			
Managers and Administrators			By process of promotion in the private sector	1,360	Demand exceeds supply by 2,300. Foreign recruitment may not be as high as indicated, since several positions may be kept vacant or some ad-hoc *arrangements made for the* execution of the associated functions.
Private Sector		3,930	University graduates	300	
Petromin		70	Petromin training	40	
		4,000		1,700	
Technicians and Other Sub-professional Workers			*Training programs of* the various Ministries & Government Agencies	1,500	Facilities for training within the Kingdom at this level are very limited.
Public Sector		3,200	Private sector	900	There is no alternative to recruitment of foreigners.
Private Sector		4,580	Petromin	200	
Petromin		730	Secondary vocational schools	1,400	
		8,510		4,000	
Skilled and Semi-skilled Workers			Training programs of the various Ministries & Government Agencies	2,500	The magnitude of the difference, 45,700 workers, will depend on the extent to which unskilled members of the labor force might be upgraded through various ad-hoc means and become qualified for inclusion in this category by virtue of *experience*
Public Sector		5,000	6 existing Vocational Training Centers	7,000	
Private Sector		55,600	6 new small Vocational *Training Centers*	3,000	
Petromin		1,100	Apprenticeship and In-plant training programs	3,500	
		61,700		16,000	
Workers with Secondary, Intermediate or Primary Certificates: Public Sector			*Boys' and Girls' Primary* Teacher Training Institutes	13,100	**If we omit teachers from the analysis, the situation could be described as varying from 'somewhat inadequate' to 'more than ample' *in going from secondary through intermediate* to primary. No immigration will be necessary for workers with academic education only at these levels and no training or work experience.**
Secondary	*Teachers & Educational* Administrators	14,500	Boys' Secondary Schools	400	
	Others	500	Girls' Teacher Training Institutes	2,000	
		15,000			
Intermediate	Teachers & Educational Administrators	4,700	Boys' Intermediate Schools	2,000	
	Others	1,600	Girls' Intermediate Schools	14,500	
		6,300			
Primary		2,600	Boys' Primary Schools	More than ample supply	
Clerical and Sales Workers:			Secondary Vocational Schools	350	
Private Sector					
1st Class—Intermediate plus 2—3 years training		1,060	*Boys' and Girls' Primary* & Intermediate Schools without any training, and ad-hoc training in establishments		
2nd Class—*Primary* plus one year or less of training		5,210			
3rd Class—Less than full primary certificate and less than one year training		61,230	Drop-outs from the educational system at *the primary level*		
Manual and Service Workers (Mainly Unskilled)			Natural growth of the labor force		
Public Sector		3,000			
Private Sector					
1st Class		450			
2nd Class		18,800			
3rd Class		118,450			
Petromin		1,100			
		141,800			

Table 16. PETROMIN PROJECT EXPENDITURES (SR Millions)

		Total
1. Projects Under Construction		
Lubricating Oil Blending Plant (Jeddah)	71,000 b/Y	10.0
Sulphuric Acid Plant (Dammam)	16,500 T/Y	4.7
2. Projects Approved		
Jiddah Refinery Expansion	33,000 b/d	141.0
Riyadh Refinery	15,000 b/d	179.0
Sulphur Company (Dammam)	225,000 T/Y	126.0
Tanker Company	40,000 DWT x 2	10.0
Steel Rolling Mill Second Stage (Jeddah)	55,000 T/Y	85.0
3. Feasibility Studies Proposed or In Progress		
Uthmaniya-Riyadh Gas Pipeline	cap. 70 MMcfd	116.0
Potash (Tarut Bay)	100,000 T/Y	126.0
Magnesium (")	20,000 T/Y	135.0
Petrochemicals (Anic-Philips) (Dammam)	182,000 T/Y (ethylene)	320.0
Petrochemical Intermediates (liquified natural gas and petrochemical feed stocks)		1,507.5
Phosphate Rock (mining) (Thaniyat)	Export 2,000,000 T/Y	262.5
Elemental Phosphorus (A qaba)	300,000 T/Y	295.0
Phosphoric Acid (")	300,000 T/Y	345.0
Sulphuric Acid from Gypsum	330,000 T/Y	175.5
Ammonia-Urea (Dammam)	288,000 T/Y	288.0
Ammonia (")	190,000 T/Y	190.5
Aluminum (")	140,000 T/Y	765.0
Others		30.8
		5,112.5

TABLE 17

SOME PROJECTED INDUSTRIES FOR THE PLAN PERIOD

ISIC(b)	Subsectors and Industries	Opportunities	Location	Estimates of Capital Requirements(a) (SR 000)
	FOOD AND BEVERAGES			
201	*Meat and by-products*	*A slaughterhouse and meat packing plant capable of producing 1,500 metric tons of meat annually*	*Mecca-Tayif area*	5,310
202	Dairy products	Expansion of the al-Khobar, Riyadh and Jiddah manufacturers of milk and milk products as well as establishment of additional plants for the manufacture of ice-cream, yogurt and other dairy products	Mecca, Medina and Buraydah	5,380
203	Vegetables, processed and canned	A plant processing and canning 825 metric tons of vegetables annually	Close to areas of vegetable production	2,600
203	Tomato paste and juice	An integrated tomato processing industry producing 5,875 metric tons of paste and 600 metric tons of juice per year	Near areas of tomato production	6,100
204	Processed fish	Establishment of an additional fishing enterprise for packing and shipping and expansion of existing firms in Dammam	Red Sea coast	14,250
205	Polished rice	Rice milling facility capable of producing 3,000 metric tons per year	Eastern Province	1,115
206	Biscuits	*Manufacture of 520 metric tons of biscuits and crackers annually*	*Riyadh or Jiddah*	1,288
207	Date syrup	Date syrup plant capable of processing 5,000 metric tons *of dates annually*	Eastern Province	2,660
209	Macaroni and vermacelli	Plant capable of producing 600 metric tons per year	Riyadh or Dammam	1,120
209	Animal feed	Expansion of the animal feed mill in the Eastern Province and the establishment of another one	Western Province	1,750
312	Vegetable ghee	Two vegetable ghee processing plants producing 12,000 metric tons per year	Western and Central regions	9,800
	TEXTILES AND WEARING APPAREL			
231	Cotton textiles	A mill for the weaving of cotton textiles using imported cotton yarn with an annual capacity of approximately 16 million yards	—	24,436
244	Canvas and products	A canvas cloth manufacturing company with an annual capacity of 500,000 meters	Western Province	1,860
391	Surgical bandages and supplies	A plant to manufacture annually 125 metric tons of surgical cotton, 1.2 million square meters of bandages and 1 million packets of sanitary napkins	Dammam	1,500
	FURNITURE AND FIXTURES			
260	Doors and windows	Expansion of existing manufacturing units	Regionally according to demand	2,025
260	Metal furniture	Expansion of existing units	Jiddah and Riyadh	6,500
260	Wooden furniture	Expansion of existing units	Regionally according to demand	2,100
	PAPER PRODUCTS AND PRINTING			
272	Paper Products	Expansion of existing paper industry to produce 100 million cardboard boxes annually	Jiddah	3,440
280	*Printing*	*Expansion of existing establishments*	*Jiddah, Riyadh and al-Khobar*	9,000
	LEATHER AND LEATHER PRODUCTS			
291	Skin pickled	A skin pickling plant capable of processing 300,000 sheep and goat skins per year	Jiddah-Mecca	2,130
	RUBBER AND PLASTIC PRODUCTS			
300	Tire retreading	Two tire retreading plants with an annual capacity of 20,000 tires	Riyadh-Jiddah	655
399	Plastic pipes	Expansion or establishment of new plant to manufacture plastic pipes for use in water, sewage and drain, waste and vent systems with an additional annual capacity of 2,000 metric tons	—	2,880
	CHEMICALS AND CHEMICAL PRODUCTS			
313	Paints	A paint plant to produce 25,000 gallons per year	Jiddah, Riyadh or Dammam	776
319	Detergents	Expansion of the existing plant	Jiddah	6,000
319	*Pharmaceuticals*	*Production of 200 million tablets per year*	*Jiddah*	3,228
	CEMENT AND NON-METALLIC PRODUCTS			
334	Cement	Expansion of existing cement plants (additional capacity 6,000 metric tons)	Jiddah, Riyadh and Dammam	74,000
339	Concrete posts	A plant with an annual capacity of 150,000 posts of various sizes	—	1,350
330	Ready mixed concrete	Plants for ready mixed concrete with a total annual capacity of 10,000 metric tons	Riyadh, Dammam and Jiddah	2,200
	METALS AND METAL PRODUCTS			
342	Aluminum extrusion	A plant to manufacture aluminum extrusions with an annual capacity of 1,500 metric tons	—	12,500
350	Gas stoves	Production of 20,000 stoves per year	—	580
350	Enamelware	Production of trays, dishes, coffee and teapots and ashtrays with a total annual capacity equivalent to 500 metric tons	Jiddah or Dammam	2,500
350	Wire mesh and netting	A plant to manufacture wire mesh with an annual capacity of 1,500 metric tons	Jiddah or Dammam	1,720
	MACHINERY, APPLIANCES AND MAINTENANCE			
360	*General purpose foundry*	*Expansion of existing units with an annual capacity of* 6,000 metric tons	*Riyadh, Jiddah and Dammam*	1,780
360	Air conditioners, refrigerators and refrigerator cases	A plant to produce 6,000 units of air conditioners, refrigerators and refrigerator cases per year	Jiddah or Dammam	3,700
370	Electric fans	A plant with an annual capacity of 10,000 units	—	660
370	Electric wires	A plant to produce 120 metric tons of insulated wire per year	Jiddah	640
370	Dry cell batteries	A plant to produce 3 million units per year	—	3,200
	TRANSPORT EQUIPMENT, SUPPLIES AND REPAIRS			
381	Boats	Expansion of the four existing establishments in the western region	Jiddah	2,250
383	Wood-stake truck bodies	A plant to produce 2,000 bodies annually for installation on trucks varying in capacity from 2 to 7 tons	Jiddah	1,815
385	Bicycles	A plant to produce annually 12,000 bicycles	Jiddah or Dammam	1,055
370	Automobile batteries	A plant to produce 24,000 batteries per year	Dammam	1,152
	UNCLASSIFIED INDUSTRIES			
332	*Glass bottles*	*A plant to produce 20 million bottles per year*	—	6,750
370	Electric light bulbs	A plant with an annual capacity of 11 million bulbs	—	2,180
			TOTAL REQUIRED CAPITAL	235,933

(a) *Including working capital.*
(b) *International System of Industrial Classification.*

Source: ISDC.

Table 18. GROWTH OF THE AGRICULTURAL SECTOR DURING THE DEVELOPMENT PLAN

(production in thousands of tons; value in millions of Saudi riyals)

Crop	Constant Price	Current Year 1969-70 Estimated (a)		Final Plan Year Targets		Percentage Increase in Value	
	SR/Ton	Production	Value	Production	Value	Plan	Annual(b)
Wheat	720	135	97	231	166	71	11
Barley	608	37	22	56	34	55	9
Rice	700	3	2	7	5	150	20
Sorghum	734	112	82	131	96	117	3
Millet	734	155	114	160	117	3	1
Alfalfa	80	1,760	141	2,380	190	35	6
Vegetables	354	510	181	693	245	35	6
Dates	500	250	125	240	120	- 4	-1
Fruit	834	94	78	100	83	6	1
Total Crops(c)	-	-	701	-	866	24	4.3
Meat	3,700	48	178	71	262	47	8
Broilers	4,500	4	18	6	29	61	10
Eggs(d)	2.4	50	10	75	15	50	8
Fish	2,000	30	60	36	72	20	4
Dairy Products(e)	1,000	210	210	252	252	20	4
Total Animal Products	-	-	476	-	630	32	5.8
Total Agriculture	-	-	1,177	-	1,496	27	4.9

(a) Estimates of botanical crops are based largely on Saudi Arabian census area and FAO yield data for the Middle East, applicable to a common base period; prices from the area studies; and subjective assessment of changes in area and yield since the base period. Estimates of animal products are derived by subjective assessment from a variety of source materials.

(b) Rate of growth which compounds annually from the current period would achieve the targeted increase by the final plan year.

(c) Total excludes alfalfa which is almost altogether an input for animal products.

(d) For eggs, price is per dozen and production is in millions of eggs.

(e) Dairy products are shown as milk equivalent.

APPENDIX I.

Appendix I. Predictive Feasibility Study of Olefine-Based Petrochemical Industry

Summary and Conclusion

With the understanding that, for the industrial development of the Kingdom of Saudi Arabia, Japanese companies in cooperation with PETROMIN will plan a chemical industry utilizing natural gas, the present study has as its object the exploration for an appropriate plan. Chemical industries using natural gas are divided into two categories. In one, methane is used to produce ammoniacal fertilizers and methanol; in the other, Olefinic compounds are produced from ethane and higher components. The methane-based chemical industries are relatively simple in the variety of products. The main product is ammonia. An ammoniacal fertilizer plant has already been set up by SAFCO and is now in operation. Dealt with here, therefore, is the feasibility of an olefinic chemical industry centering on ethylene, such an industry being a new field and promising to develop into an extensive chemical complex.

Production of olefines in Europe and Asia depends on naphtha for feedstock. While the price of naphtha in these regions is about $30 per ton, lower-price raw material is available abundantly in Saudi Arabia. This is because in that country large quantities of natural gas, which contains potential feedstock hydrocarbons ranging from ethane to pentane, are being flared away.

On the other hand, however, there is no major market either in Saudi Arabia or neighboring areas. For this reason, to achieve economies of scale--on which product cost is dependent in this type of industry--a market must be sought in Japan and Southeast Asia.

The present study was made on this supposition. Following are the results of the study.

(1) Nations in Southeast Asia, a potential market, are planning to develop their own chemical industries based on olefines. This would make it necessary to effect coordination with these countries. From this point of view, it seems advisable for Saudi Arabia and other gas-producing nations to produce large quantities of primary products, and for countries with consumer markets to produce a wide variety of end products in limited quantities.

(2) Among the derivatives of ethylene, the mainstay of olefine chemicals, the one that requires the least amount of auxiliary raw materials in polyethylene. However, specifications of polyethylene vary so widely that it will be considerably difficult commercially to produce polyethylene in Saudi Arabia and maintain, at the same time, an economic advantage while keeping production, shipment and sales in line with demand.

(3) The production cost of ethylene depends to a large extent on the credit rating of the value of by-products. Propylene, the major by-product, has no outlets in Southeast Asia and therefore will have to be marketed in Japan. To transport it economically, the only way seems to be to recover C_3-C_4 fractions as liquefied petroleum gas (LPG) in a sufficient quantity to be shipped along with propylene.

(4) In view of the foregoing, cost calculations were made for two different cases. In one case, the major portion of ethylene is to be shipped in liquid form to Japan and Southeast Asia and some ethylene is to be used in the production of styrene butadiene rubber (SBR) for automobile tires, and synthetic fiber vinylon, which requires a lesser amount of auxiliary raw materials, both SBR and vinylon to be sold on the domestic market.
In the other case, ethylene is to be converted to polyethylene.

(5) Following are the results of the cost calculations. Estimates were made on the assumption that the profit-to-capital ratio is 30% (before tax).

Both ethylene and LPG are to be stored, shipped, and transported at low temperatures. This means that if a long pipeline would be needed for shipment, the shipment cost should expensive due to expensive shipment facilities.

At Dammam, there is a distance of 10 km between the shore and a point where the water is deep enough to enable a tanker to take on the cargo. There the ex-factory price excluding the shipment cost for propylene, propane and butane, all by-products, will be relatively low, which means a small by-product credit evaluation. Accordingly, the ex-factory price of ethylene including profit will be at a relatively high level of about $69 per ton. Since the shipment cost and shipping charge will be added to this, the price on delivery in Japan or Southeast Asia will be increased. Thus, profitable sales in these regions are critical.

However, in an area where the pipeline shipping length can be reduced to, say, 3 km (at Ras-Tanura, for example), the cost of shipping the cryogenic liquefied gas can be considerably reduced. In other words, the by-product credits for propylene, propane and butane will increase, making it possible to cut the ex-factory price of ethylene to around $42-43 per ton. In addition to this, the shipment cost for ethylene itself can be reduced. Accordingly, the price on delivery in Japan or Southeast Asia may be estimated at $80-95 per ton.

Where high- and low-density polyethylene is to be produced from ethylene priced at $69, the price of polyethylene is estimated at $212 and $225, respectively; if ethylene is available at $43, then the estimated price of polyethylene will be $157 and $195, respectively. It is open

to question, however, how production can be maintained in line with sales when polyethylene, given dozens of different specifications, is produced in Saudi Arabia, which is located at a great distance from the market. It is also an unknown factor how high will be the annual rate of capacity utilization under such conditions. And how the product will be shipped out as an export, and what will be the shipment cost, are questions that have yet to be answered. In the absence of data on this, no cost estimates were made on this score.

(6) The ex-factory prices of SBR and vinylon will vary only slightly with changes in the ethylene price, ranging between $613 and $614 per ton and between $5,190 and $5,199 per ton, respectively. These prices are, however, rather high by international standards. Whether the development plan should be carried out even with protection to compensate for the high prices is a question that depends directly on the industrialization policy of the Saudi Arabian Government.

(7) This study, as stated above, is no more than a predictive study. It is desirable, therefore, that more detailed studies should be conducted with the participation of interested Japanese companies.

1. Feed Gas

In considering utilization of natural gas for a chemical production project in Saudi Arabia, the first to come to mind is the gas from the Abqaiq oil field. A large part of the gas is being reinjected and consumed now, so that if the supply falls short, it is possible to use the gas from the Ain Dar and Shedqum oil fields.

In an olefine chemical industry, feedstock consists of C_2 and higher hydrocarbon fractions. Therefore, gases containing as much higher hydrocarbons as possible will have to be used. Spheroid tank gas, which has the highest content of higher hydrocarbons, is being used by ARAMCO to produce LPG and will be excluded from the available feedstock sources for the present plan.

Gas output is expected to increase in parallel with an increase in crude oil production. Moreover, both reinjection and consumption are also expected to expand. It is not known at this moment, therefore, how much gas will be available, or where and at what pressure it will be obtained. It is not entirely certain as yet whether the needed volume of the most likely supply source, the separator gas at a pressure of 50 psi at Abqaiq, will be available. In the study that follows, it will be assumed that a mixture of 50 psi gas and 200 psi gas from Abqaiq is to be used. The average gas composition is presented in Table I-1.

2. Market for Petrochemical Products

Judging from the geographical conditions in which Saudi Arabia is located, principal markets for the products are likely to be Japan and Southeast Asia. The market prospects for ethylene and propylene derivatives in these regions will be described below. It might be added here that in view of the nature of the products involved, sufficient market research is prerequisite to any successful project.

(1) Market in Southeast Asia

Southeast Asia and Oceania in 1969 consumed about 609,000 tons of ethylene derivatives and about 144,000 tons of propylene derivatives (as feedstock olefines). The supply capacity in the same year was about 194,000 tons of ethylene and about 48,000 tons of propylene (see Tables I-2 and I-3) for 1965-1970 in the nations of the region, the 1975

demand for ethylene derivatives is estimated at 980,000 tons and that for propylene derivatives at 240,000 tons.

The combined capacity of plants now in operation and under construction at the beginning of 1972 in this region is estimated at 880,000 tons of ethylene and 220,000 tons of propylene.

(2) Market in Japan

Demand for ethylene and propylene in Japan was 2,107,000 tons and 1,989,000 tons, respectively, in 1970. Demand for olefines expanded at an astonishing annual rate of over 30% in 1965-1970, accompanying the continued rapid rise in GNP. However, with the Japanese economy now entering a period of stabilized growth following a high-growth period, the increase of demand is tending to slows. An annual rate of about 7% is estimated for the years just ahead. The olefine producers estimate the demand in 1972 at 3,520,000 tons (as ethylene). The supply, according to current statistics, is 5,050,000 tons, or about 30% more than what is needed. Supply and demand are expected to balance around 1975. After 1975, an annual increase in demand of 250,000 to 350,000 tons is expected at a GNP growth rate of 5-7%.

3. Basic Plan for Ethylene Complex

A plan to build an ethylene complex in the Kingdom of Saudi Arabia must meet the following two conditions:

1. The advantageous position that Saudi Arabia enjoys with regard to raw materials should be put to use. This would more than offset the disadvantages of unfavorable climatic and geographical conditions in the country.

2. The plan must contribute most effectively to the industrialization of Saudi Arabia. Cooperative relations must be maintained with nations that will provide markets for products of Saudi Arabia so that their industrialization plans may not be jeopardized because of the influx of those products.

The merits and demerits that Saudi Arabia has are listed in the following table.

Merits	Demerits
(1) Raw material is cheap and available in abundance.	(1) Atmospheric temperature is high.
(2) Land is available at low cost.	(2) Water is scarce.
(3) Political situation is stable.	(3) Domestic market is limited.
	(4) Major consumer markets are located at a great distance.
	(5) Plant construction cost is relatively high.
	(6) Skilled labor is scarce.

In order that the drawbacks (1), (2), (4) and (5) may be covered by taking full advantage of the strong points (1), (2) and (3), it is necessary that the plant be sufficiently large.

In Southeast Asia, a potential market for products from Saudi Arabia, petrochemical production plans are under way in various nations. Once these projects are completed, it is likely that prohibitively high tariffs will be levied on polymer imports. In terms of operation and management, Saudi Arabia, as noted above, is located at a great distance from consuming regions. In the case of polymers, which must be produced in a wide variety and in limited quantities on an individual basis since orders are not geared for mass production, it will be very difficult to conduct profitable

operations by keeping production, shipment and sales on a par with demand. There are, for example, 30 to 40 kinds of low-density polyethylene and more than 22 kinds of high-density polyethylene.

With the exception of Indonesia, which is rich in oil resources, other countries in this region apparently offer little promise for large-scale petrochemical projects. That is, the scale of production in those countries is now so limited that there will be not much advantage to be gained from operating integrated petrochemical plants on a small scale. The question of utmost importance, therefore, will be how these nations, which have industrialization plans under way starting from end products, will be able to co-operate most effectively with a raw-material supplying nations. The question, in other words, is how evenly the value added by industrialization can be distributed between resources-holding and market-holding nations. From this point of view, it seems reasonable, considering the availability of large-capacity cryogenic storage and cryogenic transportation facilities, to assign operations up to olefine production to the raw-material producing nation and production of products from olefines to the market-holding.

The Major problem involved in transporting ethylene in liquid form from Saudi Arabia to Japan or Southeast Asia is that the shipping cost will represent as much as 25-30% of the product price. For example, the shipping charge from Saudi Arabia to Japan is estimated $30.80 per ton and that between Saudi Arabia and Southeast Asia, $24.50. In view of the relative price advantage of Southeast Asia it may be said that this region could offer a more profitable market. Demand for propylene, by-product of ethylene, is limited in this region, however. Moreover, the freightage is lower than that of ethylene. It follows, therefore, that propylene should be shipped to Japan instead of Southeast Asia. But in order to make this possible, demand for propylene must be large enough to require shuttle transportation by a large tanker.

The fact remains that, no matter what the production scheme, the amount of by-product propylene to be obtained from ethylene production is only 138,000 tons a year at the maximum as against 300,000 tons of ethylene a year. Considering, in addition, the market price in Japan, shipping propylene alone would be economically infeasible. By shipping recovered propane and butane simultaneously, by-product propylene can be exported from Saudi Arabia on an economic basis.

The Saudi Arabian project has been described above largely from the standpoint of international competitiveness. While this is one essential aspect of the project, it is also important that the project serve as a base for supply of the needed raw materials to domestic industry for the purpose of promoting Saudi Arabian industrialization. To meet this objective, olefine derivatives that would contribute to the development of domestic industry were also covered in the study. These are vinylon for synthetic textile mills, which form a basic industry, and styrene butadiene rubber for tires, which are expected to find a large demand in that vast desert country.

To produce one ton of vinylon 2,000 tons of water is needed. Moreover, at the contemplated production capacity of 10 tons per day, which is relatively small, the price of this product would be higher than the international price. Nevertheless a study was made in view of the importance of textile industry. For SBR, on the other hand, considerable demand is expected, and no large quantity of water is required for production. There is a good feasibility of producing SBR for automobile tire manufacturing in Saudi Arabia.

4. Basic Data Used in the Study

Basic data used in the study are as follows:

i. Construction site for ethylene complex
Dammam or Ras-Tanura

ii. Ethylene plant capacity
300,000 tons per annum

iii. Regions to which products will be shipped

Liquid ethylene	Japan, Southeast Asia
Propylene	Japan
Vinylon	Saudi Arabia
Styrene butadiene rubber	Saudi Arabia
High-density polyethylene	Japan, Southeast Asia, Middle East
Low-dendity polyethylene	same as above
Propane	Japan
Butane	Japan

(6) Raw Material Supply to Ethylene Complex

Separator gas at 50psi and 200psi pressure will be supplied at separator outlet in Abqaiq oil field free of charge. After recoverying from it, the condensate will be piped to the plant site to provide the main feedstock. The methane-rich gas separated through condensate recovery will be separately piped the plant site, to be used as fuel.

5. Cases of Study

(1) By-products from Ethylene Plant

At the ethylene plant by-product credit will have a great effect on the production cost for the main product. Where the natural gas condensate is used as feedstock, the

major by-products are propylene, butadiene, and liquefied petroleum gas (LPG). The output ratio of these by-products to ethylene can be adjusted to some extent by controlling the feedstock composition and by recycling ethane or propane.

A. By-product Schemes

The main by-product schemes are presented in Table I-4. At an ethylene production of 300,000 tons a year, product distribution in each scheme will be as shown in Table I-5. The balance is based on the following recovery rates of fractions at the condensate recovery plant:

	Recovery Rates	
Fraction	Schemes 1 - 4	Scheme 5
C_1	2%	0%
C_2	60	10
C_3	92	90
C_4	99	99
C_5	100	100

B. Study of Schemes

The market price of propylene in Japan is about the same as that of propane. The minimum transportation scale that is economically feasible is therefore 300,000-400,000 tons per annum. Accordingly, even if by-production of propylene is maximized at 138,200 tons a year as in Scheme 5, it will be economical to transport it to Japan by tanker. In order to secure the economic advantage of shipping propylene by this method it will be necessary to transport it together with LPG. From this point of view, in order to improve the feasibility of a project in total, Scheme 1, should be adopted.

(2) Types of Product and Outputs at Complex

With regard to ethylene production under Scheme 1, two

cost studies were made. One study assumes ethylene is to be shipped in liquid form; the other assumes that the entire amount of ethylene will be converted to polyethylene. Types of products and their quantities in both cases are as follows:

Case	Products	Shipment (tons per annum)
Scheme 1-A	Liquid ethylene	296,230
	Propylene	36,300
	Propane	396,800
	Butane	221,400
	Vinylon	3,300
	Styrene butadiene rubber	18,000
Scheme 1-B	High-density polyethylene	89,000
	Low-density polyethylene	189,000
	Propylene	36,300
	Propane	396,800
	Butane	221,400
	Vinylon	3,300
	Styrene butadiene rubber	18,000

A block flow diagram for a process plant under Scheme 1-A is shown in Fig. I-2.

(3) Shipment Terminal for Liquid Products

The length of a jetty leading to a point of required water depth will vary depending on the plant location. That will affect the shipping cost for the loading terminal. Cost estimates were made for the following two cases where Scheme 1-A was adopted.

Case	Plant site	Jetty length
A	Dammam	10 km
B	Ras-Tanura	3 km

(4) Transport Distance for Liquid Ethylene

The transport distance from Ras-Tanura to Japan is about 2,400 miles longer than to Southeast Asia, which means of course that the shipping cost will vary accordingly. In the present study, cost estimates were made for both Cases A and B, where Scheme 1-A was adopted, on the assumption that the following three different patterns of transportation will be used:

Pattern	Destination of liquid ethylene	Quantity shipped
Pattern A	Japan	Whole amount
Pattern B	Japan and Southeast Asia	50% each
Pattern C	Southeast Asia	Whole amount

(5) Shipment Method for Polyethylene

Since polyethylene, both high- and low-density, comes in many different kinds and is produced in large quantitites, the method of shipment must be carefully selected. The product may be packed in bags or shipped in bulk. Two different methods loading at the wharf and offshore loading will be available for loading the product on out-bound ships. A detailed study of local conditions is essential to the selection of a shipment method. This was not taken up for study.

6. Feed Gas Plant and Pipeline

The needed amount of usable separator gas will be compressed at the Abqaiq oil field. Acidic gas will be removed from the compressed gas, through chemical absorption, while water will be removed by means of ethylene glycol. The condensate will be recovered through distillation. The recovered condensate will be transported over a 12-inch surface pipeline to the ethylene plant. The dry gas, which is separated through distillation and consists mainly of methane, will be re-compressed after cold recovery, then transported to the plant site over a 10-inch pipeline to be used as fuel for the ethylene complex.

7. Ethylene Plant

The condensate piped to the plant site will be subjected to distillation for recovery of propane and butane. Then the stream, made up chiefly of ethane and C_5 plus hydrocarbons, will be fed to a tubular steam cracking unit to produce ethylene and other products. Crude ethane will be recycled as cracker feedstock. Product ethylene will be piped to the storage base after being liquefied. Other by-products will be handled as follows:

Light end, C_4 raffinate, and C_5 plus fractions--To be used as fuel.

Butadiene--After being extracted from the C_4 fraction it will be supplied entirely to the SBR plant as feedstock for styrene butadiene rubber.

Propane and butane--To be piped to the LPG storage base.

Some amount of ethylene, which will also be used in the production of SBR and vinylon, will be sent direct to the manufacturing plants.

8. Petrochemical Plant

(1) Production of Styrene Butadiene Rubber

The SBR process to be used consists of a styrene monomer production stage and a styrene monomer/butadiene polymerization stage. Raw material ethylene and butadiene will be supplied entirely from the ethylene plant.
Benzene will be purchased from outside.

The styrene monomer section is divided into an alkylation stage, where ethylbenzene is produced from ethylene and benzene, and a dehydrogenation stage, where the ethylbenzene is dehydrogenated to make styrene monomer.

The main reaction product will be introduced into a quenching section where it will be separated into condensate and gas. Polymer-grade styrene monomer is obtained from the top of the column by rectifying the condensate. Unreacted ethylbenzene will be recycled. In the polymerization stage, styrene-butadiene polymer is produced through low-temperature continuous polymerization of styrene and butadiene. This section consists of polymerization, recovery and finishing steps. In the finishing stage, an anti-aging agent is added to the latex from the recovery section. The latex is also washed and dried. The dried rubber is formed, and then baled to make packages of a given weight for storage and shipment.

(2) Production of Vinylon

The vinylon manufacturing porcess to be used is made up of the following three major sections:

Vinyl acetate production
Polyvinyl alcohol production
Vinylon production

The required raw material ethylene will be supplied by the ethylene plant while oxygen will come from an oxygen plant. Other raw materials, i.e., acetaldehyde, formalin, caustic soda, methanol and catalysts, will all be purchased from outside.

The vinyl acetate production section consists of reaction and purification stages. Vinyl acetate, obtained through reactions of ethylene, acetaldehyde and oxygen, is recovered from the top of a rectifier and sent to the next stage--the polyvinyl alcohol production stage.

In this stage, the vinyl acetate is polymerized into polyvinyl acetate; the polymer is saponified to make polyvinyl alcohol; and the catalyst used in the saponification stage is recovered. In the saponification stage, polyvinyl alcohol is subjected to such unit operations as pulverizing, compressing and drying. The PVA thus treated is introduced into the vinylon manufacturing section, where it goes through spinning, heat treatment, and acetalization. Further treatment is given to improve its heat and water resistance. Then after washing, an oil additive is applied to the product. Finally, drying gives vinylon as a finished product, which will be crimped and sent to the shipment base.

(3) Production of Low-density Polyethylene

This process involves polymerizing ethylene gas at high pressure (1,000-4,000kg/cm^2) and high temperature (100-300°C). The major steps of the process are polymerization, granulation, and kneading. Polyethylene leaving the separator following reaction is granulated by means of a gear pump screw extruder. After being subjected to various tests, the granular polyethylene will be delivered to the shipment base.

(4) Production of High-density Polyethylene

Polymerization takes place under relatively mild reaction conditions--60-80°C temperature and 0-10kg/cm^2 pressure. The process consists of these main stages: Polymerization, post-treatment, pelletizing, catalyst decomposer purification, and solvent recovery. Polyethylene that has undergone reaction is made into a dry powder in the post-treatment stage. The powder is sent to a powder hopper to be fed to an extruder, which produces pellets of various grades. The pellets will be sent to a storage.

9. Utilities and Off-site Facilities

(1) Utilities

The following utilities will be supplied by the utilities center, which will use the gas to be piped in from the condensate recovery plant.

Cooling water--Sea water will be used.

Deionized water--To be produced from sea water through distillation.

Steam--To be produced at a boiler plant using the deionized water obtained by the above method.

Electricity--Generated at power plant using steam turbine

(2) Off-site Facilities

The following off-site facilities will be required:

Maintenance center, testing center, fire-fighting facility, flare stacks, waste disposal facility, wastewater treatment facility, offices and recreation facilities, and housing for foreign personnel.

10. Transportation of Products

(1) Marine Transport of Liquid Ethylene

A. Loading Terminal

Liquid ethylene produced by the ethylene plant will be stored in a double-walled surface tank, from which it will be transferred to an ocean tanker via a special loading pipeline. The boil-off gas from the liquid ethylene in storage will be recovered. The storage capacity at the terminal will be equal to the ocean tanker capacity.

B. Marine Transport

One ocean tanker will be used exclusively for this purpose. The cruising speed will be 17 knots. If the ethylene shipments are to be divided equally between Japan and Southeast Asia, the tanker will visit the two destinations alternately. Boil-off gas rising from the liquid ethylene in transit will be liquefied.

C. Unloading Terminal

The storage capacity at the unloading terminal will be equal to the ocean tanker capacity. Ethylene will be gasified before shipment by pipeline. Boil-off gas will be pressurized before being fed into the shipment line.

(2) Marine Transport of Propylene, Propane and Butane

A. Loading Terminal

Conditions will be the same as those mentioned for liquid ethylene.

B. Marine Transport

One ocean tanker will be used exclusively for the purpose of transporting these products at the same time. Boil-off gas rising from the cargo will be liquefied.

C. Unloading Terminal

The propylene storage capacity at the terminal will be the same the case as ethylene storage capacity. However, the storage capacity for propane and butane will be equal to the sum of tanker capacity and seasonal fluctuation. All boil-off gas will be liquefied.

(3) Vinylon and Styrene Butadiene Rubber

These will be transported by truck or by railroad to domestic markets in Saudi Arabia.

(4) High-density and Low-density Polyethylene

These products were not taken up for study as stated in Section 6, (5).

11. Fund and Fuel Requirements

Equipment costs, working capital, total investment, fuel and chemicals requirements, manpower requirements and needed land space were estimated on the basis of the data given in Sections 5 and 6. Results of these calculations are presented in Tables I-6 through I-9.

12. Study of Economics

(1) Basis

The basis for study of economics is presented in Table I-10. The same return on capital investment was assumed for all stages of the project so that product prices including a reasonable amount of profit may be calculated for each stage.

As for the required funds, 30% will be supplied in the form of owned capital and 70% in borrowings. The annual interest rate for the loans is estimated at 7%. Estimates on owned capital were made for two different cases; that is, the ratio of before-tax profit to capital was assumed as 30% in one case (Basis A) and 15% in the other (Basis B).

The after-tax profit/capital ratio of 15% in an industrial project is the lowest as such. It can be said, therefore, that in the first case (Basis A) 50% corporate tax is imposed to the full, and that the tax is exempted in the second case (Basis B). Cases of economic study may be summarized as follows.

Scheme (production process)

C_2 and C_5 plus cracked; C_4 recovered as such so that less propylene but more LPG will be produced.

- A: Ethylene shipped in liquid form. Vinylon, SBR obtained as products.
- B: All ethylene used for polyethylene. Vinylon, SBR obtained as products.

Case (plant site)

- A: Dammam
- B: Ras-Tanura

Transportation pattern (liquid ethylene)

- A: Japan
- B: 50% to Japan, 50% to Southeast Asia
- C: Southeast Asia

Basis (economics)

- A: Ratio of before-tax profit to capital 30%
- B: Ratio of before-tax profit to capital 15%

(2) By-product Credit

The price of ethylene varies according to the evaluation of by-product credit. The credit value of each by-product is determined by the market price in the consuming nation and the shipping cost. The ethylene price in this study was calculated on the basis of the market prices of by-products in Japan.

(3) Freight Cost and Unloading Terminal Cost

These were calculated on the basis of prevailing prices in Japan. Results of calculations are presented in Tables I-18 through I-23, which show that prices on delivery at the unloading terminal in Japan are ¥18/kg ($58.5 per ton)

for propylene ¥13.8/kg ($44.9 per ton) for propane and butane. These prices minus shipping charges and transport costs would give the ex-factory prices of each product. From these prices, the credit values of ethylene by-products will be obtained as presented in the following table (classified by case).

	Case A (Dammam)		Case B (Ras-Tanura)	
Case	Basis A	Basis B	Basis A	Basis B
Propylene ex-factory price	$10.1/ton	$13.3/ton	$20.8/ton	$22.6/ton
Propane/butane ex-factory price	13.6	14.7	17.0	17.6
Ethylene ex-factory price	68.98	66.32	42.03	43.44
Ethylene price on delivery in Japan	126.18	120.22	88.83	88.94
(Pattern A)	(¥38.9/kg)	(¥37.1/kg)	(¥27.2/kg)	(¥27.4/kg)

Estimates on SBR, vinylon and polyethylene were made for two different cases, i.e., Case A (Basis A) and Case B (Basis B).

TABLE - I-1

ESTIMATED ASSOCIATED GAS COMPOSITION

	Composition (Mol %)
CO_2	8.4
H_2S	4.6
C_1	43.0
C_2	23.0
C_3	13.0
C_4	5.0
C_5 Plus	3.0
Total	100.0

TABLE - I-2

SUMMARY SHEET OF PROSPECTIVE OLEFIN MARKET FOR PETROCHEMICAL PRODUCTS IN SOUTH EAST ASIA

Unit Ton/Year as Olefin

Olefin Material	1969 Need	1975 Prospective Need	1975 Prospective Production
Ethylene Delivative	609,200	983,500	347,500
Propylene Delivative	144,300	242,800	137,500
Butadiene Delivative	43,000	70,200	47,200

TABLE - I-3

PROSPECTIVE OLEFIN MARKET FOR PETROCHEMICAL PRODUCTS IN SOUTH EAST ASIA

Unit = Ton/Year As Olefin

Need	Korea 1969	Korea Factor	Korea 1975	Taiwan 1969	Taiwan Factor	Taiwan 1975	Thailand 1969	Thailand Factor	Thailand 1975	Philippines 1969	Philippines Factor	Philippines 1975
Ethylene Delivative	45,600	1.98	90,000	73,800	1.85	136,400	47,700	1.60	76,400	28,300	1.40	39,600
Propylene "	38,400	1.98	76,000	21,500	1.85	39,700	9,500	1.60	15,200	23,300	1.40	32,600
Butadiene "	5,000	1.98	9,900	9,100	1.85	16,800	3,400	1.60	5,500	4,400	1.40	6,200
Production												
Ethylene	0	-	* 107,500	0	-	198,000	0	-	126,400	0	-	250,000
Propylene	0	-	83,500	0	-	54,000	0	-	25,200	0	-	0
Butadiene	0	-	11,700	0	-	18,500	0	-	24,000	0	-	0

Need	Indonesia 1969	Indonesia Factor	Indonesia 1975	Malaysia 1969	Malaysia Factor	Malaysia 1975	Singapore 1969	Singapore Factor	Singapore 1975	Hong Kong 1969	Hong Kong Factor	Hong Kong 1975
Ethylene Delivative	45,400	1.50	68,000	12,700	1.48	18,800	25,500	1.82	46,500	117,900	1.65	194,000
Propylene "	1,900	1.50	2,800	1,700	1.48	2,500	8,000	1.82	14,600	11,600	1.65	19,200
Butadiene "	0	1.50	0	1,700	1.48	2,500	1,700	1.82	3,100	3,100	1.65	5,100
Production												
Ethylene	0	-	0	0	-	0	0	-	0	0	-	0
Propylene	0	-	0	0	-	0	0	-	0	0	-	0
Butadiene	0	-	0	0	-	0	0	-	0	0	-	0

Need	India 1969	India Factor	India 1975	Pakistan 1969	Pakistan Factor	Pakistan 1975	Australia 1969	Australia Factor	Australia 1975	New Zealand 1969	New Zealand Factor	New Zealand 1975
Ethylene Delivative	61,800	1.20	74,000	12,900	1.44	18,600	115,600	1.65	190,000	22,000	1.42	31,200
Propylene "	11,600	1.20	13,900	3,000	1.44	4,300	10,300	1.65	17,000	3,500	1.42	5,000
Butadiene "	3,100	1.20	3,700	2,300	1.44	3,300	4,500	1.65	7,400	4,700	1.42	6,700
Production												
Ethylene	42,000	-	151,500	0	-	0	0	-	0	0	-	0
Propylene	0	-	47,600	0	-	0	0	-	0	0	-	0
Butadiene	20,000	-	55,000	0	-	0	0	-	0	0	-	0

Notes : 1. "Factor" described above is estimated from the average growth rate of each country's GNP for the past six years (1965 - 1970).

2. Facilities for "Production" marked with asterisk (*) are under construction stage, while those without such mark are under planning stage.

TABLE - I-4

ITEMIZED ETHYLENE PLANT SCHEME

Scheme	Fractions to Cracker Feed				Recycle		Description
	C_2	C_3	C_4	C_5^+	C_2	C_3	
1	Yes	No	No	Yes	Yes	No	C_2 & C_5^+ feed, C_2 Recycle
2	Yes	Yes	Yes	Yes	No	Yes	C_2^+ feed, C_3 Recycle
3	Yes	Yes	Yes	Yes	Yes	Yes	C_2^+ feed, C_2 & C_3 Recycle
4	Yes	Yes	Yes	Yes	No	No	C_2^+ feed, No Recycle
5	No	Yes	Yes	Yes	No	No	C_3^+ feed, No Recycle

TABLE - I-5

LIST OF PRODUCTS DISTRIBUTION

Product	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Scheme 5
Hydrogen	20,300	15,200	16,900	15,450	12,400
Methane	60,100	146,800	118,000	143,200	186,000
Ethylene	300,000	300,000	300,000	300,000	300,000
Ethane	-	120,000	-	121,000	62,900
Propylene	36,300	97,500	76,000	96,500	138,200
Propane	396,800	-	-	43,800	63,300
Butane	221,400	2,350	2,180	2,440	2,800
Butadiene	14,000	21,100	17,700	21,000	27,600
C_4 Raffinate	15,500	15,000	11,750	15,350	22,000
C_5 Plus	34,600	67,050	53,470	67,260	96,800
Total:	1,099,000	785,000	596,000	826,000	912,000
Required Well Head Gas Quantity (MMSCFD)	191	137	104	144	213

TABLE - I-6 SUMMARY OF PLANT INFORMATION-SCHEME 1-A

(1 US$ = 308 Japanese Yen)

Unit	Gas Compression & Condensate Recovery Plant	Olefine Plant	SBR Plant	Vinylon Plant	Oxygen Plant	Total
Plant Capacity	191 MMSCFD	300,000 MTA	18,000 MTA	3,300 MTA	4,100 MTA	
Total Plant Cost (MM$)	26.188	59.018	14.876	27.018	1.345	128.445
Utilities & Common Facilities Allocation (MM$)	0.070	13.813	2.819	14.540	0.487	31.729
Fixed Capital Investment (MM$)	26.258	72.831	17.695	41.558	1.832	160.174
Working Capital (MM$)	1.838	5.091	1.24	2.910	0.128	11.207
Total Capital Investment (MM$)	28.096	77.922	18.935	44.468	1.960	171.381
Fuel Consumption (MMSCFD)	25	18.8	2.3	13	0.3	59.4
Supervisory Personnel (Expatriate)	10	35	18	35	2	100
Supervisory Personnel & Operator (Local)	60	190	100	200	12	562
Land Area Required (m^2)	15,000	110,000	41,000	30,000	500	181,500

* Including fuel condensate recovery unit and pipe lines.
* Excluding land area required for gas compression and condensate recovery plant.

TABLE - I-7 SUMMARY OF PLANT INFORMATION-SCHEME 1-B

(1 US$ = 308 Japanese Yen)

Unit	Scheme 1-A Total	Low Density P.E. Plant	High Density P.E. Plant	Total
Plant Capacity		189,000 MTA	89,000 MTA	
Total Plant Cost (MM$)	128.445	53.700	32.666	214.811
Utilities & Common Facilities Allocation (MM$)	31.729	10.752	4.259	46.740
Fixed Capital Investment (MM$)	160.174	64.452	36.925	261.551
Working Capital (MM$)	11.207	4.548	2.575	18.330
Total Capital Investment (MM$)	171.381	69.000	39.500	279.881
Fuel Consumption (MMSCFD)	59.4	13.0	5.8	78.2
Supervisory Personnel (Expatriate)	100	50	50	200
Supervisory Personnel & Operator (Local)	562	80	100	642
Land Area Required (m^2)	181,500	100,000	66,000	347,500

Excluding land area required for gas compression and condensate recovery plant.

TABLE - 1-8

SUMMARY OF LIQUID PRODUCTS SHIPPING TERMINAL (SCHEME 1-A)

Item 3	Unit	Ethylene Pattern A	Ethylene Pattern B	Ethylene Pattern C	Propylene	C_3 LPG	C_4 LPG	Total Pattern A
Annual Throughput	1,000 T/Y	300	300	300	36.3	396.8	221.4	
Market		Japan	50% Japan 50% South East Asia	South East Asia	Japan	Japan	Japan	
Number of Round Trip	Times/Year	9.4	11.3	14.1	9.4	9.4	9.4	
Tanker Cargo Size	Ton	31,900	26,600	21,300	3,860	42,200 69,500	23,500	
Shipping Terminal Storage Capacity	1,000 Ton	16x2	14x2	17x2	2x2	21x2	12x2	
Shipping Line Size	inch	20x2	18x2	16x2	6x2	18x2	12x2	
Supervisory Personnel (Expatriate)		1	1	1	1	1	1	4
Supervisory Personnel & Operator (Local)		5	5	5	5	5	5	20
Land Area Required	1,000 m^2	74	1.5	49.3	6.8	96.3	52.2	229.3
Case A (Dammam, with 10 Km Jetty)								
Fixed Capital Investment	Million $	19.7	18.1	16.5	2.5	8.9	5.0	36.1
Working Capital	"	1.4	1.3	1.2	0.2	0.6	0.3	2.5
Total Capital Investment	"	21.1	19.4	17.7	2.7	9.5	5.3	38.6
Fuel Consumption	MMSCFD	1.03	0.92	0.77	0.09	0.90	0.34	2.36
Annual Loading Loss	%	1.30	1.37	1.39	1.30	1.10	0.90	4.60
Case B (Ras Tanura, with 3 Km Jetty)								
Fixed Capital Investment	Million $	10.3	9.4	8.4	1.3	4.9	2.8	18.3
Working Capital	"	0.7	0.6	0.6	0.1	0.3	0.2	1.4
Total Capital Investment	"	11.0	10.0	9.0	1.4	5.2	3.0	20.7
Fuel Consumption	MMSCFD	0.34	0.10	0.29	0.03	0.30	0.11	
Annual Loading Loss	%	0.43	0.45	0.46	0.43	0.36	0.30	

TABLE - I-9 SUMMARY OF CAPITAL INVESTMENT

SCHEME 1-A, CASE B, PATTERN-A

(1,000 US$)

	Gas Compression & Condensate	Olefin Plant	Shipping Terminal	SBR	Vinylon	Total
Fixed Capital Investment	26,258	72,831	19,336	17,695	43,390	179,510
Working Capital	1,838	5,091	1,351	1,240	3,038	12,558
Total Capital Investment	28,096	77,922	20,687	18,935	46,428	192,068

SCHEME 1-B, CASE B

	Total of Scheme 1-A	Ethylen Shipping Adjustment	L.D.P.E.	H.D.P.E.	Total
Fixed Capital Investment	179,510	- 6,422	64,452	36,925	274,465
Working Capital	12,558	- 450	4,548	2,575	19,231
Total Capital Investment	192,068	- 6,872	69,000	39,500	293,696

TABLE - I-10 BASIS OF ECONOMIC EVALUATION

	Charge Factor on Fixed Capital Investment	
	Basis-A	Basis-B
Insurance and propriety tax	2 %	2 %
Amortization 1)	8 %	8 %
Interest of long and short bank loan 2)	5.3 %	5.3 %
Profit including income tax 3)	9.6 %	4.8 %
Total charge factor on fixed capital investment	24.9 %	20.1 %

Maintenance cost; 5 % on fixed capital investment

Labour cost

Supervisory personnel (Expatriate & Local)	1,000 $/man-month
Operating personnel (Local)	500 $/man-month
Well head gas price	Zero value
Raw materials	Market price
Chemicals and catalysts	Market price
Stream days	330 days/year

Remarks : 1) • Straight line depreciation
• Plant life ; 12 Year
Salvage value ; 4 %

2) • Working capital of 7 % on fixed capital investment.
• Bank loan of 70 % on total capital investment.
• Interest of 7 % on bank loan.
(Fixed Capital Inv. x 1.07) x 0.7 x 0.07
= (Fixed Capital Inv.) x 0.053

3) • Equity of 30 % on total capital investment.
• Profit (including income tax) of 30 % on Equity.
(Fixed Capital Inv. x 1.07) x 0.3 x 0.3
= (Fixed Capital Inv.) x 0.096

TABLE - I-11 CONDENSATE RECOVERY AND PIPE LINE

SCHEME 1-A & SCHEME 1-B

Production Capacity 1,099,000 MTA

	Basis - A	Basis - B
Charge on fixed capital investment	5.144 M$	4.152 M$
Maintenance cost	1.033 "	1.033 "
Labour cost	0.456 "	0.456 "
Chemicals	0.010 "	0.010 "
Total cost	6.643 M$	5.651 M$
Ex-pipe line profitable selling price	6.045$/MT	5.142$/MT

TABLE - I-12 FUEL GAS COMPRESSION AND PIPE LINE

SCHEME 1-A & SCHEME 1-B

Production Capacity 34.41 MMSCFD

	Basis-A	Basis-B
Charge on fixed capital investment	1.394 M$	1.125 M$
Maintenance cost	0.280 "	0.280 "
Labour cost	0.096 "	0.096 "
Total cost	1.770 M$	1.501 M$
Ex-pipe line profitable selling price	15.87¢/MSCF	13.46¢/MSCF

TABLE - I-13 ETHYLENE PLANT

SCHEME 1-A & SCHEME 1-B

Production Capacity 300,000 MTA

	Basis-A	Basis-B
Charge on fixed capital investment	18.179 M$	14.580 M$
Maintenance cost	3.640 "	3.640 "
Labour cost	1.787 "	1.787 "
Raw Materials cost		
Condensate	6.643 "	5.651 "
Catalyst & Chemicals cost	0.775 "	0.775 "
Fuel cost (18.76 MMSCFD)	0.965 "	0.818 "
Total cost	31.989 "	27.251 "

By-products credit

	Case-A	Case-B	Case-A.A	Case-B.B
Propylene 36,300 MTA a)	10.1 $/MT	22.6 $/MT	0.367 M$	0.820 M$
Butadiene 14,000 MTA	180 "	180 "	2.520 "	2.520 "
C_3&C_4 LPG 618,200 MTA	13.6 "	17.6 "	8.408 "	10.880 "
By-products credit total			11.295 M$	14.220 M$
Total cost on ethylene			20.694 "	13.031 "
Ex-onsite profitable selling price			68.98 $/MT	43.44 $/MT

Note: Case A.A = Case A - Basis A

Case B.B = Case B - Basis B

TABLE - I-14 SBR PRODUCTION PLANT

SCHEME 1 - A & SCHEME 1 - B

Production Capacity 18,000 MTA

				Basis-A	Basis-B
Charge on fixed capital investment				4.423 M$	3.538 M$
Maintenance cost				0.885 "	0.885 "
Labour cost				0.936 "	0.936 "
Raw materials cost					
		Case-A.A	Case-B.B	(Case-A.A)	(Case-A.A)
Ethylene	1,450 MTA	a) 68.98 $/MT	43.44 $/MT	0.100 "	0.063 "
Benzen	3,900 MTA	100 "	100 "	0.390 "	0.390 "
Butadiene	14,000 MTA	180 "	180 "	2.520 "	2.520 "
Raw materials cost total				3.010 M$	2.973 M$
Catalyst & Chemicals cost				1.682 "	1.682 "
Fuel cost (2.33 MMSCFD)				0.120 "	0.102 "
Total cost				11.056 M$	10.116 M$
Ex-factory profitable selling price				614.2 $/MT	562.0 $/MT

TABLE - I-15 VINYLON PRODUCTION PLANT

SCHEME 1 - A & SCHEME 1 - B

Production Capacity 3,300 MTA

	Basis-A	Basis-B
Charge on fixed capital investment	10.852 M$	8.682 M$
Maintenance cost	2.165 "	2.165 "
Labour cost	1.968 "	1.968 "

Raw materials cost

	Case-A.A	Case-B.B	(Case-A.A)	(Case-B.B)
Ethylene 2,320 MTA a)	68.98 $/MT	43.44 $/MT	0.160 "	0.101 "
Acetoaldehyde 3,670 MTA	130 "	130 "	0.476 "	0.476 "
Methanol 660 MTA	325 "	325 "	0.215 "	0.215 "
Caustic soda 600 MTA	130 "	130 "	0.078 "	0.078 "
Formaldehyde 990 MTA	130 "	130 "	0.129 "	0.129 "
Raw materials cost total			1.058 "	0.999 "
Catalysts & Chemicals cost			0.429 "	0.429 "
Fuel cost (13.33 MMSCFD)			0.686 "	0.581 "
Total cost			17.158 "	14.824 "
Ex-factory profitable selling price			5,199$/MT	4,492$/MT

TABLE - I-16 HIGH DENSITY POLYETHYLENE PRODUCTION PLANT

SCHEME 1 - B

Production Capacity 89,000 MTA

	Basis-A	Basis-B
Charge on fixed capital investment	9.245 M$	7.396 M$
Maintenance cost	1.845 "	1.845 "
Labour cost	1.320 "	1.320 "
Raw materials cost		
Ethylene 98,000 MTA a) Case-A.A 68.98 $/MT Case-B.B 43.44 $/MT	6.760 "	4.257 "
Chemicals cost	0.553 "	0.553 "
Fuel cost (5.80 MMSCFD)	0.298 "	0.253 "
Total cost	20.021 "	15.624 "
Ex-onsite profitable selling price	225 $/MT	176 $/MT

TABLE - I-17 LOW DENSITY POLYETHYLENE PRODUCTION PLANT

SCHEME 1 - B

Production capacity 189,000 MTA

			Basis-A	Basis-B
Charge on fixed capital investment			16.125 MM$	12.900 MM$
Maintenance cost			3.225 "	3.225 "
Labour cost			1.176 "	1.176 "
Raw materials cost				
	Case-A.A	Case-B.B	(Case-A.A)	(Case-B.B)
Ethylene 198,230 MTA	a) 68.98$/MT	43.44$/MT	13.674 "	8.611 "
Chemicals cost			5.1 "	5.1 "
Fuel cost (13.04 MMSCFD)			0.671 "	0.569 "
Total cost			39.971 "	31.581 "
Ex-onsite profitable selling price			211.5$/MT	167.1$/MT

TABLE - I-18

SUMMARY OF LIQUID PRODUCTS SHIPPING TERMINAL COST

SCHEME 1 - A, CASE - A, Basis A

(1 U.S.$ = 308 Japanese Yen)

Item	Unit	Ethylene Pattern A	Ethylene Pattern B	Ethylene Pattern C	Propylene	LPG
Annual throughput	MTA	300,000	300,000	300,000	36,300	618,200
Charge on fixed capital investment	1,000 $	4,912	4,540	4,134	632	3,462
Maintenance cost	1,000 $	987	910	826	126	688
Labour cost	1,000 $	48	48	48	48	96
Fuel cost	1,000 $	96	85	71	8	114
Loading loss	1,000 $	156	164	167	19	190
Total cost	1,000 $	6,199	5,747	5,246	833	4,550
Shipping terminal cost including profit	$/MT	20.7	19.1	17.5	23.0	7.4

Table - I-19 SUMMARY OF LIQUID PRODUCTS SHIPPING TERMINAL COST

SCHEME 1-A, CASE - B, BASIS - A

Item	Unit	Ethylene Pattern A	Ethylene Pattern B	Ethylene Pattern C	Propylene	LPG
Annual throughput	T/Y	300,000	300,000	300,000	36,300	618,200
Charge on fixed capital investment	1,000 $	2,065	1,872	1,680	261	1,534
Maintenance cost	1,000 $	515	468	420	65	384
Labour cost	1,000 $	48	48	48	48	96
Fuel cost	1,000 $	26	23	20	2	31
Loading loss	1,000 $	52	54	55	6	63
Total cost	1,000 $	2,706	2,465	2,228	882	2,109
Shipping terminal cost include profit	$/T	9.0	8.2	7.4	10.5	3.4

TABLE - I-20

EXRECEIVING TERMINAL PROFITABLE SELLING PRICE (1)

SCHEME 1 - A, CASE A, BASIS A

(1 U.S.$ = 308 Japanese Yen)

Item	Unit	Ethylene Pattern A	Ethylene Pattern B		Ethylene Pattern C	Propylene	LPG
			Japan	Asia			
Annual Throughput	MTA	300,000	300,000		300,000	36,300	618,200
Ex-onsite Profitable Selling Price	$/MT	68.98	68.98		68.98	10.1	13.6
Shipping Terminal Cost	$/MT	20.7	19.1		17.5	23.0	7.4
Freight Cost	$/MT	30.8	33.8	21.9	24.5	19.5	19.5
Receiving Terminal Cost	$/MT	5.7	9.8	9.8	4.2	5.9	4.4
Overall Transportation Cost	$/MT	57.2	62.7	51.8	46.2	48.4	31.3
Ex-receiving Terminal Profitable Selling Price	$/MT	126.18		120.7	115.2	58.5	44.9
"	¥/Kg	38.9	40.6	37.2	35.5	18.0	13.8

Plant Site: Damman W/10 Km Jetty

TABLE - I-21

EXRECEIVING TERMINAL PROFITABLE SELLING PRICE (2)

SCHEME 1 - A, CASE B, BASIS B

(1 U.S.$ = 308 Japanese Yen)

Item	Unit	Ethylene Pattern A	Ethylene Pattern B		Ethylene Pattern C	Propylene	LPG
Annual Throughput	MTA	300,000	300,000		300,000	36,300	618,200
Ex-onsite Profitable Selling Price	$/MT	43.44	43.44		43.44	22.6	17.6
Shipping Terminal Cost	$/MT	9.0	8.2		7.4	10.5	3.4
			Japan	Asia			
Freight Cost	$/MT	30.8	33.8	21.9	24.5	19.5	19.5
Receiving Terminal Cost	$/MT	5.7	9.8	9.8	4.2	5.9	4.4
Overall Transportation Cost	$/MT	45.5	51.8	39.9	36.1	35.9	27.3
Ex-receiving Terminal Profitable Selling Price	$/MT	88.94	95.24	83.34	79.54	58.5	44.9
"	¥/Kg	27.4	29.3	25.7	24.5	18.0	13.8

Plant Site: Ras Tannura W/3 Km Jetty

Table - I-22 EXRECEIVING TERMINAL PROFITABLE SELLING PRICE (3)

SCHEME 1-A, CASE - A, BASIS - B

Item	Unit	Ethylene Pattern A	Ethylene Pattern B		Ethylene Pattern C	Propylene	LPG
Annual throughput	T/Y	300,000	300,000		300,000	36,300	618,200
Ex-onsite Profitable Selling Price	$/T	66.32	66.32		66.32	13.3	14.7
Shipping Terminal Cost	$/T	17.4	16.2		14.8	19.8	6.3
			Japan	Asia			
Freight Cost	$/T	30.8	33.8	21.9	24.5	19.5	19.5
Receiving Terminal Cost	$/T	5.7	9.8	9.8	4.2	5.9	4.4
Overall Transportation Cost	$/T	53.9	59.8	47.9	48.5	45.2	30.2
Ex-receiving Terminal Profitable Selling Price	$/T	120.22	126.12	114.22	109.82	58.5	44.9
"	¥/Kg	37.1	39.0	35.3	33.8	18.0	13.8

Table - I-23 EXRECEIVING TERMINAL PROFITABLE SELLING PRICE (4)

SCHEME 1-A, CASE B, BASIS A

Item	Unit	Ethylene Pattern A	Ethylene Pattern B		Ethylene Pattern C	Propylene	LPG
Annual throughput	T/Y	300,000	300,000		300,000	36,300	618,200
Ex-onsite Profitable Selling Price	$/T	42.03	42.03		42.03	20.8	17.0
Shipping Terminal Cost	$/T	10.3	9.7		8.7	12.3	4.0
			Japan	Asia			
Freight Cost	$/T	30.8	33.8	21.9	24.5	19.5	19.5
Receiving Terminal Cost	$/T	5.7	9.8	9.8	4.2	5.9	4.4
Overall Transportation Cost	$/T	46.8	53.3	40.4	37.4	37.7	27.9
Ex-receiving Terminal Profitable Selling Price	$/T	88.83	95.33	82.43	79.43	58.5	44.9
"	¥/Kg	27.2	29.4	25.4	24.4	18.0	13.8

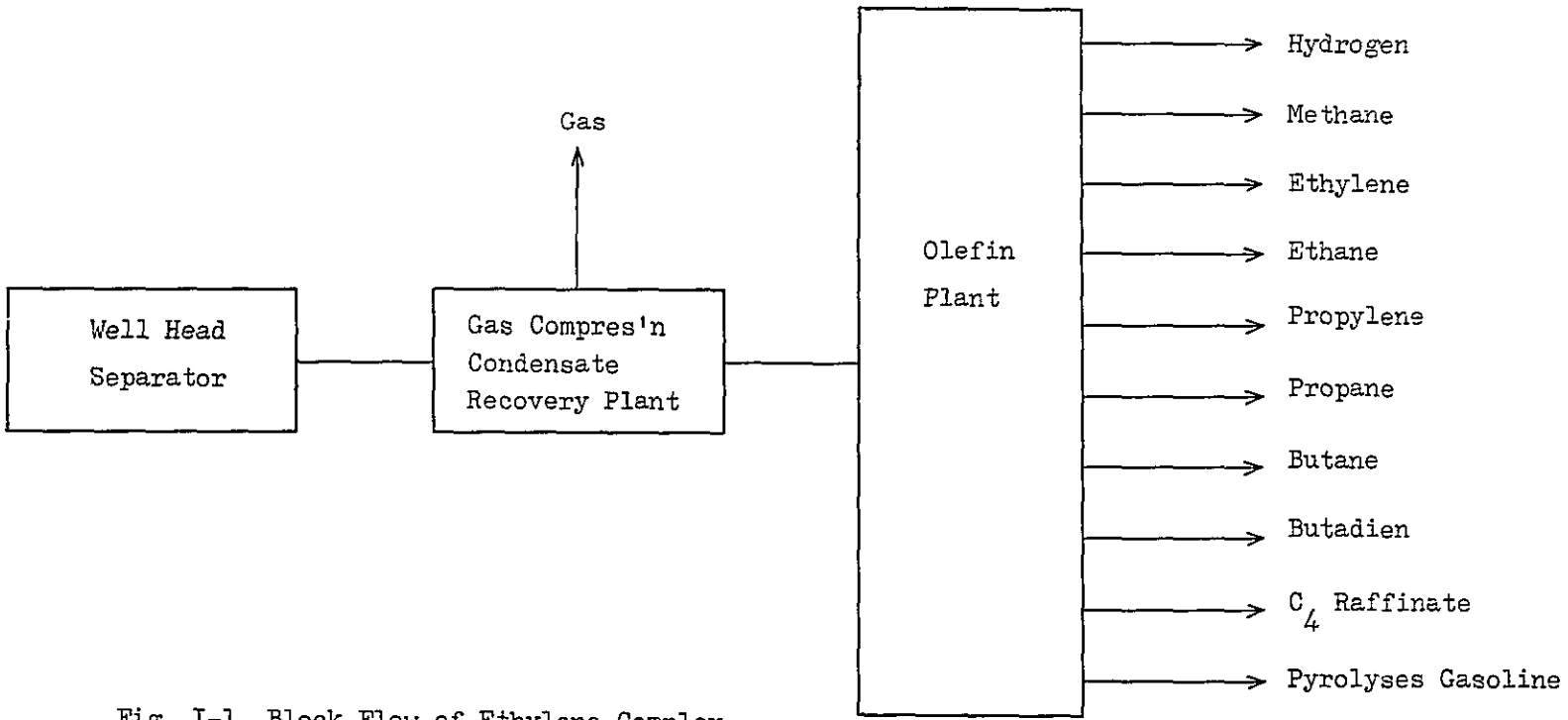


Fig. I-1 Block Flow of Ethylene Complex

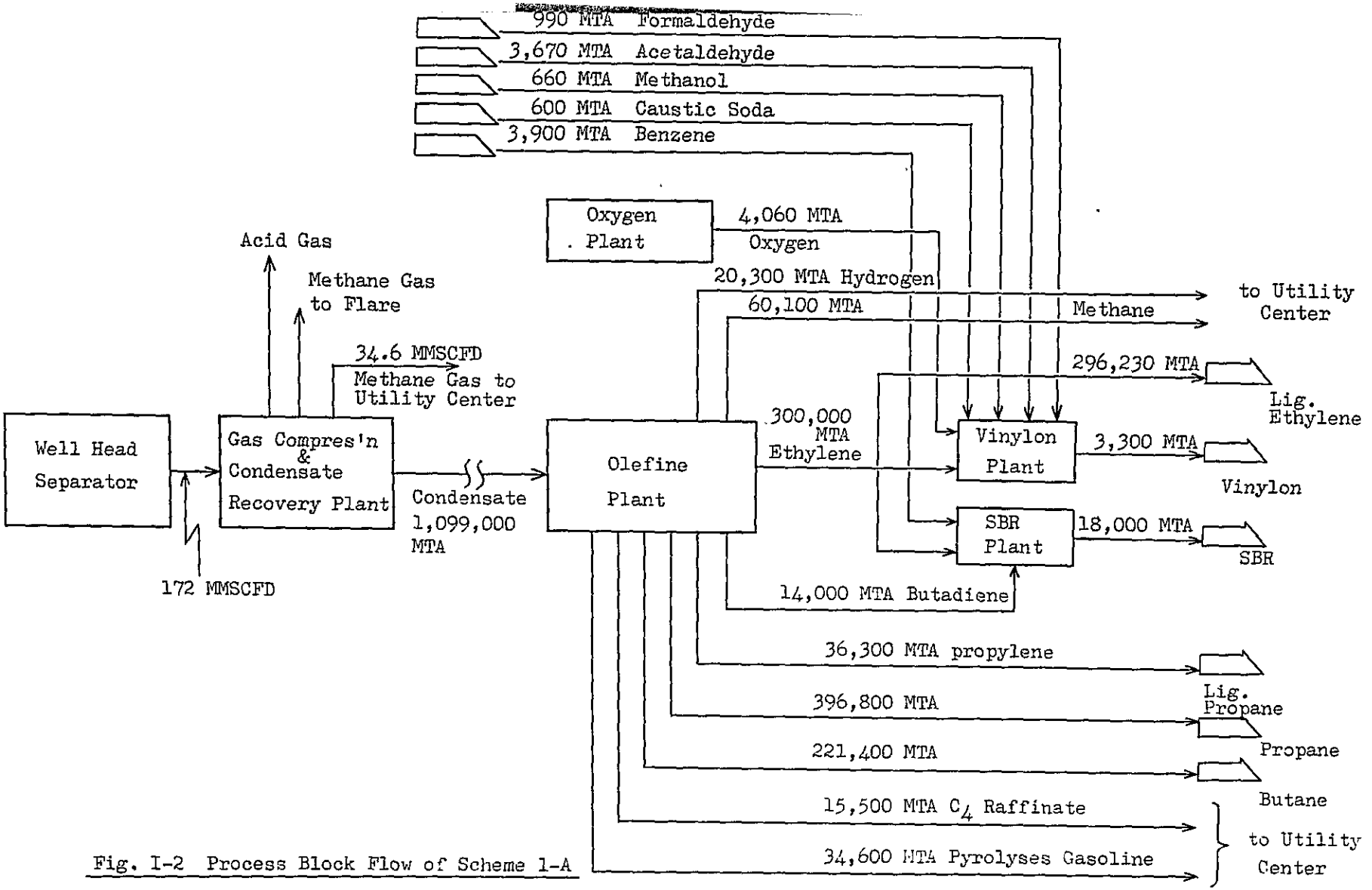


Fig. I-2 Process Block Flow of Scheme 1-A

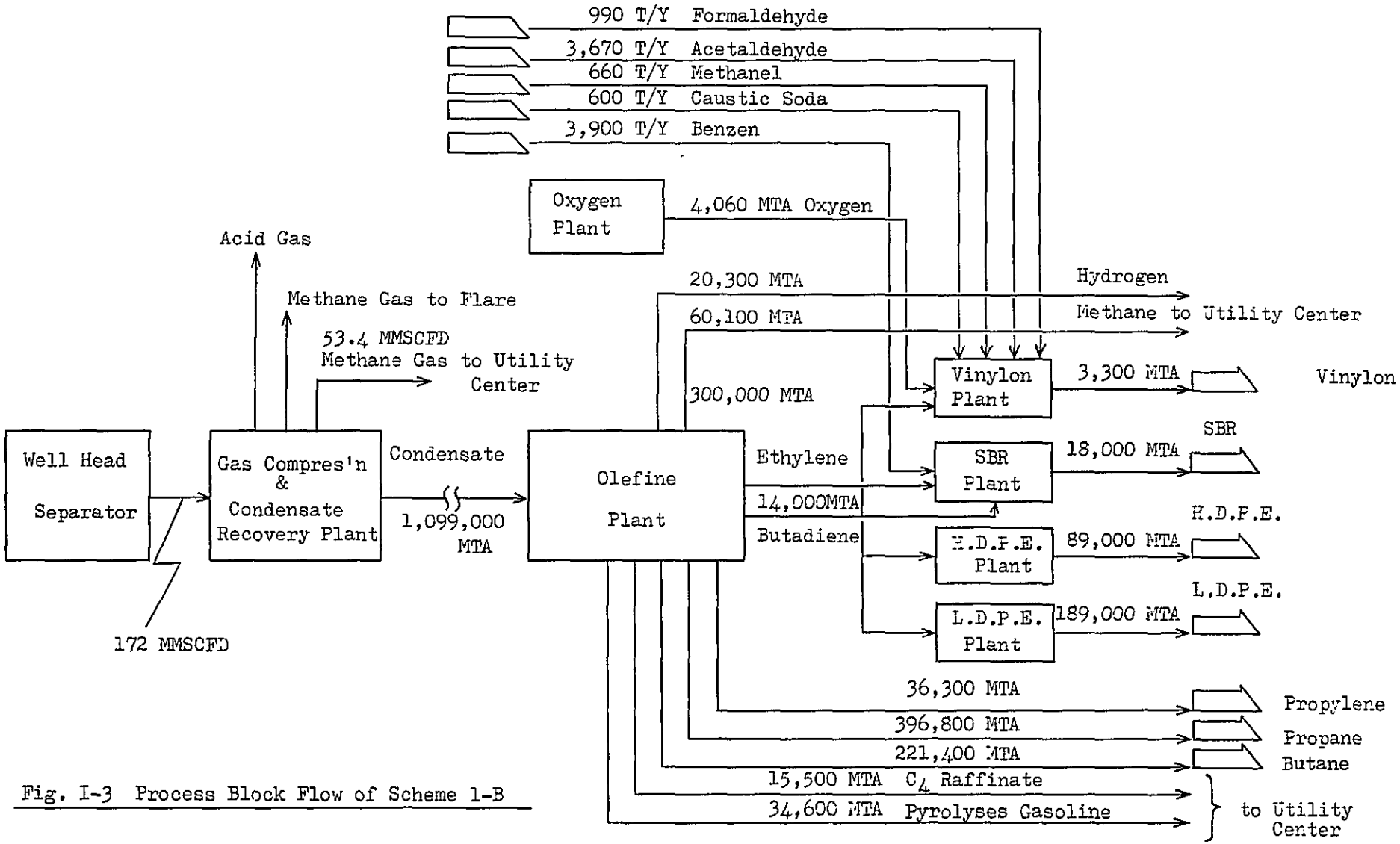


Fig. I-3 Process Block Flow of Scheme 1-B

Fig. I-4 Master Plot Plan of Ethylene Complex (Scheme 1-A)

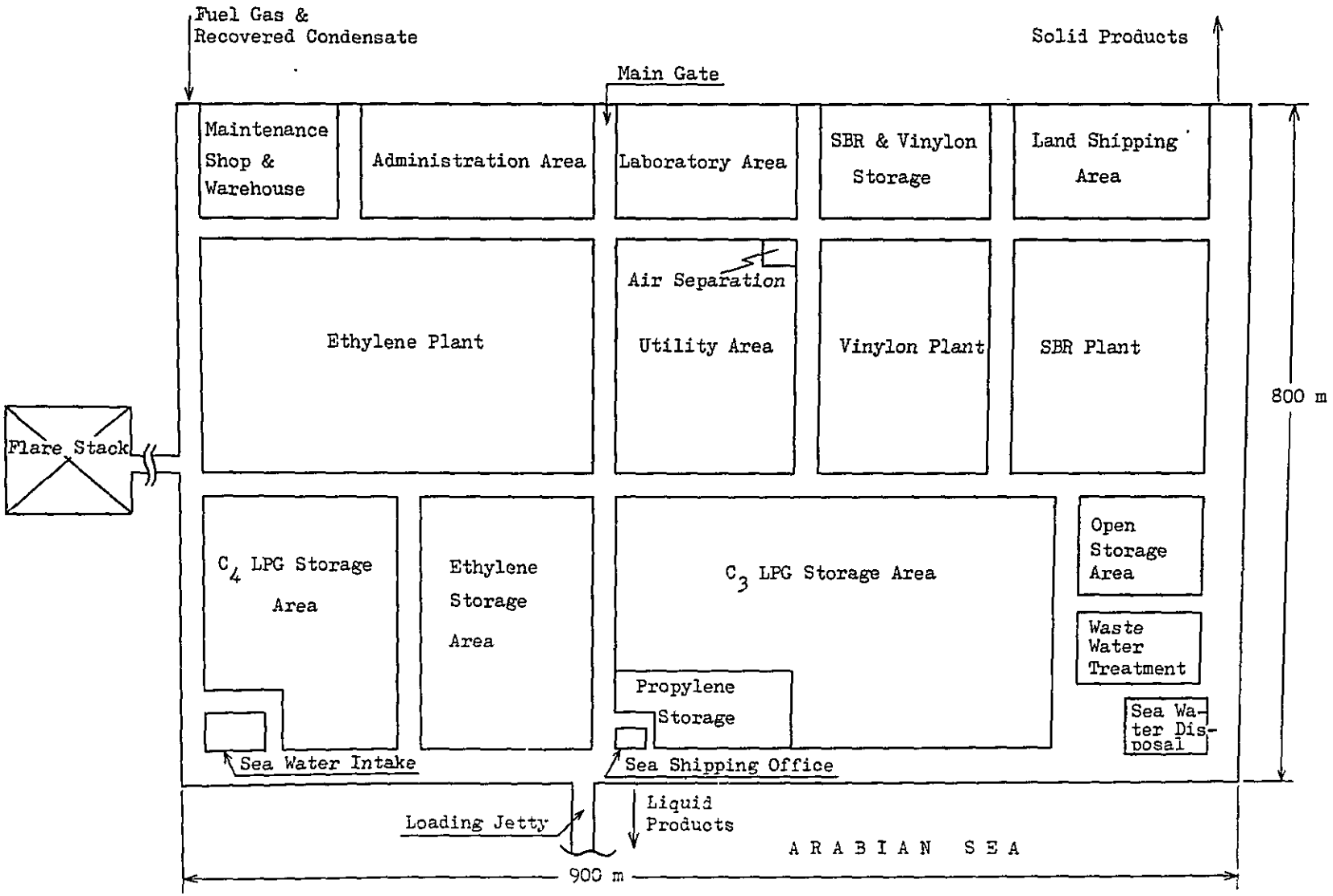
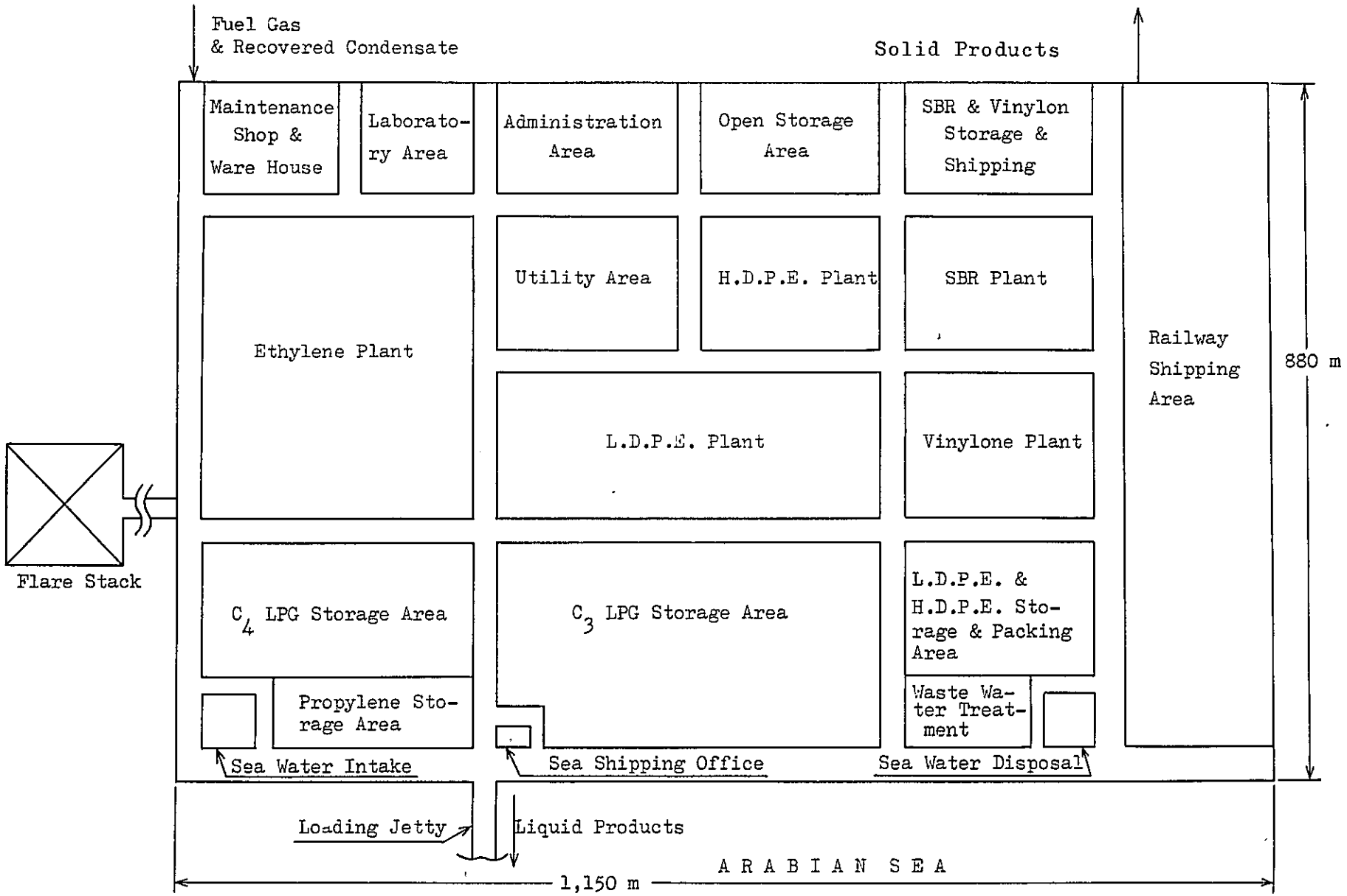


Fig. I-5. Moster Plot Plan of
Ethylene Complex (Scheme 1-B)



APPENDIX II.

Appendix II. On Feasibility of Development of Wadi Sawawin Iron Ore Deposits

Summary

In the Wadi Sawawin district, iron ore deposits of varied sizes consisting primarily of jaspilite are distributed in a strip zone extending about 18 km east to west, and their total ore reserves are estimated to amount of 330 million tons of low-grade iron ores of 40-42% Fe. The deposit is not of a single ore body, but comprises 15 separate ore bodies as seen in Fig. II-2 (showing more than 100 outcrops).

Upon the supposition that the feasibility of development of iron ores in this district depends upon the economical workability of No. 3 ore body of West Shinfa-Sahaloola deposits, which is the largest of the 15 ore bodies, emphasis was laid, for the present research, upon obtaining an understanding of the quantity, quality, and dressing characteristics of ores of that ore body.

The West Shinfa-Sahaloola No. 3 ore body is the largest single ore body, and the condition of the deposit is, as seen in Fig. II-3 suitable for open-cut mining. The minable crude ore quantity is 66 million tons, but its ore is by no means desirable as raw material for iron smelting, because of its low iron and high phosphorus content, estimated as some 35% Fe, 4-10% FeO, and 0.2-0.4% P. Moreover, as the ore is fine-grained and compact in texture and low in iron content, the rate of iron recovery is estimated as low as 20-30%.

Therefore, the amount of concentrates recoverable from this ore body as pellet feed of some 67% Fe is istimated as 6-9 million tons, and, upon the basis of the minimum economical production scale of 2 million t/y in the case of pellet feed or pellet production from such taconitic low-grade ores, it might not be exploited economically, due to short mine life of three to five years.

Some other ores found near diorite bodies in the same district are coarser-grained and higher in FeO than other ores, have Fe recovery rates as high as 84% and have good dressing characteristics, but the deposits cannot be an object of mining on account of the small extent of the ore reserves, some 2.4 million tons in total.

Generally, for the enriching treatment of such low-grade iron ores as these, a great amount of power and water, and many workers, are needed, but because the area in which the deposits are found is a desert, bringing these together at the site would be extremely difficult.

From the above examination, the economical development of Wadi-Sawawin iron ores seems, at the present time, far from realization.

History of Surveys

Since the discovery of iron ore boulders by Philby and R.C. Bougue of U.S. Geological Survey in 1953, surveying of the deposits has been done by many foreign surveying institutions, and in 1966-1967 a detailed geological survey was performed by a team dispatched by the Geological Survey of Japan, as a result of which six prospecting borings were sunk in 1969. Besides, ore dressing experiments for ores of this district were done by Pickands Mother & Co. in 1963 and by the Royal Institute of Technology, Sweden, in 1967, but no successful results have been reported to date.

Topography

This district is in the Al Hejaz mountain range and generally shows a mature stage of topography, but valleys are silted up with sand and gravel, becoming flat lands that are called silty deserts. This desert level is 600-900m above sea-level, and the relative height of the ridges to the desert is 300-600m and that of the hills consisting mainly of diorite is 100-150m.

Geology

Geology of this district consists of Pre-Cambrian sedimentary rocks that are comprised under the name of Silasia formation and igneous rocks that are intruded in them as meta-diabase, quartz-porphyrite, diorite, granite, etc.

According to the Geological Survey of Japan, the Silasia formation is roughly divided into the upper strata, consisting of sedimentary rocks of green schist facies, and the lower strata, consisting of meta-volcanic green rocks, and the former occupies almost half of the southern part of this district and the latter is found only in the southwest corner of the district.

Stratigraphical sequence of the upper strata, from the upper to the lower strata, is (according to the Japanese geological mission) as follows :

	Thickness
Diabase tuff breccia	16 m
Tuffaceous slate sandstone thin seams of iron ore	13 m
Sandstone slate iron ore	40 m
Iron ore thin seams of sandstone and slate	50 m
Sandstone slate iron ore	10 m
Sandstone slate many thin iron ore	100 m
Sandstone minor slate	60 m
Sandstone several thin beds of canglomerate minor slate	360 m
Sandstone minor slate	400 m
Slate, sandy slate, sandstone	110 m
Total	1,159 m

Ore deposits

Iron ore deposits are intercalated, as above, in the uppermost portion of the Silasia formation, and are regionally metamorphosed syngenetic deposits of the Lake Superior type as those occurring in Brazil, India, and elsewhere.

The ore is generally fine-grained, compact, and banded jaspilite, consisting of hematite and jaspar bands, and its mineral composition is as follows :

Hematite band

Essential minerals :	hematite, jaspar
Accessory minerals :	magnetite, martite, chlorite, calcite, epidote

Jaspar band

Essential minerals :	jaspar
Accessory minerals :	hematite, chlorite, calcite

Ores of smaller deposits such as Odei, Arigato, Sofro, etc., scattered in diorite body are fairly coarse-grained and rich in magnetite, owing to the effect of thermal metamorphism, and their mineral composition is as follows :

Ore band

Essential minerals :	specularite, magnetite, quartz
Accessory minerals :	chlorite, actinolite, epidote, calcite, garnet

Quartz band

Essential minerals :	quartz
Accessory minerals :	specularitie, magnetite, chlorite, calcite

Ore reserves and grades

Ore reserves and ore grades, estimated and determined by the Geological Survey of Japan are as shown in Table II-1.

Calculation of ore reserves was done upon the results of prospecting borings shown in Fig. II-2.

From the above calculation of ore reserves, 322 million tons of iron ore is reported to exist in the Wadi Sawawin district. This amount, however, is that of total existing ores, and the deposit supposed, at present, to be economically recoverable is the No.3 ore body only, for the following reason;

(a) Only a few single ore bodies in the district have considerable ore reserves. Ore deposits in this district, originally formed as iron ore beds of the Lake Superior type, have undergone dynamometamorphism accompanied by folding, faulting, and igneous intrusion after their deposition, and were torn off into small ore bodies, indicated by outcrops which number more than 100. Thus, for instance, the East Shinfa Rahas deposit in the foregoing table possesses some 45 million tons of ore reserves, but this is, as shown by Table II-2, the total sum of reserves of several small ore bodies.

(b) Even within the same ore body ore beds and overburdens vary in thickness. As seen in Table II-3, in SW-8 the thickness of 69 m of ore versus that of 50 m of overburden would require much rock-scraping, increasing the costs of mining. In SW-5 and SW-6, though overburden is zero, the ores are thin, being 24-25m, and high mining costs are expected due to the rugged topography of the land; thus these deposits also would be uneconomical to mine. In SW-9, overburden is 24m and total thickness of iron ore is 85.71m, the deposit being thickest among those found by the six borings. Judging from the columnar section, however, only ores existing above the depth of 78.70m from the surface may be efficiently mined, so that ores from 46.86m below the overburden must be included in ore estimation, that will give figures about

50 % smaller than that in the table based on the ore thickness of 85.71m. In addition, the area is in the southernmost part of the district, and ores are least in iron content, so that this deposit also does not seem to be promising.

(c) As cited in (a) and (b), as a workable deposit that is unified into a single ore body having a thin overburden and sufficient thickness, the West Shinfa Sahaloola No.3 ore body through which SW-2 and SW-3 borings were made might well be taken into consideration, so that, further descriptions of this deposit are provided below.

The West Shinfa Sahaloola No.3 ore body

(a) Occurrence: This ore body is the largest in scale among the iron ore deposits in the Wadi Sawawin district, and is found in the Ash Shinfa mountain range in nearly WNW orientation. On the western side of it there are No.1 and No.2 ore bodies, and on the eastern side No.4, No.5, and other small ore bodies are seen. The ore body is a syngenetic deposit, consisting of jaspilite layers conformably overlying sandstone and slate in the upper part of Silasia formation, and on the roof side it is covered by sandstone, slate, tuff, and meta-diabasic rock. These jaspilite layers crop out for a distance of about 1,500m along the whole ridge (relative height to the desert is about 300m) in nearly WNW orientation, and exposes along the northern slope, for about 700m on its eastern side and about 500m on its western side. Thus, this ore bed is two-thirds covered, as seen in the profile of Fig. 3, by the above-cited roof layers, and its general strike is WNW and its dip is 25 degrees N.

(b) Ore and grade: Jaspilite of this ore body has a banded structure consisting of hematite and jaspar, and is very fine-grained and compact. Thus, ore mineral is hematite and gangue mineral is mostly jaspar. Granularity of these minerals is very small in general, mostly being 10-40 microns.

Continuous samplings (though their lengths are unknown) in the direction nearly 90 degrees to the strike of the ore body were performed by the Geological Survey of Japan for outcrops along the whole ridge and the eastern side of the northern slope, and analyses of these samples are as shown in Table II-4.

Besides these, in 1969 two prospecting borings were done near the central part of the northern dip-side of the ore body at an interval of about 350m, and their results were inspected and recorded by the Japanese geologic survey mission as follows :

(1) SW-2 hole (Fig. II-4, Table II-5)

0 - 54 m	Overburden
54.90 - 88.10m	Iron ore bed 33.20m, including two partings of slate, totalling 2.60m (approx. 8% of the ore bed).
88.10-120.02m	Graywacke

(2) SW-3 hole (Fig. II-4, Table II-6) Hole length 70.00m

0 - 13.67m	Overburden
13.67 - 61.64m	Iron ore bed 47.97m, incl. two partings of slate and tuff, totalling 1.98m (approx. 4% of the ore bed).
61.64 - 70.00m	Graywacke

From the results of samplings of outcrops and borings cited above, ore grade of No.3 ore body is approximately estimated as follows :

Total Fe	40 - 42 %
FeO	7 - 8 %
P	0.34 - 0.17 %
S	0.3 - 0.4 %
SiO_2	25 - 30 %

From this analysis it is concluded that the ore of this ore body is of low Fe and FeO and of high SiO_2 and P, and that it needs some effective treatment before dressing to improve its grade and quality. The dressing characteristics of a sample, which was taken this time from the ores near the diorite body, that are expected to be coarser-grained and higher in FeO, will be referred to in a later paragraph.

(c) Ore reserves: This ore body is of bedded form, dipping nearly parallel to the northern slope (inclination of approx. 30 degrees) of the Ash Shinfa mountain range, and in ore mining it is necessary to remove its overburden for an area about two-thirds of the deposit, and, owing to the rugged topography, construction of a mining track, etc. would be very expensive.

Though precise calculation of ore reserves requires a more detailed survey, the quantity and its grade of minable crude ore may be estimated at present as follows. The ore reserves as given by the Japanese survey mission are, as cited before, 98 million tons with average grade of 42.50%Fe.

Minable crude ore quantity 61,600,000t

1,100mx500mx40mx3.5(Sp.gr.)x0.8(minability)=61,600,000t

Overburden to be removed

300mx450mx50mx2.7(Sp.gr.)	18,000,000t
550mx650mx14mx2.7(Sp.gr.)	13,000,000t
Total	31,000,000t

Grade of minable ore Fe 35 %

Fe 41% (grade of jaspilite)x0.85(rock partings + waste inclusion 7%)=34.85% ≒ 35%

Dressing characteristics

Since the discovery of the Sawawin ore deposits, dressing tests of their ores have been done by many consultants, and all of them have pointed out the extreme difficulty which would be involved if enriching treatments were attempted for these iron ores, especially because the ore minerals are extremely fine-grained and closely intergrown with jaspar.

That is to say, the granularity of hematite in relatively iron-rich ores is in the region of 0.008-0.01 mm, and even that of relatively coarse magnetite is 0.05-0.06 mm, so that, if ores are minutely ground down to -400 mesh (0.037 mm), free magnetite may be isolated, but separation of hematite is difficult even they are ground to -400 mesh.

At present, the limit of commercial grinding fineness of low-grade iron ores is some -325 mesh with 60-80 % recovery, and further grinding of ores is thought to be very questionable economically.

Moreover, since ores are extremely hard and compact, the power cost for the -400 mesh grinding is expected to be very high. The second trouble in ore dressing comes from the predominance of low-grade hematite as the main constituent mineral. As enriching treatments of low grade hematite, gravitative slrting, floatation process, and high-power magnetic separation may be taken into consideration in general, but from the extreme difficulty of isolation of individual ore minerals in these ores, the effect of such methods of ore dressing is questionable. To overcome this difficulty of ore-sorting, the Royal Institute of Sweden has performed a magnetic sorting of ground ores, previously undergone magnetizing roasting, and obtained results is shown in Table II-7.

As seen from the experimental results shown in Table II-7, through magnetic sorting of roasted material, ground to -230 to -400 mesh, a rate of iron recovery as high as over 90% and concentrates of some 54-58 % Fe have been obtained. The enriching treatment of low-grade hematite ores by means of combined reducing roasting and magnetic sorting will be extremely costly, and it is economically impracticable. Moreover, unfortunately, it has never been commercially performed in any country, although there has been some success in laboratory-scale work.

However, as this ore does not consist solely of hematite, but contains some FeO, numerous experiments have been tried by various research institutes in several countries, with the purpose of ascertaining the possibility of the application of magnetic sorting for this ore, and among those the most practical ore is that done by Pickands Mother Co. in 1963 the results of which are as seen in Table II-8.

From that experimental data we can draw no exact conclusion, as the iron contents of ores used are unknown, but, as far as this experiment shows, iron recovery of some 20-30 % is quite uneconomic and, even if this point is disregarded, the amount of pellet feed, more or less 67 % in iron content, to be obtained from the No.3 ore body will be :

$$61,600,000t \times 1/9.63 - 1/6.32 = 6,400,000 - 9,700,000t$$

Thus, the ore quantity also seems to be insufficient in the economic point of view.

On account of the limitation of our survey period and also because the above results of experiments by Pickands Mother Co. and Royal Institute of Sweden were available, the mission took the following three samples, A, B, and C, and, after Davis' tube test, discussed the applicability of magnetic ore-sorting tests that are supposed most economical at the present time. Special features of the samples taken are as follows :

A (Sample 1, 2): Jaspilite-type ores representing the ore of West Shinfa No.3 ore body.

B (Sample 3, 4, 5): Ores of West Shinfa No.3 ore body, which are found near diorite rock bodies and for which magnetic sorting seems to be possible.

C (Sample 6, 7): Ores of an ore body which is clearly attached to a diorite rock body and high rate of recovery of Fe by magnetic sorting is expected.

Values of chemical analyses of these samples are as shown in Table II-9.

As seen in Table II-9, though total Fe of the samples taken is variable, i.e., 32%-49%, it is notably higher than the expected average grade of Fe 35% of West Shinfa No.3 ore body. This difference may be due to the fact that for the expected average grade some influence of soil and waste inclusions was taken into consideration, and the samples taken are mostly superficial ones that have been enriched to some extent.

FeO of the jaspilite-type samples 1 and 2, that of the near-diorite samples 3,4 and 5, and samples 6 and 7 from ores in diorite are in the region of 3 %, 4-5 %, and 5-10 % respectively, thus being least like the jaspilite type, and FeO content becomes higher the nearer the diorite rock body, and this indicates the gradual increase of magnetite, though small in amount, towards the diorite by thermal metamorphism.

Concerning impurities, there is scarcely any sulphur, as is naturally expected in this kind of deposit, but phosphorus, 0.1-0.4 % in amount would cause great trouble if the ore was used for the manufacture of steel. Incidentally, the Australian iron ores that amount to about 40 % of total iron ores now imported by Japan contain only 0.05 % phosphorus.

For the above samples Davis tube test was done, and its result is shown in Table II-10.

In that test each sample used was previously ground to -325 mesh for its 80 %, but in samples so low in Fe content, as, for example, the 32-35 % Fe of samples 1 and 7, the Fe content of concentrates falls to less than 50 % regardless of their FeO values, and they cannot be used as pellet feed. This is a very critical problem, seeing that the expected average grade of ores of West Shinfa No.3 ore body, which is regarded as the main body, is 35 % of Fe.

The rate of recovery (Fe recovery and the tonnage of concentrate per that of crude ore) is gradually increasing in the order of A, B, C, namely, in direct proportion to proximity to the diorite rock body, and also, as the FeO content becomes higher. So, there is some possibility of obtaining pellet feed of 62-64 % Fe even from ores in the main West Shinfa No.3 ore body, so long as they are above 40%Fe and are in the proximity of a diorite body (that is, they are higher in FeO and coarser in grain size).

As the samples of C group, which were taken as supplementary ones, if Fe recovery of some 84% as shown by the samples is secured, the ores, with their excellent dressing character, certainly have the possibility of becoming an object of exploitation. Reserves of these ores as low as 2.4 million tons, however, actually denies this possibility.

From the above results of inquiries, for the possibility of development of this deposit, the question is whether or not such ores as those of B group exist in a state available for open-cut mining that need no selective mining, and, as to ore reserves, whether or not a sufficient amount of ores, say, at least 2 million tons/year x 15 years = 30 million tons, necessary for the working of those low-grade iron ores in consideration of the recovery of capital invested for mine track, harbor construction etc., may be expected.

According to the results of our surveying hitherto obtained, however, the estimated ore reserves with an average grade of Fe 35% is 66 million tons and the rate of recovery of concentrates, 60% in Fe, is 7.46%, even when the grade of crude ore is Fe45%, so that the whole amount of concentrates to be obtained will be 5 million tons, which will not permit economical working of the deposit.

Table II-1, Reserves and Grades of Iron Ores in Wadi Sawawin

Areas	(Million tons)	Fe %	Kind of Ores
Wadi Sawawin Area			
Odei	0.4	47.50	Magnetic
Arigato-Sofro	2.0	42.60	"
Sub-Total	2.4	43.41	"
West Shinfa Sahaloola Area			
No. 1	37.0	37.10	Jaspilitic
No. 2	88.0	41.27	"
No. 3	98.0	42.50	"
No. 4	20.0	47.11	"
No. 5	4.8	38.60	"
Sahaloola left	5.6	48.50	"
Sahaloola right	1.6	50.20	"
Sub-Total	205.0	41.88	"
Other Area			
Ujara	32.0	47.88	Jaspilite
Azbeizib	11.7	42.25	"
Slekh Groups	24.0	45.70	"
East Shinfa-Rahas	45.2	37.46	"
Gohs Groups	12.0	46.51	"
Sub-Total	124.9	43.03	"
Grand-Total	332.3		

Table II-2, Distribution of Reserves among Ore Bodies in Shinfa-Rahas Area

Name of Ore Body	Elongation	Width	Ore Reserves (Million tons)
East Shinfa	2,500 m	10 m	24.0
Rahas No 1	600 m	30 m	2.4
No 2	410 m	30 m	4.4
No 3	400 m	30 m	7.0
No 4	800 m	40 m	4.5
No 5	500 m	70 m	1.0
Others			1.9
		Total	45.2

Table II-3 Thickness and Overburden of Iron-Ore Beds in Boreholes

Borehole	Iron-Ore Bed	Av. Total Fe %	Total Thickness of Iron Bed	Overburden
SW - 2	54.90 - 88.10	40.01	30.60	50 m
SW - 3	13.67 - 61.64	42.63	45.99	14 m
SW - 5	0.00 - 32.81	41.14	23.90	0 m
SW - 6	0.00 - 26.40	46.46	25.43	0 m
SW - 8	50.87 - 57.20			50 m
	70.35 - 83.10	36.89	67.26	
	89.23 - 102.48			
	113.10 - 149.12			
SW-9	24.55 - 78.70		(46.86)	24 m
	91.00 - 97.00			
	107.21 - 118.48	35.62	85.71	
	137.10 - 146.43			
	158.81 - 164.48			

Table II-4, Sample Analyses of West Shinfa Sahaloola No3 Ore Body

%

Sample	Fe	SiO_2	P_2O_5	S	Cu
W 3-1	35.6	44.2	3.01	0.48	0.1
3-2	42.5	23.3	2.41	0.47	0.8
3-3	46.7	28.1	2.73	0.40	0.45
3-4	42.5	33.2	4.81	0.37	0.1
3-5	41.0	36.0	1.01	0.51	0.1
3-6	40.7	25.4	1.08	0.31	0.1

Table II-5, Sample Analyses of SW-2 Borehole in West Shinfa No3 Ore Body (%)

%

Sample	T.Fe	FeO	Fe_2O_3	SiO_2	P_2O_5	Thickness(m)
SW 2-1	40.17	11.53	44.62	27.6	0.69	3.85
" 2	39.95	7.34	48.96	33.4	0.35	7.45
" 3	41.06	7.88	50.01	32.8	0.31	2.90
" 4	39.62	8.25	47.48	32.8	0.53	7.20
" 5	34.41	9.43	38.57	38.0	0.86	2.75
" 6	42.39	7.34	52.49	28.6	0.56	

Table II-6, Sample Analyses of SW-3 Borehole in Ore Body

Sample No.	T. Fe	FeO	Fe_2O_3	SiO_2	P_2O_5	% Thickness
SW 3-1	44.68	7.33	55.72	25.8	0.44	16.18
" 2	41.77	8.04	50.78	35.6	0.45	14.39
" 3	37.30	4.54	48.28	36.1	0.44	4.22
" 4	42.80	8.04	52.25	86.1	0.83	11.20
Average	42.86					45.99

Table II-7, Result of Concentration Test by the Method of Magnetizing Roast by Royal Institute, Sweden

Crude ore ground to	Magnetized ore ground to	Concentrate Fe grade	% of head Fe recovered	Concentrate SiO_2 grade
1) -10 mesh	-230 mesh	58.7%	94.4%	180.16%est.
2) -10 mesh	-400 mesh	58.9%	91.9%	"
3) - 5 mesh	-400 mesh	54.8%	90.2%	21.65%

Table II-8, Result of Magnetic Concentration Test by Pickands Mother Co.

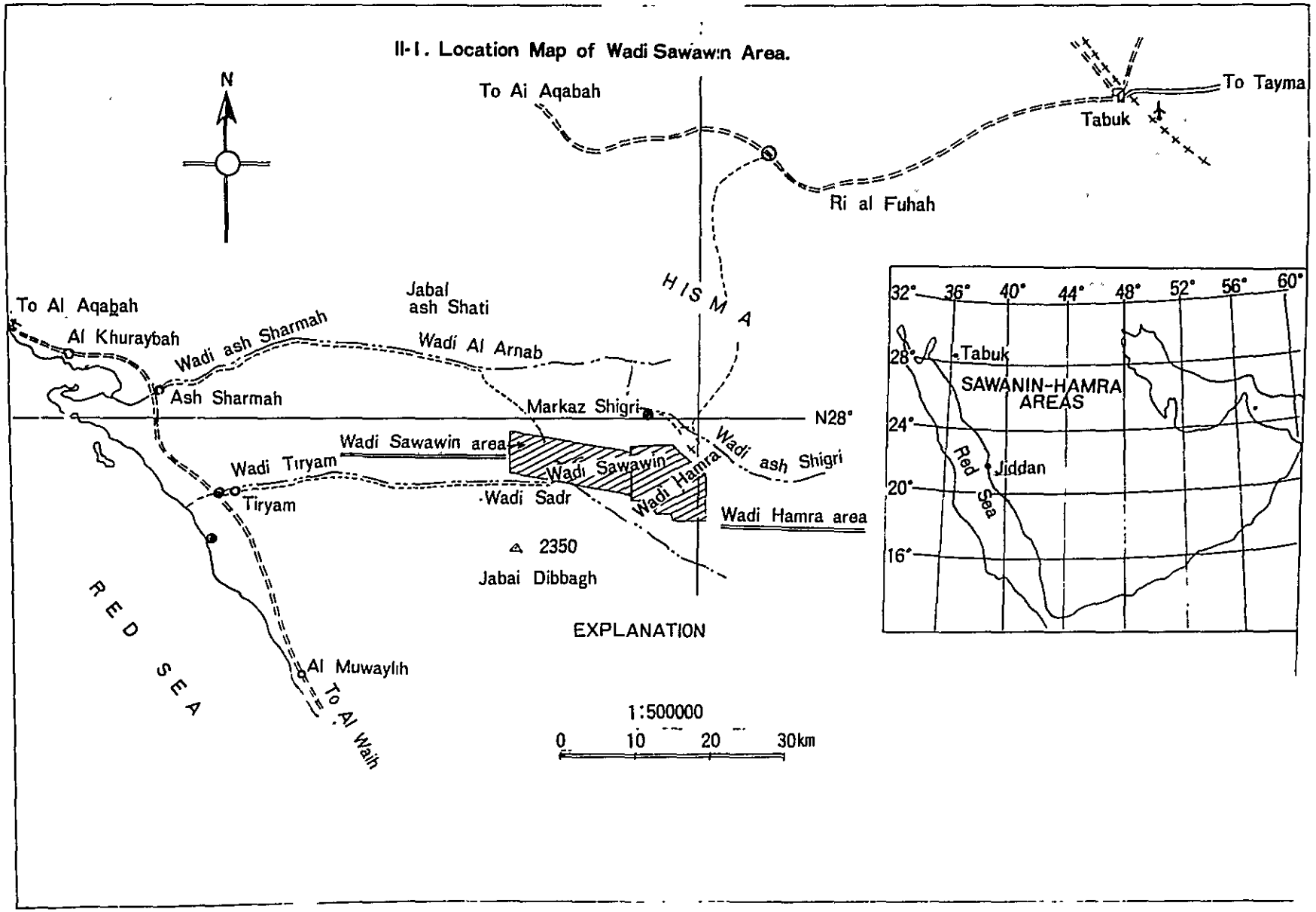
No.	Sample	Total Weight %	Fe %	Fe Recovery %	Tons crude ore per conc.
1	Crude -400 mesh	100	85.10	100	
	Magnetite conc.	10.68	65.24	19.74	9.36
2	Crude -325 mesh	100	32.41	100	
	Magnetite conc.	10.38	67.71	21.69	9.68
3	Crude -325 mesh	100	36.10		
	Magnetite conc.	15.82	67.07	29.39	6.32

Table II-9, Chemical Analyses of Samples for Davis Tube Test

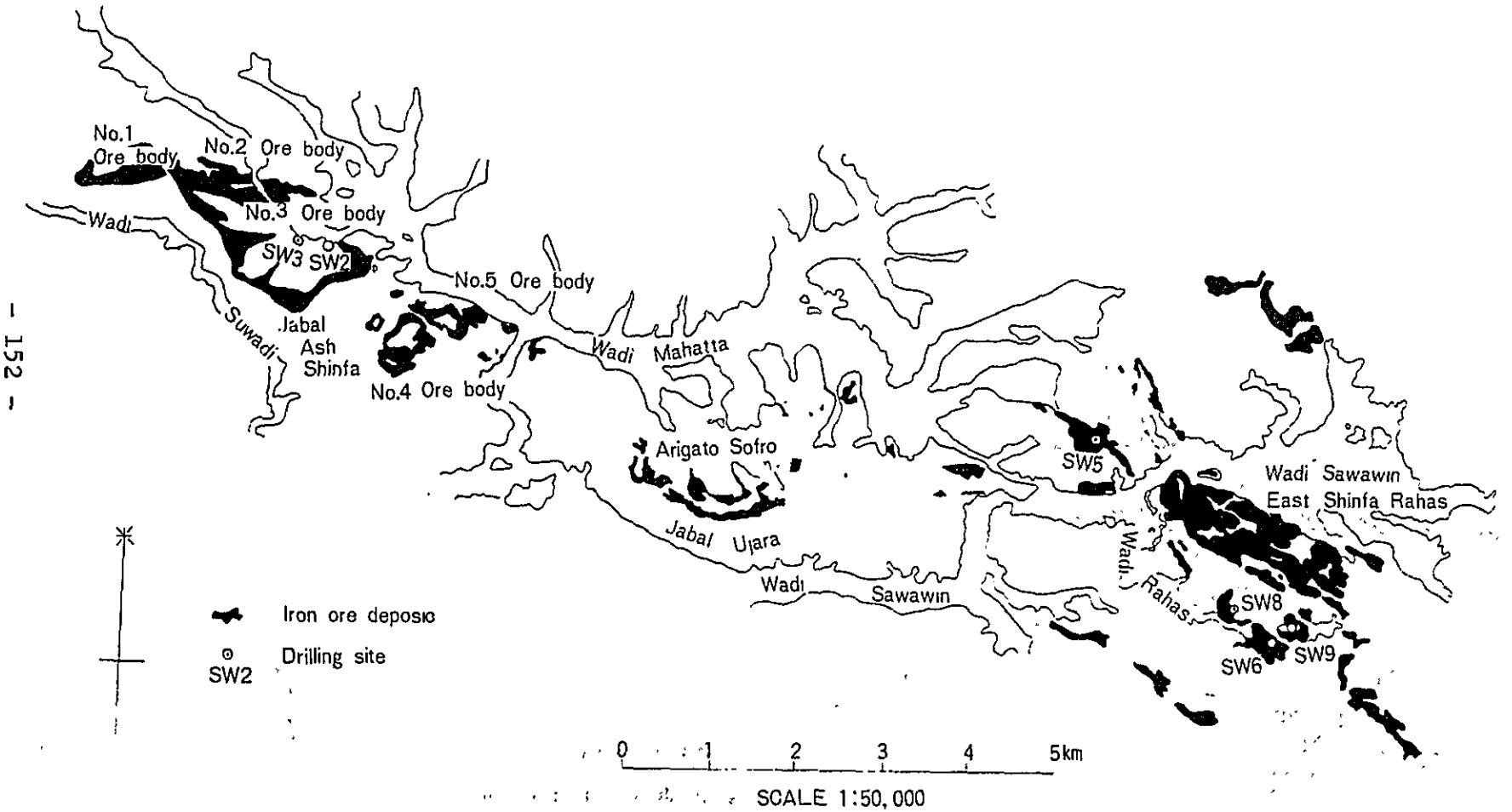
Sample group	Sample No.	T.Fe %	Fe O %	P %	SiO_2 %	Al_2O_3 %	S %
A	1	32.91	3.41	0.241	39.88	3.74	0.013
	2	45.19	3.49	0.298	26.57	1.82	0.006
B	3	48.39	5.90	0.222	21.84	2.74	0.003
	4	49.31	4.21	0.392	18.36	3.30	0.003
	5	40.82	5.62	0.190	30.58	2.95	0.024
C	6	49.73	5.34	0.091	20.70	1.81	0.004
	7	35.41	10.68	0.252	38.66	8.87	0.009

Table II-10, Result of Davis Tube Test

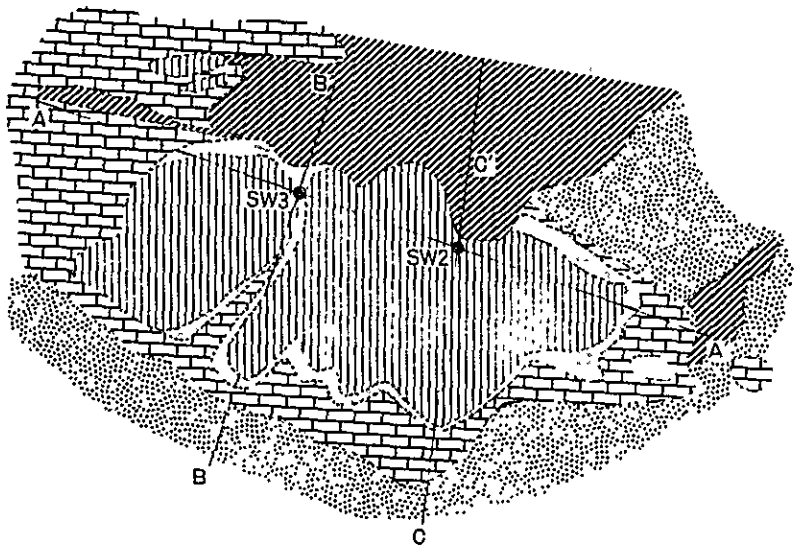
Sample grop	Sample No.	Sample Fe% / Weight(gr)	Mag. Conc Fe % / gr	%	Tail Fe % / gr	%	Slime Fe % / gr	%	Fe Recovery %	Tons Crude Ore Per Cont.
A	1	32.91	49.94		31.70				10.1	3.61
		11.004	3.651	27.7	6.633	60.3	1.320	12.0		
	2	45.19	60.10		36.71				48.2	7.46
		11.252	1.504	18.4	9.334	52.0	0.414	3.6		
B	3	48.39	64.02						47.8	2.77
		9.63	3.778	37.9	5.574	56.0	0.611	6.1		
	4	49.21	62.54						63.5	1.99
		10.708	6.291	50.1	6.262	49.9	-	-		
	5	40.82	64.02		32.06				70.1	2.63
		10.311	3.778	37.9	5.574	56.0	0.611	6.1		
C	6	49.78	12.90		22.96				84.8	1.53
		8.109	6.703	65.0	3.035	25.4	0.578	5.6		
	7	35.41	4.406		16.95				84.7	1.47
		12.553	5.841	67.9	1.654	19.2	1.114	12.9		

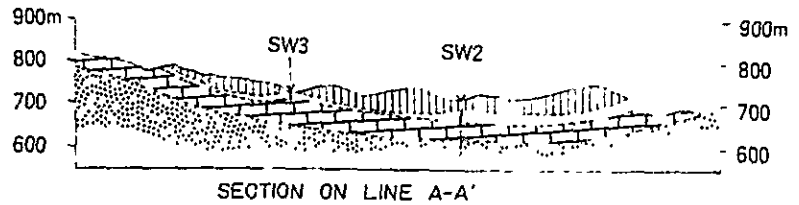

II-1. Location Map of Wadi Sawawin Area.
N
To Ai Aqabah
To Tayma
Tabuk
Ri al Fuhah
HISMA
Jabal
ash Shati
To Al Aqabah
Al Khuraybah
Wadi ash Sharmah
Wadi Al Arnab
Ash Sharmah
Markaz Shigri
N28°
Wadi Sawawin area
Wadi Tiryam
Wadi Sawawin
Wadi Hamra
Wadi ash Shigri
Tiryam
Wadi Sadr
Wadi Hamra area
2350
Jabai Dibbagh
EXPLANATION
RED SEA
Al Muwaylih
To Al Wajh
1:500000
0 10 20 30km
32° 36° 40° 44° 48° 52° 56° 60°
28°
24°
20°
16°
Tabuk
SAWANIN-HAMRA
AREAS
Red Sea
Jiddan

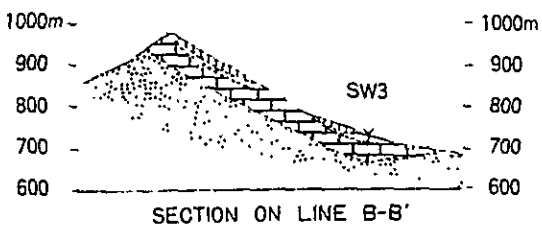
II-2. Distribution Map of Wadi Sawawin Iron Ore Deposits.

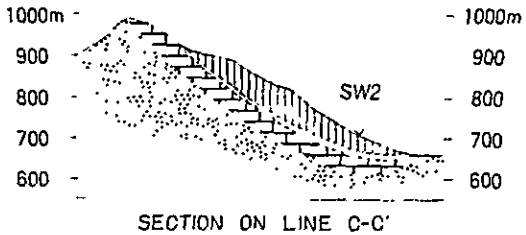


II-3. Geological Map and Profile of West Shinfa-Sahaloola No.3 Ore Body.

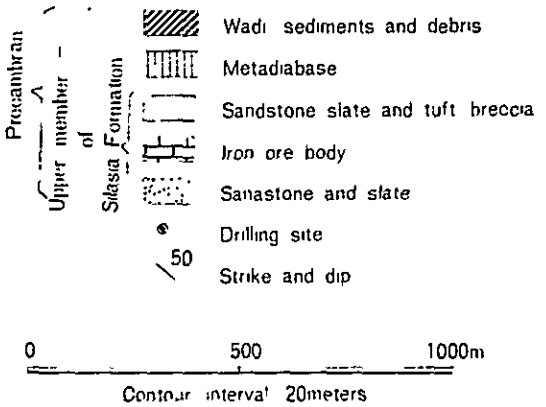








LEGEND



II-4. Geological Logs of Boreholes in Wadi Sawawin Area.