No. 6

THE FEASIBILITY STUDY REPORT ON THE EXPANSION PROJECT OF THE EL DIKHEILA IRON AND STEEL WORKS IN THE ARAB REPUBLIC OF EGYPT

JANUARY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY

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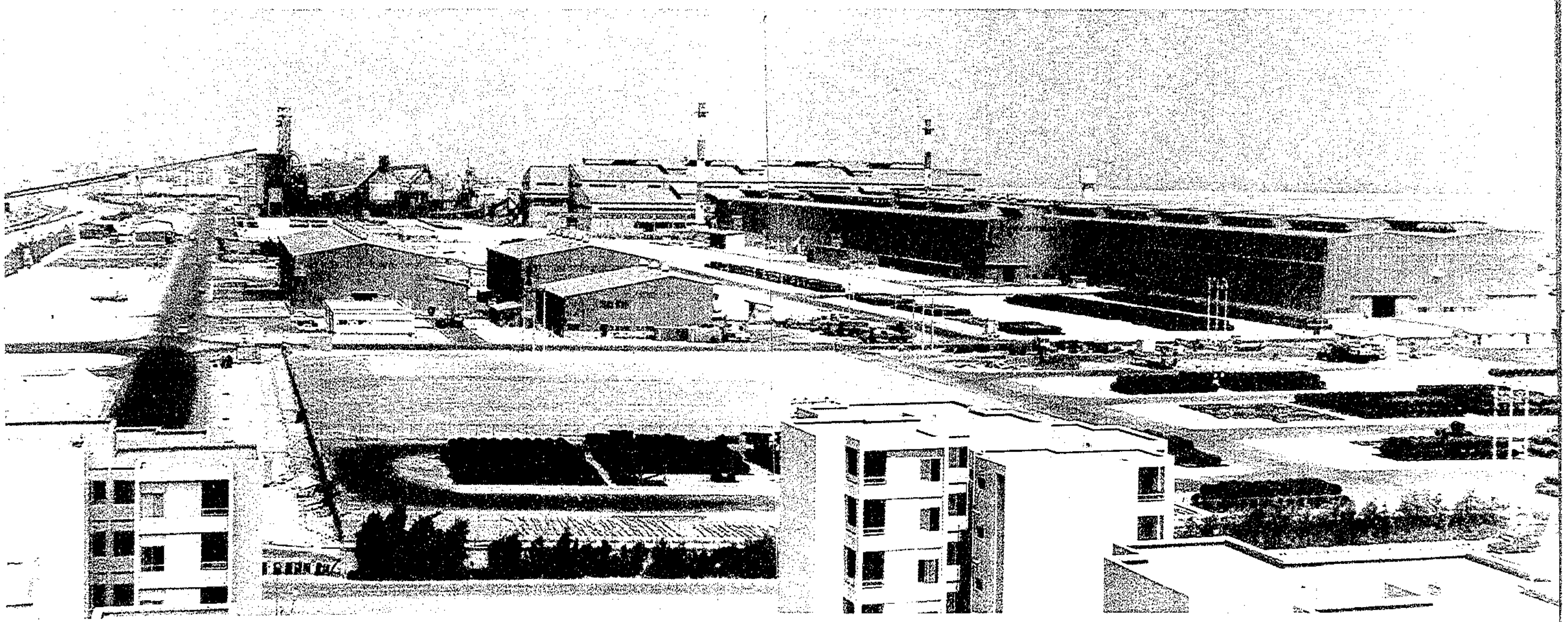


General view on El Dikheila Iron and Steel Works of ANSDK

Rose Garden in Site

PREFACE

In response to the request of the Government of the Arab Republic of Egypt, the Government of Japan has decided to conduct a feasibility study on the Expansion Project of the El Dikhela Iron and Steel Works in Egypt and entrusted the study to the Japan International Cooperation Agency (JICA). JICA sent to Egypt a study team headed by Dr. Hiromoto Toda, Japan Iron and Steel Federation, from March 6 to March 22, 1987.

The team had discussions on the Project with the officials concerned of the Government of Egypt and conducted a field survey in the project-related areas. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of the Arab Republic of Egypt for their close cooperation extended to the team.

January 1988

Keisuke Arita

Keisuke Arita
President
JAPAN INTERNATIONAL COOPERATION AGENCY

C O N T E N T S

ABBREVIATIONS AND ACRONYMS USED

ANSDK	Alexandria National Iron and Steel Company SAE
A&I	Analysis and Inspection Facility
ADF	Administrative Facility: Administration building, Road and parking lot, Drainage system
BF	Blast Furnace
BMP	Bar Mill Plant
BSC	British Steel Corporation
BT	Billet
CAPMAS	Central Agency for Public Mobilization and Statistics
CIF	Cost, Insurance and Freight
CCM	Continuous Casting Machine
DRI	Direct Reduced Iron
DRP	Direct Reduction Plant
DSM	Delta Steel Mill
ECW	The Egyptian Copper Works
EEA	Egyptian Electricity Authority
EAF	Electric Arc Furnace
EGITALIC	Egyptian-Italian Engineering and Construction Joint-Stock Co.
EGPC	Egyptian General Petroleum Corporation
FOB	Free on Board
F/S	Feasibility Study
FY	Fiscal Year (July 1 to June 30)
GOFI	General Organization for Industrialization
HADISOLB	The Egyptian Iron and Steel Co.
IFC	International Financing Corporation
IISI	International Iron and Steel Institute
IMC	Executive Organization for Industrial Mining Complexes
IMF	International Monetary Fund
IRR	Internal Rate of Return
JC	Japanese Consortium
JICA	Japan International Cooperation Agency
JISF	The Japan Iron and Steel Federation

LC(S)	Lime Calcining (Shop)
LE	Egyptian Pounds
LF	Ladle Furnace
MS	Maintenance shop
MS	Molten Steel
NMI	The National Metal Industries Co
OHF	Open Hearth Furnace
RMP	Rod Mill Plant
SMP	Steelmaking Plant
str.	Strand
S/W	Scope of Work
T, Ton	Metric Ton
T/ch	Ton per charge
T/D	Ton per day
T/h, T/hr	Ton per hour
T/ht	Ton per heat
T/Y	Ton per year
UNIDO	United Nations Industrial Development Organization

SUMMARY

1. Introduction

1-1. Background of the study

Egypt achieved high economic growth from the middle of 1970s to early 1980s and is still keeping about 7% growth under the 5-year economic and social development plan. With the main object of decentralization of industries and population regionally, the plan promotes urban development while it aims at greening desert areas, and this caused increase of steel demand. However, the domestic capacity of steel supply is limited and the steel demand and supply gap shows a sign of steady increase and can be filled only by import of a large quantity of foreign steel.

In January 1979, the Government of the Arab Republic of Egypt, for the purpose of decreasing import of steel and saving foreign currencies, contemplated a plan to construct in the El Dikheila area on the west of Alexandria an integrated steel works based on direct reduction (DR) process and asked the Government of Japan to provide technical cooperation for its feasibility study. The Japan International Cooperation Agency (JICA) carried out such feasibility study (F/S) concerning the construction of El Dikheila Iron and Steel Works in March 1979 and submitted a F/S report to the Government of Egypt in August the same year.

Based on the report, the Government of Egypt consulted with the World Bank Group and decided to implement the project as a joint venture business under the Law No. 43, 1974. A consortium (Nippon Kokan, Kobe Steel and Toyo Menka) was designated as technical partner and the construction of El Dikheila Works with World Bank loan and Yen loan was decided. The construction was commenced in 1983 and the Works was completed as an integrated steel works with start-up of SMP in May, BMP in July and DRP in November 1986 and RMP (Rod Mill plant) in April 1987. Its product mix includes bar and rod with production capacity of 745,000 T/Y in total.

The Government of Egypt has planned to expand the Works to cover persisting shortage of steel products, especially re-bars, and requested Japan's cooperation again in the F/S for the expansion project of El Dikheila Works from May 1985 and JICA dispatched a preliminary study mission in October 1986 to discuss the contents of the study on the expansion project of El Dikheila Works.

The mission studied the background of the request and the operation condition of the Works and collected relevant data and information. They also discussed with those concerned of Egypt about the scope of work (hereinafter referred to as S/W).

With the backdrop as above, this F/S was to conduct market research and cover technical, financial and economic analyses of the expansion project of the Works and the results of the study are compiled in this report.

1-2. Process of execution of the study

1-2-1. Field survey

For the purpose of making the F/S for the expansion project of El Dikheila Works, the field survey was conducted mainly in Cairo and Alexandria for 17 days from March 6 to March 22, 1987.

In order to investigate whether the expansion project is feasible technically, financially and economically, and to plan product mix, production and also the most suitable facilities, studies were made on general economic condition, steel policy including price and sales channel, steel demand and supply condition in Egypt, and the existing facilities and their operation condition of the Works. For the study, the mission visited not only El Dikheila Works but also such relevant governmental offices as Ministry of Planning and International Cooperation, Ministry of Industry, Ministry of Housing and Utilities, Ministry of Finance, Ministry of Metallurgical Industries, Central Agency for Public Mobilization and Statistics and Electric Power Agency, and other steel mills, related industries, steel-consuming industries, financial institutions, etc.

The members of the mission consisted of 13 persons including the leader and experts in the fields of technical coordination, civil engineering and building, DR, steelmaking, rolling, utilities, infrastructure, market research, financial and economic analyses. In addition, 9 experts joined in the analysis work in Japan.

1-2-2. Analysis work in Japan

Based on the findings of the field survey, the mission engaged in analysis work in Japan, which included compilation of data on the economic condition and other relevant matters in Egypt forming the background of the project, study on the present condition and outlook of steel demand and supply in Egypt and the availability of raw materials forming the premises for the expansion project and also formulation of the expansion plan and related facilities plan, construction schedule and operation plan. It included financial and economic analyses also. The result of such work is compiled in this report.

In addition, in preparing the report, the mission met two counterparts of Egypt, who visited Japan during the period from July 12 to July 23, 1987, and had interim consultation with them. At the same time, JICA provided them with opportunities to visit similar or related steel mills in Japan. During the consultation, a number of requests and confirmations were expressed from Egypt and it was agreed that some of those matters would be reflected in the report.

1-2-3. Explanation on the report

For giving explanation on the draft final report, JICA dispatched a mission to Egypt during the period of October 16 - 25, 1987, and the mission had discussion with Egypt. The mission visited ANSDK and Ministry of Planning and International Cooperation and gave detailed explanation on the report and it was agreed that the final report be submitted by the end of January 1988.

2. Steel Demand and Supply

2-1. Demand and supply

It is expected that the demand for steel products will increase from 2.93 million tons in 1985 to 4.13 million tons in 1990, 5.34 million tons in 1995 and 6.94 million tons in 2000. Of the figures, demand for long products, mainly bars and rods is expected to increase from 2.18 million tons in 1985 to 2.93 million tons in 1990, 3.67 million tons in 1995 and 4.71 million tons in 2000.

On the other hand, though the production capacity of the existing steel mills in Egypt is expected to be increased one after another, it may not be able to catch up with the increase of demand for steel products. Consequently, the shortage of supply of 2.07 million tons in 1985 will decrease slightly to 1.86 million tons in 1990, but it will rise again to 2.36 million tons in 1995 and 3.02 million tons in 2000. Of the figures, long products show supply shortage of 1.70 million tons in 1985 and the shortage is expected to be 1.28 million tons, 1.57 million tons and 2.04 million tons in 1990, 1995 and 2000, respectively.

When the expansion project of El Dikheila Works is implemented as discussed in following chapters, production of re-bars and billets is expected to increase by 375,000 tons and 67,000 tons, respectively. In view of the demand and supply balance of re-bars in Egypt, such increase in re-bar production is judged fully realizable. It is possible also to sell billets to the other steel mills in Egypt.

(1) Consumption of steel products by sector in Egypt (1984-86 Average)

Sector	Consumption 1,000 t	%
Construction:	2,199	75
(Housing)	(1,050)	(36)
(Others)	(1,149)	(39)
Manufacturing:	733	25
(Industrial & electric machinery)	(293)	(10)
(Automobile)	(131)	(4)
(Others)	(309)	(11)
Total	2,932	100

(2) Forecast of production activities of major sectors

	1985	1990	1995	2000
Housing (1,000 units)	161	210	230	270
Industrial & electric machinery (Real, LE1,000)	21,008	28,849	39,184	52,840
Automobile (1,000 units)	23	75	125	175
GDP (Real, LEMillion)	22,586	29,884	39,916	53,417

(3) Forecast of demand for steel products by sector

(Unit: 1,000 T)

	1985*	1990	1995	2000
Construction:	2,199	2,889	3,530	4,477
(Housing)	(1,050)	(1,369)	(1,499)	(1,760)
(Others)	(1,149)	(1,520)	(2,031)	(2,717)
Manufacturing:	733	1,238	1,805	2,465
(Industrial & electric machinery)	(293)	(402)	(547)	(737)
(Automobile)	(131)	(427)	(712)	(997)
(Others)	(309)	(409)	(546)	(731)
Total	2,932	4,127	5,335	6,942

* 1984-86 Average

(4) Capacity expansion plans of the existing steel mills

(Unit: 1,000 T)

	1985	1990	1995	2000
Public sector	830	1,090	1,540	2,170
Private sector	70	1,175	1,435	1,750
Total	900	2,265	2,975	3,920

Note: Figures show the capacity after the expansion.
Note: The figures of the private sector for 1990 includes 745,000 tons of ANSDK. But, it does not include the 375,000 tons of the expansion project of ANSDK under the study.

(5) Forecast of steel demand and supply balance in Egypt

(Steel products in total) (Unit: 1,000 T)

	1985	1990	1995	2000
Demand (A)	2,932*	4,127	5,335	6,942
Production (B)	864**	2,265	2,975	3,920
Demand/supply gap (B - A)	-2,068	-1,862	-2,360	-3,022

Note: Export is not taken into account in the balance.
* 1984-86 Average
** Actual in 1985

(Long products) (Unit: 1,000 T)

	1985	1990	1995	2000
Demand (A)	2,175*	2,932	3,670	4,705
Production (B)	477**	1,655	2,130	2,750
Demand/supply gap (B - A)	-1,698	-1,277	-1,540	-1,955

Note: Export is not taken into account in the balance.
* 1984-86 Average
** Actual in 1985

2-2. Distribution

(1) Steel price policy in Egypt

The Government of Egypt provides four steel mills under the public sector with indirect subsidies such as supply of utilities at low prices. On the other hand, however, it put into force "price control" under the decree of the Ministry of Housing and Utilities as regards bars and rods for specified uses which are helpful to social development.

Prices of bars and rods for uses other than specified ones reflect their demand and supply condition at the time.

Incidentally, controlled price (37 kg class base price being LE400/ton) is set about LE100/ton lower than the free market price.

(2) Steel distribution system in Egypt

Distribution channel for bars and rods in Egypt may be divided into the above "distribution channel for specified uses" and the so-called "free distribution channel" for the other uses.

The distribution channel for specified uses is under the control of the Ministry of Housing and Utilities, and the Egyptian Cement Sales Office is in charge of actual distribution. Bars and rods for uses other than specified uses are distributed through free distribution channel.

Functionally, the distribution channel may be classified into "importer", "wholesaler" and "retailer." In Egypt, private distribution channel is not yet fully established and development of distribution system remains as a task for the future as the trade of steel products increases.

(3) Billets

In the nine months from August 1986 to April 1987, ANSDK concluded sales contracts for about 98,000 tons of billets and shipped 42,000 tons. When the expansion project which is the subject of the present F/S is carried out, it will be necessary for ANSDK to sell 67,000 tons of billets a year, and in view of the sales by ANSDK in the past, it is considered that all the billets can be sold to the domestic users.

3. Raw Materials

3-1. Premises

Matters considered in preparing the report are as given below.

(1) A study was made mainly about the present supply source of raw materials to ANSDK to find out whether required raw materials can be obtained stably after the expansion of ANSDK.

(2) Raw materials which can be obtained domestically are to be continuously purchased after the expansion.

3-2. Iron ore

As pellet and lump iron ore having quality suited for direct reduction process are in limited supply, they have to be purchased overseas after the ANSDK expansion as well.

As supply sources of DR grade pellet, LKAB (Sweden), CVRD (Brazil) and SAMARCO (Brazil) are considered likely.

However, as the worldwide supply of DR grade pellet is showing tendency to become tight, it is considered necessary to study medium- or long-term purchasing contracts or diversification of supply sources so as to ensure stable supply of the pellet.

3-3. Steel scrap

1) Present scrap condition in Egypt

The supply of steel scrap to the steel industry in Egypt was 180,000 to 200,000 tons a year in the last few years as shown in Table 3-1. Users of those domestic scrap are the existing three steel mills based on open hearth furnace or electric arc furnace process, namely National Metal, Delta Steel and ECW. Those three companies purchase 50,000 to 60,000 T/Y of pig iron from HADISOLB in addition to the scrap.

Table 3-1. Consumption of Scrap by Egyptian Steel Industry (Domestic Supply) (Unit: Ton)

Year	Quantity
1980/81	187,740
1981/82	146,203
1982/83	198,551
1983/84	194,003
1984/85	181,824

Source: CAPMAS

As the scrap recycling system is not well developed in Egypt, the supply of scrap is getting tight after the start-up of EAFs of ANSDK (April 1986). Incidentally, no scrap was imported in the past 4-5 years.

2) Present condition of scrap purchase by ANSDK

ANSDK consumed 98,000 tons of scrap in 1986, of which 35,000 tons was return scrap and the remainder purchased scrap. When ANSDK is in full operation, it is expected that it will have to purchase about 190,000 T/Y of scrap.

As the supply of domestic scrap becomes tight, ANSDK is buying scrap actively from the public sector such as the Ministry of Transport, Suez Canal Authority, etc. as well as scrapped materials of HADISOLB in addition to the sources in the private market.

The scrap of HADISOLB which could be obtained in large quantity so far cannot be considered a stable supply source, and unless the domestic scrap recycling system is established and developed, it is considered that in the long run it will be difficult for ANSDK to satisfy the requirement by domestic scrap alone, not relying on imported scrap.

3) Forecast of demand and supply of domestic scrap

It is expected that the demand for scrap in Egypt will expand rapidly as a result of the full operation of ANSDK and expansion of the other steel mills.

On the other hand, the supply of domestic scrap cannot be expected to increase rapidly though it may depend on the progress and improvement of its recycling system.

The forecast of future scrap demand and supply in Egypt is shown in Table 3-2. According to the table, the import requirement of scrap for the entire Egyptian steel industry is expected to reach about 570,000 tons in 1990.

When scrap is to be imported, it is considered that USA will be the principal supplier, but from the viewpoint of short distance, UK and USSR also can be considered suppliers of scrap to Egypt.

Table 3-2 Forecast of Demand and Supply of Scrap in Egypt

(Unit: Ton)

	1985	1986	1990	1995
(A) Demand				
Existing steel mills	190,000	190,000	190,000	190,000
ANSDK (Existing facilities)	-	60,000	190,000	190,000
Expansion project of EAFs	-	-	460,000	950,000
Total	190,000	250,000	840,000	1,330,000
(B) Domestic supply	190,000	250,000	270,000	370,000
(A) - (B) Shortage = Import	-	-	570,000	960,000

Note: The increase of supply is assumed at a rate of 7% a year.

4) Trend of scrap prices

Reflecting the slowdown in steel production in the world, the price of scrap in the world is low at present.

For example, USA C&F prices to Japan in the past two or three years were $100-130/ton, but since May 1986, it fell below the level of $100/ton.

USSR CIF prices to Japan also are below $90/ton recently.

As regards the scrap prices in major European countries also, the prices at the end of 1986 showed considerable drop as compared with high prices during the 3 years of 1984-1986 on their respective currencies as follows:

	1986		High price
UK	£50/t,	41% drop from	£85/t
W. Germany	DM170/t,	35% drop from	DM260/t
Belgium	BF2800/t,	53% drop from	BF6000/t
Italy	L.it100/t,	53% drop from	L.it190/t

Although the world scrap prices are low at present as seen above, the scrap price in USA shows an upward trend in 1987 (C&F Japan being $110/t in July 1987). When ANSDK makes study on use of imported scrap in future, it should be kept in mind that scrap is basically merchandise subject to wide price fluctuation. At present, the price of domestic scrap in Egypt is about LE110/t.

Postscript:
As of March 1987 when the F/S was started, the price of scrap was very low worldwide, but its consumption began to recover rapidly from around May 1987 and U.S. scrap price in October and November 1987 is US$140-160/ton on CIF Japan.

3-4. Limestone

Limestone is abundantly available in Egypt and it is fully possible for ANSDK to obtain limestone domestically in future as at present.

Burnt lime is produced by its own lime calcining plant. As the facilities has adequate production capacity, there should be no problem in the supply of burnt lime.

3-5. Electrode

Electrodes are not produced in Egypt at present and all the requirement is imported. After the expansion of ANSDK also, the electrodes will have to be imported.

3-6. Refractories

At present, ANSDK imports a large part of refractories from developed countries. Though it is expected that after the expansion, ANSDK will basically have to import a large part of the requirement, domestic purchase may be considered if Egyptian Refractories works being planned at present are put into operation.

4. Present Condition of El Dikheila Iron and Steel Works

4-1. Outline of the Works

El Dikheila Iron and Steel Works is located about 15 km west of Alexandria City and was constructed with a plan to produce about 745,000 tons of bar and rod a year. Outline of major production facilities of the Works is given below.

Facilities	Description	Capacity	Start-up
DR plant	600,000 t/y x 1	DRI 716,000 t/y	Nov.'86
SMP			
EAF	70 t/heat x 4	Liquid steel 840,000 t/y	May '86
CC	4-strand CC x 3	Billet 798,000 t/y	
Bar mill plant	One complete set	Bar 425,000 t/y	Jul.'86
Rod mill plant	One complete set	Rod 320,000 t/y	Apr.'87

In addition to the above, the Works has lime calcining plant, power receiving and distributing facilities, oxygen plant, water treatment plant, compressed air plant, analysis and inspection facilities, maintenance shop, warehouse and intra-works transportation facilities, administration office and other auxiliary facilities and has adequate function as an integrated steel mill.

4-2. Production

Since the start-up of SMP in May 1986, the Works engages in production of billet and bar, and the accumulated production as at the end of January 1987 was 134,600 tons of billet and 65,500 tons of bar, the both considerably exceeding the planned figures.

With start-up of Rod Mill plant in April 1987, the construction project of the Works was completed.

4-3. Management

At present, ANSDK is being managed with about 1,640 Egyptian and 156 Japanese staff, and the start-up production has been smooth supported by Japanese type of management and operation.

5. Expansion Project of El Dikheila Iron and Steel Works

5-1. Basic policy of the expansion project

5-1-1. Product mix and production

As a result of the study of market condition of steel products in Egypt and the layout and facilities of El Dikheila Works, increase in production of bar and rod was made the basic policy in planning the expansion project. At present, the Works has capacity to produce about 745,000 T/Y, and after the expansion, the capacity will be increased by about 50% to 1.1 million T/Y.

The result of the study on expansion of product mix and production of higher grade steels under the expansion project is as discussed below.

In general, the higher grade steels are manufactured through the rolling process of ingot or bloom by bloomer. The El Dikheila Works is equipped with the facilities to produce re-bars using 130-mm square billets cast by billet CCM. It is very difficult technically to produce the higher grade steels from this size of billets cast by billet CCM.

In planning the expansion project, efforts are made to make the best use of the existing facilities and hold the investment as low as possible, and therefore the production of the higher grade steels which requires a considerable remodelling of the facilities cannot be recommended at the moment.

As regards the expansion of product mix, technological study and calculation of manufacturing cost were made on the production of secondary processed products of rods produced in the Works and the result is described in ANNEX V to the report.

5-1-2. Expansion of major facilities

An outline of the expansion of major facilities based on the above premises is as follows:

DRP: One 400,000-600,000 T/Y unit to be added
SMP: Two 70-t/heat EAFs, a ladle furnace and a 4-strand CCM to be added
Rod Mill plant: One more line of No.2 intermediate mill and subsequent facilities with the scale same as the existing line to be added

In line with the expansion of the above major facilities, water treatment plant, power receiving and distributing plant, intra-works transportation facilities, etc., are to be also expanded. The plant layout after the expansion is attached to page 371.

5-2. Outline of major facilities

5-2-1. DR plant

Whether iron source required for the operation of the expanded facilities is to be covered by scrap or by DRI by installing another DR plant is governed by the availability and price of domestic scrap.

At present, the price of domestic scrap is low, but the supply is not sufficient and it is expected that the price will rise influenced by the price of imported scrap. In this F/S, it was decided as a result of technological and economic study that DR plant using pellet/ore, supply of which is stable, should be adopted. As regards the capacity of the DR plant, it was decided to install 600 module type same as the existing one with a view of supplying some DRI to the other Egyptian steel mills.

Incidentally, study was made on the case where DR plant is not expanded and increased requirement of iron source is filled by scrap alone, but the result of financial analysis indicated that the case is infeasible. The DR plant to be added will be constructed at a site reserved next to the existing DR plant and the existing transportation facilities utilized as much as possible with addition of only those newly required.

5-2-2. SMP (Steelmaking plant)

(1) In order to increase the capacity of SMP to produce liquid steel by 50% from the present 840,000 T/Y to 1,260,000 T/Y, two EAFs and one CCM, all of the same capacity and specification as those of the existing ones, are to be added in consideration of operation, maintenance and building in common.

(2) For adjustment of molten steel temperature and composition and matching EAF tapping and CCM casting, and also for expansion of kind of steel, one unit of ladle furnace is to be installed.

(3) In line with increase of EAFs and CCMs and installation of the ladle furnace, related facilities are to be built.

5-2-3. Rod Mill plant

In the expansion project, the bar mill facilities are to be kept as it is and only the rod mill facilities are to be expanded to double the capacity. Namely, the rolling line will be increased from 1-strand to 2-strand. Billet yard and product yard also are to be expanded. By the above, the annual production will increase to 427,000 tons by Bar Mill plant and 693,000 tons by Rod Mill plant, totalling 1,120,000 tons. Size structure will be same as that before the expansion, and the product is principally re-bars.

5-2-4. Utilities

In planning the expansion of utility plants, estimation was made on the requirements of utilities when the existing facilities of the Works are in full operation based on the result of the field survey in March 1987. This was to find out whether the existing utility plants can satisfy the requirements after the expansion and also utilize the capacity of the existing facilities to the maximum.

As a result of the study, it was found that the capacity of the existing facilities of the raw water treatment plant, oxygen, nitrogen and compressed air plants are adequate, but increase of the water recycling facilities and outdoor piping work is necessary.

5-2-5. Infrastructure

As regards the supply of natural gas and industrial water, the existing facilities have adequate capacity to satisfy the requirement after the expansion. But it may be necessary to increase pumping capacity for industrial water at the supply side to eliminate drop of the pressure, and except this, natural gas and industrial water are considered available stably in future as well.

However, electric power supply is not always adequate even now, and besides, no concrete plans for construction of power station in Alexandria area exist, which poses a big problem.

The Egyptian Government aims at industrial development including the expansion project of ANSDK, but the expansion of facilities for generating power, essential for the development, is extremely delayed. In order to realize the industrial development in Alexandria area, the Government should materialize construction of power station as soon as possible.

The expansion at ANSDK will require about 74 MW of additional power, but until a new power station is built, special measures are necessary such as to supply the power of No.4 unit (150 MW) of Abu-Qir power station now under repair preferentially to ANSDK.

In the meantime, the port facilities for receiving raw materials are exclusively used by ANSDK at present and have adequate capacity. However, because of the expansion of DR plant, it is necessary to construct another ore storage yard. Fortunately the present layout of IMC is so designed as to meet the requirement after the expansion, and therefore the need can be satisfied by extension (expansion) of the existing storage yard by IMC.

5-2-6. Other ancillary facilities

In addition to the above major facilities, the following are to be expanded.

- Power receiving and distributing facilities
- Intra-works transportation facilities
- Inspection and analysis facilities

5-3. Estimation of construction cost

Construction cost of the project was estimated on the basis of the following.

(1) Assumption for estimation

Purchase of equipment	Based on the present international prices
Erection of equipment & civil engineering & building works	Construction equipment and materials imported from overseas to be based on the present international prices, and equipment, materials and labor available in Egypt to be based on local prices

(2) Case with escalation

Imported materials and equipment	To be 5% p.a.
Materials and equipment locally purchased	To be 0% on dollar base assuming price rise to be offset by change in exchange rate of LE against US dollar

(3) Currency used for indication

Construction cost is to be indicated in US dollars. Exchange rate of Egyptian pounds (LE) to US dollars is assumed to be US$1 = LE2 in the calculation.

(4) Import duty (Tariff)

Equipment	5%
Materials	Based on Customs Tariff 1986
Construction equipment and materials for temporary structure	Free on the condition that they are to be re-exported.

(5) Construction cost

Summary of the construction cost, for without Escalation Case and Case with Escalation, is shown in Tables 5-1 and 5-2, respectively.

5-4. Construction schedule

Basic policy:

(1) Start-up of main plants

Start-up of D.R.P, S.M.P. and R.M.P. was planned as given below in view of the time required for training and getting full operation of each plant as well as the material balance.

Start-up of R.M.P. comes first, the first project month.
S.M.P. is to be started up in the third project month.
D.R.P. is to be started up in the 4th project month.

Other ancillary facilities are to be started up so as not to hinder the start-up of the main plants.
(Refer to Implementation Schedule attached.)

(2) Construction period

The time required from CIF contract to start-up was assumed to be 30 months for D.R.P., 32 months for S.M.P. and 28 months for R.M.P.

(3) Tender period

This project is conditioned that all the contracts are to be made through international tenders, and the time from issue of I.T.B. to contract was planned to be 8 months.

(4) Preliminary preparation period

Decision making for implementing the project, basic engineering and preparation for tenders were assumed to take 16 months after the completion of the F/S.

(5) Implementation schedule

The implementation schedule of the expansion project based on the above premises is attached hereto. Planned start-up date of each main plant is set as follows:

R.M.P.	May 1, 1992
S.M.P.	July 1, 1992
D.R.P.	August 1, 1992

Table 5-1 Summary of Capital Cost Estimate (Without Escalation Case)

UNIT: 1000 USD

	Equipment & Spares (CIF)			Installation of Equipment			Civil & Buildings			Total		
	FOREIGN	LOCAL	TOTAL	FOREIGN	LOCAL	TOTAL	FOREIGN	LOCAL	TOTAL	FOREIGN	LOCAL	TOTAL
D.R.P.	76,100	—	76,100	7,021	1,999	9,020	4,753	2,334	7,087	87,874	4,333	92,207
S.M.P.	80,767	—	80,767	4,267	1,234	5,501	16,034	3,720	19,754	101,068	4,954	106,022
R.M.P.	21,847	—	21,847	2,166	607	2,773	6,995	1,274	8,269	31,008	1,881	32,889
U.T.	8,067	—	8,067	1,699	464	2,163	2,118	896	3,014	11,884	1,360	13,244
S.S.	2,655	—	2,655	655	174	839	436	324	760	3,756	498	4,254
Trp. F	6,883	—	6,883	390	100	490	3,082	869	3,951	10,355	969	11,324
A/I	1,534	—	1,534	65	15	80	88	75	163	1,687	90	1,777
Adm. F	—	—	—	—	—	—	445	365	810	445	365	810
Total	197,853	—	197,853	16,273	4,593	20,866	33,951	9,857	43,808	248,077	14,450	262,527
Eng. Fees	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	22,603	350	22,953
Contingency:												
Price C.	—	—	—	—	—	—	—	—	—	—	—	—
Physical C.	10,056	—	10,056	826	233	1,059	1,709	495	2,204	12,591	728	13,319
Imp. Tax	—	9,892	9,892	—	—	—	—	2,500	2,500	—	12,392	12,392
Total	10,056	9,892	19,948	826	233	1,059	1,709	2,995	4,704	35,194	13,470	48,664
Grand Total	207,909	9,892	217,801	17,099	4,826	21,925	35,660	12,852	48,512	283,271	27,290	311,191

Table 5-2 Summary of Capital Cost Estimate (With Escalation Case)

UNIT: 1000 USD

	Equipment & Spare (CIF)			Installation of Equipment			Civil & Buildings			Total		
	FOREIGN	LOCAL	TOTAL	FOREIGN	LOCAL	TOTAL	FOREIGN	LOCAL	TOTAL	FOREIGN	LOCAL	TOTAL
D.R.P.	76,100	—	76,100	7,021	1,999	9,020	4,753	2,334	7,087	87,874	4,333	92,207
S.M.P.	80,767	—	80,767	4,267	1,234	5,501	16,034	3,720	19,754	101,068	4,954	106,022
R.M.P.	21,847	—	21,847	2,166	607	2,773	6,995	1,274	8,269	31,008	1,881	32,889
U.T.	8,067	—	8,067	1,699	464	2,163	2,118	896	3,014	11,884	1,360	13,244
S.S.	2,655	—	2,655	655	174	839	436	324	760	3,756	498	4,254
Trp. F	6,883	—	6,883	390	100	490	3,082	869	3,951	10,355	969	11,324
A/I	1,534	—	1,534	65	15	80	88	75	163	1,687	90	1,777
Adm. F	—	—	—	—	—	—	445	365	810	445	365	810
Total	197,853	—	197,853	16,273	4,593	20,866	33,951	9,857	43,808	248,077	14,450	262,527
Eng. Fees	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	N.A	22,603	350	22,953
Contingency:												
Price C.	25,140	—	25,140	2,070	—	2,070	4,272	—	4,272	31,482	—	31,482
Physical C.	10,056	—	10,056	826	233	1,059	1,709	495	2,204	12,591	728	13,319
Imp. Tax	—	9,892	9,892	—	—	—	—	2,500	2,500	—	12,392	12,392
Total	35,196	9,892	45,088	2,896	233	3,129	5,981	2,995	8,976	66,676	13,470	80,146
Grand Total	233,049	9,892	242,941	19,169	4,826	23,995	39,932	12,852	52,784	314,753	27,920	342,673

6. Financial Analysis

6-1. Calculation of production cost

(1) Premises for cost accounting

Cost accounting was done based on the following premises.

a) Cost accounting standards:
Process cost accounting system was adopted.

b) Exchange rate:
Calculation of acquisition cost of the existing facilities: US$1 = LE1.35
Others: US$1 = LE2 = ¥150

c) Price fluctuation:
Price level used in cost accounting was set considering the result of the filed survey, discussion with counterparts and the global trends.

i) Without Escalation Case

This is the case where no escalation is considered and cost accounting and financial analysis are to be made by using the price level at the time of field survey in March 1987.

ii) With Escalation Case

This is the case where cost accounting and financial analysis are made using the price level at the time of field survey as the base and taking account of inflation at the rates indicated in Table 6-1 for the first 5 years to 1992 when the expansion plants commence operation.

Table 6-1 Escalation Rate (Annual rate)

	Case IV	Case V	Case VI
Domestic expenses	0%	0%	0%
Imported goods	3%	3%	3%
Product sales price	0%	1.5%	3%

Concerning domestic expenses, escalation rate is to be 0% on US dollar base as it is considered that in view of the past trend and the circumstances at home and abroad, the inflation rate in Egypt and the rate of depreciation of Egyptian pound in exchange rate against US dollar are almost same.

Prices of imported goods are expected to rise 3% in view of price rise in the past in Japan, W. Germany, U.S., Italy and U.K. Cencerning product sales price, three escalation rates, 0%, 1.5% and 3%, are adopted.

d) Depreciation method:
Fixed instalment method was adopted.

e) Production:
In full operation after the expansion, the production was assumed to be 427,000 T/Y of bars and 693,000 T/Y of rods.

(2) Production cost

For three cases out of six cases (Case I, Case IV, Case V, Case VI-Natural Gas Purchase Price 2.3 US$/Million BTU, Case II-Natural Gas Purchase Price 1.5 US$/Million BTU, Case III-Natural Gas Purchase Price 1.0 US$/Million BTU), production costs at five production processes were calculated separately for fixed cost and variable cost. The year 1992 is the year when the facilities under the expansion project are started up and the year 1993 is the year when the Works is in full operation.

Table 6-2 Manufacturing costs by process (Case I)

(US$/Ton)

		1992	1993	1994	1995	1996
DRP	Fixed cost	17.7	16.2	16.2	16.2	16.2
	Variable cost	75.5	75.3	75.3	75.3	74.9
	Total	93.2	91.5	91.5	91.5	91.1
LCP	Fixed cost	52.5	46.1	46.1	46.1	44.9
	Variable cost	33.0	32.5	32.5	32.5	32.2
	Total	85.5	78.6	78.6	78.6	77.1
SMP	Fixed cost	45.2	42.3	42.3	42.3	42.1
	Variable cost	140.3	140.4	140.4	140.4	138.8
	Total	185.5	182.7	182.7	182.7	180.9
BMP	Fixed cost	63.3	60.8	60.8	60.8	60.4
	Variable cost	150.0	149.9	149.9	149.9	148.0
	Total	213.3	210.7	210.7	210.7	208.4
RMP	Fixed cost	64.2	59.0	59.0	59.0	58.7
	Variable cost	150.5	150.2	150.2	150.2	148.2
	Total	214.7	209.2	209.2	209.2	206.9

Note: The production costs as herein used do not include selling, general and administrative expenses, or such non-operating expenses as interest paid and exchange rate loss.

Table 6-3 Manufacturing costs by process (Case II)

(US$/Ton)

		1992	1993	1994	1995	1996
DRP	Fixed cost	17.7	16.2	16.2	16.2	16.2
	Variable cost	67.6	67.4	67.4	67.4	67.0
	Total	85.3	83.6	83.6	83.6	83.2
LCP	Fixed cost	52.4	46.1	46.1	46.1	44.9
	Variable cost	30.5	30.0	30.0	30.0	29.7
	Total	82.9	76.1	76.1	76.1	74.6
SMP	Fixed cost	45.2	42.2	42.2	42.2	42.1
	Variable cost	131.9	131.7	131.7	131.7	130.0
	Total	177.1	173.9	173.9	173.9	172.1
BMP	Fixed cost	63.4	60.8	60.8	60.8	60.4
	Variable cost	140.3	139.9	139.9	139.9	138.0
	Total	203.7	200.7	200.7	200.7	198.4
RMP	Fixed cost	64.2	59.0	59.0	59.0	58.8
	Variable cost	140.9	140.3	140.3	140.3	138.2
	Total	205.1	199.3	199.3	199.3	197.0

Note: The production costs as herein used do not include selling, general and administrative expenses, or such non-operating expenses as interest paid and exchange rate loss.

Table 6-4 Manufacturing costs by process (Case III)

(US$/Ton)

		1992	1993	1994	1995	1996
DRP	Fixed cost	17.7	16.2	16.2	16.2	16.2
	Variable cost	62.2	62.0	62.0	62.0	61.6
	Total	79.9	78.2	78.2	78.2	77.8
LCP	Fixed cost	52.4	46.1	46.1	46.1	44.9
	Variable cost	28.8	28.3	28.3	28.3	28.0
	Total	81.2	74.4	74.4	74.4	72.9
SMP	Fixed cost	45.2	42.3	42.3	42.3	42.1
	Variable cost	126.2	125.7	125.7	125.7	124.1
	Total	171.4	168.0	168.0	168.0	166.2
BMP	Fixed cost	63.3	60.7	60.7	60.7	60.4
	Variable cost	133.8	133.2	133.2	133.2	131.2
	Total	197.1	193.9	193.9	193.9	191.6
RMP	Fixed cost	64.2	59.0	59.0	59.0	58.7
	Variable cost	134.4	133.5	133.5	133.5	131.5
	Total	198.6	192.5	192.5	192.5	190.2

Note: The production costs as herein used do not include selling, general and administrative expenses, or such non-operating expenses as interest paid and exchange rate loss.

(3) Sensitivity analysis

For Case I, change in the production cost (Total cost = fixed cost + variable cost) was calculated by altering the given conditions:

(Unit: US$)

Condition		1992	1993
Incentive rate similar to that applied to some public sectors, applied to ANSDK in supplying electric power	Bar Rod	-8.2 -8.6	-8.3 -8.6
Production increased by 5%	Bar Rod	-3.4 -3.5	-3.3 -3.2
Production decreased by 5%	Bar Rod	3.7 3.8	3.6 3.6
Domestic scrap price increased by 10% to US$63.641/ton	Bar Rod	0.7 0.8	0.5 0.6
Domestic scrap price increased by 20% to US$69.426/ton	Bar Rod	1.4 1.5	0.9 1.1

Note: (1) The negative figures represent decrease in the cost, and the positive ones, increase in the cost.

(2) Rates of electric power

	Current rate	Preferential rate
Electric power	0.016 US$/kWH	0.0075 US$/kWH

6-2. Financial analysis

(1) Assumptions for financial analysis

Financial analysis was conducted on the following assumptions:

a) Product sales price:
The product sales price was assumed to be three cases (US$250/ton for bars and rods and US$200/ton for commercial billets, US$260/ton for bars and rods and US$205/ton for commercial billets, US$270/ton for bars and rods and US$210/ton for commercial billets).

b) Income tax:
32% of the profit before tax.

c) Dividends:
60% of the profit after tax.

d) Conditions for long-term loan raising:

Kind of loan	Fund raising conditions		
	Annual interest rate	Loan period (years)	Grace period (years)
Loan 1	3.5%	30	10
Loan 2	6 %	8	3
Loan 3	8.5%	16	10

e) Project years:
20 years after the expansion facilities are brought into operation in 1992.

f) Total investments and finance plan
The total investments and finance plan for this project in the Without Escalation Case are shown in the following table.

(Unit: US$1,000)

Item		Total	1988	1989	1990	1991	1992	1993
Demand	Construction Cost	311,191	1,966	36,097	222,652	41,587	8,889	0
	Startup cost	233	0	0	0	233	0	0
	Additional working capital	1,109	0	0	0	589	481	39
	Interest during construction	22,245	34	887	7,423	13,901	0	0
	Total	334,778	2,000	36,984	230,075	56,310	9,370	39
Fund raising	Loan 1	75,362	1,966	11,766	29,612	24,091	7,927	0
	Loan 2	108,901	0	10,890	92,565	5,446	0	0
	Loan 3	50,082	34	3,536	29,944	16,048	481	39
	Capital	100,433	0	10,792	77,954	10,725	962	0
	Total	334,778	2,000	36,984	230,075	56,310	9,370	39

(2) Profit & loss and cash balance

a) In this financial analysis (without Escalation Case) following nine cases are treated.

	Case I-1	Case I-2	Case I-3	Case II-1	Case II-2	Case II-3	Case III-1	Case III-2	Case III-3
Sales Price	$/Ton	$/Ton	$/Ton	$/Ton	$/ton	$/Ton	$/Ton	$/Ton	$/Ton
Bar・Rod	250	260	270	250	260	270	250	260	270
Billet	200	205	210	200	205	210	200	205	210
Natural Gas Purchase Price	2.3 US$/Million BTU			1.5 US$/Million BTU			1.0 US$/Million BTU		

b) The profit and Loss and the cash balance for the term in Case I-1 for each year during the period from 1992 when the facilities under the expansion project are atarted up through 2011, the last project year, are as follows (shown in Table 6-5 and Table 6-6):

Table 6-5 Profit and Loss (Case I-1)

Sales Price : Bar and Rod US$250/Ton, Billet US$200/Ton
Natural Gas Purchased Price : US$2.3/Million BTU (=US$0.08707/Nm^3)
Escalation Rate of Sales Price : Without Escalation Case

(Unit: 1,000 US$)

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
With expansion	Gross profit	38,490	48,596	49,030	49,058	51,629	51,912	51,920	51,920	51,920	59,629
	Pretax profit for the current term	-35,141	-23,064	-18,547	-11,457	-3,835	5,794	10,217	16,093	24,107	40,080
	Cummulative profit or loss	-263,791	-286,856	-305,403	-316,860	-320,694	-314,901	-304,683	-293,740	-277,347	-250,093
Without expansion	Gross profit	39,504	39,504	39,504	39,525	42,101	42,384	42,391	42,391	42,392	50,101
	Pretax profit for the current term	-15,861	-14,577	-11,925	-5,842	697	4,655	7,665	11,047	15,738	28,600
	Cummulative profit or loss	-248,557	-263,134	-275,059	-280,901	-280,428	-277,263	-272,051	-264,539	-253,837	-234,389

		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
With expansion	Gross profit	64,409	64,602	64,602	64,602	64,602	60,086	61,346	61,409	61,409	61,409
	Pretax profit for the current term	51,935	59,058	67,430	76,487	85,275	89,605	99,412	106,015	110,960	116,704
	Cummulative profit or loss	-214,777	-174,617	-128,765	-76,754	-18,767	16,866	43,906	72,742	102,923	134,666
Without expansion	Gross profit	53,290	53,415	53,415	53,415	53,415	42,279	41,795	41,795	41,795	41,795
	Pretax profit for the current term	36,068	40,459	45,780	51,262	56,176	49,657	54,685	60,464	64,526	67,742
	Cummulative profit or loss	-209,862	-182,350	-151,220	-116,362	-78,162	-44,396	-7,210	13,562	31,114	49,539

Table 6-6 Cash Flow (Case I-1)

Sales Price : Bar and Rod US$250/Ton, Billet US$200/Ton
Natural Gas Purchased Price : US$2.3/Million BTU (=US$0.08707/Nm^3)
Escalation Rate of Sales Price : Without Escalation Case

(Unit: 1,000 US$)

		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
With expansion	Sales proceeds	194,446	189,438	194,761	195,001	194,998	255,637	291,954	293,411	293,418	293,419	293,419
	Balance of short-term borrowing	27,681	48,187	73,101	110,771	128,149	143,669	151,292	183,670	180,116	168,753	154,335
	Balance of cash and money deposit	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010
Without expansion	Sales proceeds	194,446	189,438	194,761	195,001	194,998	194,997	194,997	194,997	194,997	194,997	194,997
	Balance of short-term borrowing	27,703	48,227	73,304	112,535	129,547	143,535	164,730	195,035	189,322	176,530	159,088
	Balance of cash and money deposit	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,010

1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
293,419	293,419	293,419	293,419	293,419	293,419	293,419	293,419	293,419	293,419	293,419	293,419	293,419	293,419
147,351	94,021	37,331	0	0	0	0	0	0	0	0	0	0	0
1,010	1,010	1,010	24,592	69,127	133,664	204,294	281,305	347,290	427,954	492,087	544,407	579,608	646,433
194,997	194,997	194,997	194,997	194,997	194,997	194,997	194,997	194,997	194,997	194,997	194,997	194,997	194,997
152,332	121,054	86,168	47,630	26,193	0	0	0	0	0	0	0	0	0
1,010	1,010	1,010	1,010	1,010	15,394	59,887	108,160	142,322	185,179	235,634	290,259	309,490	348,721

(3) Internal rate of return:

The internal rate of return on the invested fund in the expansion project is as follows.

	Case I-1	I-2	I-3	II-1	II-2	II-3	III-1	III-2	III-3
IRR	5.93%	8.17%	9.7%	8.77%	10.19%	11.55%	10.12%	11.42%	12.73%

(4) Sensitivity analysis:

For Case I-1, the change in the internal rate of return caused by the variation of conditions was calculated:

Sensitivity analysis of internal rate of return (basic case)

Condition	Change in internal earning rate
Incentive rate, similar to that applied to some public sectors, applied to ANSDK in supply electric power	+2.13%
Increasing equipment funds by 10%	-0.76%
Decreasing equipment funds by 10%	+0.85%
Increasing production by 5%	+3.58%
Decreasing production by 5%	-5.93%
Increasing labor cost by 20%	-0.07%

Note: (1) Rates of electric power

	Current rate	Preferential rate
Electric power	0.016 US$/KWH	0.0075 US$/KWH

7. Economic Effects

7-1. Introduction

Construction of an integrated steel works in a developing country is generally believed to bring about the following effects on the national economy:

- o Import substitution of steel products has foreign currency saving effect;
- o Domestic natural resources can be utilized effectively by having the steel industry;
- o Promotion of the steel industry, especially integrated steel works, has a greater effect on creating other related industries than that of any other industry;
- o It has an effect, directly and indirectly, on creation of employment opportunity; and
- o Its technological ripple effect extends to many other industries beyond the steel industry itself.

In this chapter, some consideration will be given, based on this study, to what manner the expansion of ANSDK and resulting improvement of its competitiveness may bring about those effects on the Egyptian economy.

7-2. Foreign currency saving effect

For the Without Escalation Case in this study report, the amount of foreign currencies saved by ANSDK by the implementation of the expansion project was studied and the result is shown in Table 7-1.

a) Decrease in the amount of imports of steel products

It is assumed that the price of imported steels is US$210/ton and that the import of steel products is cut by the quantity of production by ANSDK. The decrease in the amount of the imports is about US$165 million before the expansion and will reach about US$250 million in 1993 when the expansion project is completed and in full operation and thereafter.

b) Foreign currencies required

On the other hand, the initial investments including equipment fund and the funds for yearly imports of raw materials, spare parts and other consumables were assumed as the foreign currencies required for achieving the import substitution.

c) Amount of foreign currencies saved

The difference between the decrease in the amount of imports of steel products and the amount of required foreign currencies is the amount of foreign currencies saved by ANSDK as a result of the expansion. While being negative only in 1989 when a huge amount of the initial investments is required, the difference will be positive thereafter and gradually increase to about US$100 million in 1999 as follows:

Amount of foreign currencies saved:

1990:	US$ 30	million
1992:	52	"
1994:	55	"
1996:	76	"
1998:	86	"
2000:	112	"
2002:	111	"

Table 7-1 Foreign Currencies Saved by ANSDK after Expansion
(Without Escalation Case)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Production (1,000 tons)																
Bar	427	427	427	425	425	427	427	427	427	427	427	427	427	427	427	427
Rod	171	288	318	320	320	561	688	693	693	693	693	693	693	693	693	693
Commercial billet	225	63	46	44	44	44	66	67	67	67	67	67	67	67	67	67
Total	823	770	788	789	789	1,031	1,181	1,187	1,187	1,187	1,187	1,187	1,187	1,187	1,187	1,187
CIF price of imported materials ($)	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
Decrease in amount of imported products ($1,000)	172,830	161,700	165,480	165,690	165,690	216,510	248,010	249,270	249,270	249,270	249,270	249,270	249,270	249,270	249,270	249,270
Amount of imported spare parts and other supplies ($1,000)	6,984	5,238	5,238	5,238	5,238	8,350	8,350	8,350	8,350	8,350	8,350	8,350	8,350	8,350	8,350	8,350
Amount of imported raw materials ($1,000)	69,191	59,978	60,714	60,714	60,714	88,450	103,200	103,200	103,200	103,200	103,200	103,200	103,200	103,200	103,200	103,200
Repayments of loan principal in foreign currencies ($1,000)	21,790	27,290	32,140	32,140	32,140	32,930	43,598	56,611	45,024	42,297	44,092	38,678	15,472	14,975	16,455	17,660
Payment of loan interest in foreign currencies ($1,000)	37,860	34,466	32,685	34,425	36,730	34,656	31,182	26,607	22,493	19,411	16,446	13,422	11,466	10,604	9,749	8,846
Capical in foreign currencies ($1,000)	0	7,162	62,248	3,049	0	0	0	0	0	0	0	0	0	0	0	0
Foreign currency balance ($1,000)	37,005	27,566	△27,545	30,124	30,868	52,124	61,680	54,502	70,203	76,012	77,182	85,620	110,782	112,141	111,516	111,214

Note: The capital in foreign currencies means funds contributed by investors within Egypt, which are to be appropriated for the procurement of foreign goods (forming outflow of foreign currencies). the amount was calculated in accordance with the formula: [Total investments] - [funds contributed by investors overseas] - [payments for domestic procurement].

7-3. Effective utilization of resources and effect on industry and employment in general

Promotion of the steel industry, especially integrated steel works, will have effects on the national economy such as effective utilization of resources available in the country and development of industries which consume steel products (forward-linkage effect) as well as those which are suppliers to the steel industry (backward-linkage effect). The effect of creating employment will extend from the steel industry itself to other related industries.

More specifically, the above effects of the expansion project of ANSDK are expected as follows:

a) Natural resources utilized directly by the project are as follow:

		Annual consumption
Natural gas	:	401,900,000 Nm^3
Limestone	:	99,000 tons
Ferro-silicon	:	6,032 tons
Aluminium	:	123 tons
Coke breeze	:	1,600 tons

Note: The annual consumption is based on full operation after the expansion.

b) As the effect of the project on other industries, promotion of the following industries in addition to the industries of the above raw materials and energy can be expected.

Bar and rod fabrication
Transportation
Construction
Piping and other engineering works
Manufacture of various parts
Repair and maintenance
Manufacture and distribution of various materials and office supplies
Others

c) As the effect of the project on employment promotion, it is assumed that increase of direct employment is 300 persons and in addition, manpower of several thousands will be required during the construction period. In addition, increase of employment can be expected along with the development of other industries as enumerated in a. and b. above, and the effect is expected to expand further to other areas.

7-4. Technological effect

Promotion of an integrated steel works which acts as the core of the steel industry in a developing country contributes toward the structural improvement of the entire steel industry in the country through technological ripple effect. The expansion project is to install most advanced DR plant, EAF, CCM and Rod Mill plant, which are all operated with the most modern operation technology. All those facilities are operated automatically and/or at high speed through automatic control system including computer technology, and as a result, quality products are produced efficiently and in large quantity.

The history of development of the steel industry in all the steel producing countries in the world demonstrates that those hardware and software technologies brought with the new facilities give favorable effect on other steel mills shortly through transfer of considerable technologies in a certain period of time.

In addition, automation and control technologies based on computer electronics contribute to improve efficiency and technology in other industries, and it is expected also that the contruction works will help progress in civil engineering and building technology, equipment erection technology and construction management.

8. Conclusion and recommendation

8-1. Conclusion

With respect to the expansion plan of El Dikheila Works of ANSDK, field survey was made and relevant data and information were collected. Based on data obtained from other sources later as well as those data and taking account of the actual result of construction of the existing Works, its operation condition and financial condition of ANSDK, an expansion plan of the Works was drawn up and financial and economic analysis of the plan were made.

The construction project of El Dikheila Works was completed within the period and budget as planned, and the Works is being operated very satisfactorily.

However, due to increase of repayment of foreign debts caused by fluctuation of exchange rate and decrease of the selling prices of products resulting from slowdown of the world steel market at the time of start-up, it seems the company is under difficult condition financially. If it is the case, it is considered that improvement of financial condition of ANSDK is prerequisite for implementation of the expansion plan and an important matter to be solved as soon as possible.

As a result of a study on the expansion plan based on the above consideration, it was judged that the expansion plan would be useful for the national economy and in a long run would contribute to improve the financial condition of ANSDK. The following are the results of study on major items.

(1) According to the result of market research, re-bars in Egypt will continue to be considerably short in supply in future even when expansion of production capacity of other steel mills is taken into account.

(2) El Dikheila Works has the most modern production facilities and shows high productivity, and its location is favorable. The expansion of the Works to increase rebar production will be effective to improve financial condition of ANSDK. And from the viewpoint of the national economy, it will have remarkable effects such as saving of foreign currencies, expansion or employment opportunity and progress of related industries.

(3) The production scale of El Dikheila Works after the expansion is planned to be 1.1-1.2 million t/y in consideration of the existing infrastructure and facilities. The expansion of the main plants is to be as follows:

DRP: Another unit having capacity to produce 600,000 t/y of DRI is to be installed;

SMP: Two 70-t/heat EAFs, one ladle furnace and one 4-strand CCM are to be added;

RMP: Another rod mill line of the scale same as the existing one is to be added.

Supporting facilities related to those plants are to be expanded in line with the implementation of the above main plants.

(4) Based on the above expansion plan, the construction cost was forecasted and financial analysis was made, the result of which is shown in Table 8-1 below.

Table 8-1 Result of Financial Analysis (IRR)
(Without Escalation Case)

Selling price / Production cost (1993)	$250/ton	$260/ton	$270/ton	Remarks Natural gas price/ Million BTU
$210.7/ton (Bar) $209.2/ton (Rod)	Case I-1 5.93%	Case I-2 8.17%	Case I-3 9.70%	Case I $2.3
$200.7/ton (Bar) $199.3/ton (Rod)	Case II-1 8.77%	Case II-2 10.19%	Case II-3 11.55%	Case II $1.50
$193.9/ton (Bar) $192.5/ton (Rod)	Case III-1 10.12%	Case III-2 11.42%	Case III-3 12.73%	Case III $1.0

IRR of this project is affected by difference between product selling price and production cost, and the difference should be at least $60/ton to secure IRR of about 10% which is considered necessary for making the project feasible.

Production cost of re-bar at the time of full operation after the expansion project was assumed to be $210/ton (the case of natural gas price being $2.3/Million BTU), and in this case the product selling price would be $270/ton to secure IRR of 10%.

The present product selling price of ANSDK is about $240/ton (or LE530/ton at LE2.2/dollar), and though a rise of the selling price may be expected in future, it must be considered difficult to maintain the price level of $270/ton under the current circumstances. Consequently, reduction of production cost is indispensable for improvement of the present financial condition of ANSDK as well as for realization of the expansion project.

Natural gas, electric power and import duties on raw materials are considered as factors which have a large effect on production cost and which are controllable as domestic matters, but here comments will be made mainly on the price of natural gas.

The price of natural gas supplied to ANSDK, \$2.3/Mil. BTU, is very high compared to the international price level. Price of natural gas supplied to domestic industries in oil producing countries range from \$0.3 to 1.0/ Mil.BTU and the export price by pipeline is about \$1.0/ Mil.BTU. Considering that the project was planned and realized from the viewpoint of effective utilization of natural gas available in Egypt, the price of gas needs to be lowered to the level of the international price. At present, due to depreciation of Egyptian pound against US dollar, the gas price in LE rose as much as 60% as compared to that in early 1987 when ANSDK commenced operation. At least until the product selling price reaches a certain satisfactory level and ANSDK's financial condition improves, the price of natural gas supplied to ANSDK should be held below \$1.5/Mil.BTU.

(5) The construction of El Dikheila Works made directly and indirectly a great contribution to the Egyptian economy and the same effect can be expected from its expansion. Furthermore ANSDK itself can improve its financial condition as discussed above.

A study was made on possibility of diversification of the products. But production of wire rods for cold heading, PC wire, electrode and steel cord, for example, calls for extensive modification of the existing rolling mill and the financial burden therefor is not so small. Besides, it is not certain whether their demand is enough to ensure their economic scale of production, and at this moment the above are considered infeasible.

However, as regards wire and wire products which can be produced from wire rods of ANSDK, a plan on its production was made and the production cost was also estimated, which is given in ANNEX.

8-2. Recommendation

Essential conditions for realizing this project and factors which have a large effect on the economic viability of the project are discussed in the following.

(1) In order to foster ANSDK who has the largest modern facilities in Egypt, into an integrated steel works that plays the central role in the production of re-bar in the country, the Government should provide it with the following assistance within the limits not inconsistent with the principle of sound market economy.

- Necessary measures should be taken to improve the present financial condition of ANSDK as prerequisite for realization of the expansion project. For example, temporary takeover by the Government of short-term loans or refinancing with low interest loans may be considered.
- Against dumping export or unfair trade from foreign countries, countermeasures such as import restriction for a limited period or special duties should be taken to maintain reasonable selling prices.
- The lowest possible prices should be applied to the domestic natural resources and utilities such as natural gas and electric power supplied to ANSDK. Particularly, the price of natural gas at present is at a level much higher than the international price and correction of the gas price is a key factor for realization of the project.
- Measures should be taken to ensure smooth allocation of foreign currencies required by ANSDK.
- Stable supply should be assured of electric power necessary for the expansion.
- The utmost consideration should be given to the extension of ore storage yard necessary for the expansion and the charges for use of the mineral jetty, raw material storage and transportation facilities. In this F/S, cost from the mineral jetty to DR plant is assumed to be LE4.0/ton of pellet.

(2) Adequate technical level for management and operation of the Works should be achieved before the expansion is completed.

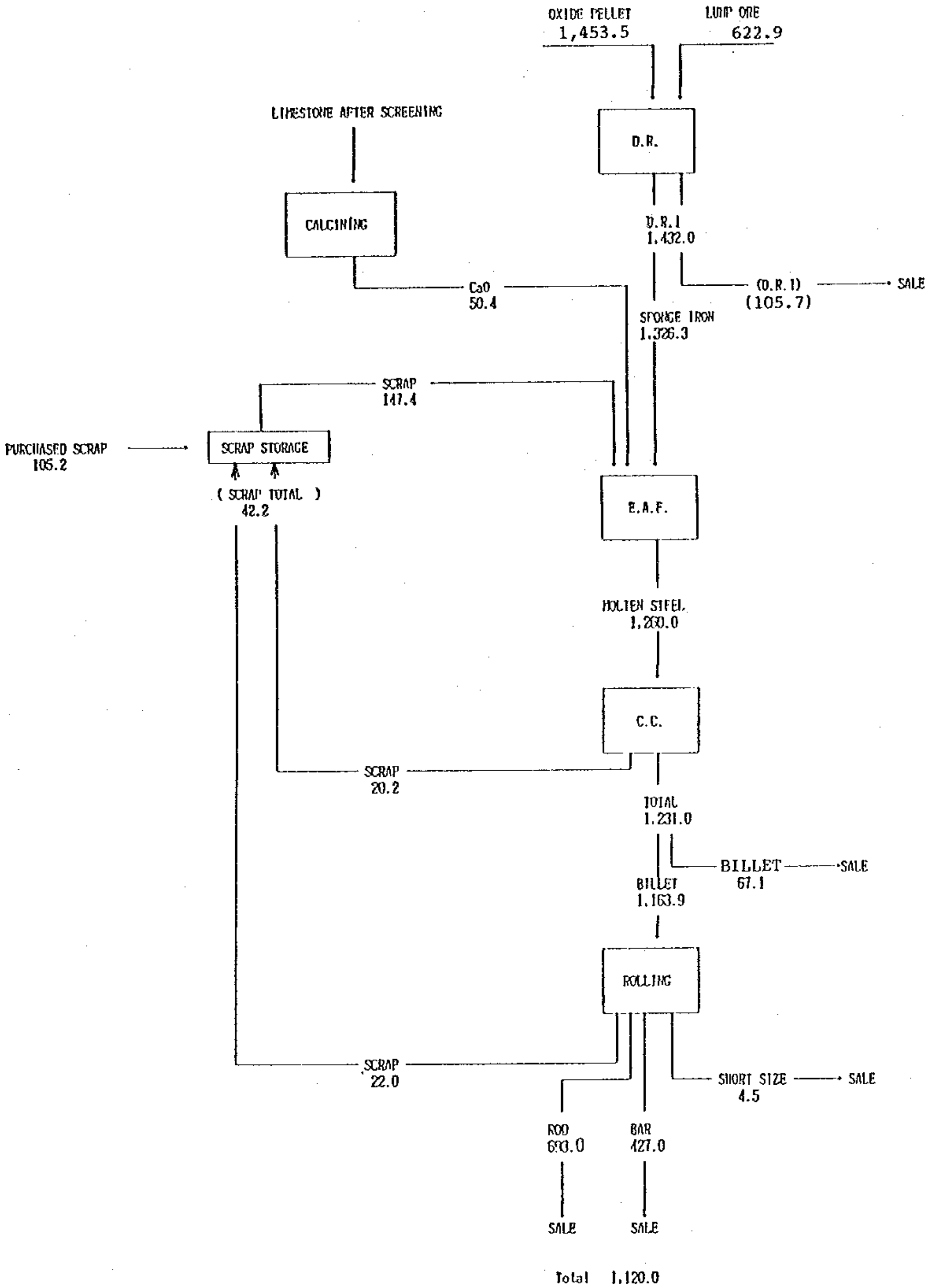
(3) To ensure early realization of the expansion project, early decision making and active approach to relevant organizations, at home and abroad, by the Government of Egypt are necessary.

(4) Customs duties levied on imported facilities, equipment and materials impose a heavy burden on the construction cost and give an adverse effect on the profitability of the project. It is desirable that special measures are applied by the Government in this respect.

It is historically obvious that such assistances of the Government have been given to ensure early establishment of the steel industry in a number of countries and considered an inevitable matter for the take-off stage of the steel industry, one of key and capital-intensive industries. It must be emphasized again that strong assistance and consideration by the Government is essential in carrying out the expansion project of ANSDK.

Material Flow (Stage II)
DRI ratio in EAF 90%

(Unit: 1,000 tons)



Chapter I. INTRODUCTION

1. Introduction

1-1. Background of the study

Egypt achieved high economic growth from the middle of 1970s to early 1980s and is still keeping about 7% growth under the 5-year economic and social development plan. With the main object of decentralization of industries and population regionally, the plan promotes urban development while it aims at greening desert areas, and this caused increase of steel demand. However, the domestic capacity of steel supply is limited and the steel demand and supply gap shows a sign of steady increase and can be filled only by import of a large quantity of foreign steel.

In January 1979, the Government of the Arab Republic of Egypt, for the purpose of decreasing import of steel and saving foreign currencies, contemplated a plan to construct in the El Dikheila area on the west of Alexandria an integrated steel works based on direct reduction (DR) process and asked the Government of Japan to provide technical cooperation for its feasibility study. The Japan International Cooperation Agency (JICA) carried out such feasibility study (F/S) concerning the construction of El Dikheila Iron and Steel Works in March 1979 and submitted a F/S report to the Government of Egypt in August the same year.

Based on the report, the Government of Egypt consulted with the World Bank Group and decided to implement the project as a joint venture business under the Law No. 43, 1974. A consortium (Nippon Kokan, Kobe Steel and Toyo Menka) was designated as technical partner and the construction of El Dikheila Works with World Bank loan and Yen loan was decided. The construction was commenced in 1983 and the Works was completed as an integrated steel works with start-up of SMP in May, BMP in July and DRP in November 1986 and RMP (Rod Mill plant) in April 1987. Its product mix includes bar and rod with production capacity of 745,000 T/Y in total.

The Government of Egypt has planned to expand the Works to cover persisting shortage of steel products, especially re-bars, and requested Japan's cooperation again in the F/S for the expansion project of El Dikheila Works from May 1985 and JICA dispatched a preliminary study mission in October 1986 to discuss the contents of the study on the expansion project of El Dikheila Works.

The mission studied the background of the request and the operation condition of the Works and collected relevant data and information. They also discussed with those concerned of Egypt about the scope of work (hereinafter referred to as S/W).

With the backdrop as above, this F/S was to conduct market research and cover technical, financial and economic analyses of the expansion project of the Works and the results of the study are compiled in this report.

1-2. Scope of the study

The scope of this study is specified in S/W which the preliminary study team negotiated with the Egyptian side and later concluded between the both sides, and is as summarized in the following.

(1) To Study on the background and relevant conditions of the project

a. General economic situation of Egypt
b. Present situation and policies on iron and steel industry in Egypt (including policies regarding steel prices and distribution)
c. Relevant law and regulations
d. Comparative advantage of ANSDK
e. Other relevant information

(2) To conduct demand and supply analysis

a. Domestic demand of rebars and other products
b. Domestic supply of rebars and other products

(3) Study of the existing system of the works

a. To study the existing iron and steel works' facilities and the operating performance
b. To study the performance of the infrastructure such as port facilities, gas supply, electricity, water, and transportation facilities
c. To study the status of the procurement of raw materials
d. To study the financial status and profitability of ANSDK
e. To study the existing engineering services, management and training arrangement in ANSDK

(4) To study raw materials for the expansion project

a. Availability of iron ore, pellets, steel scrap, and directly reduced iron

b. Availability of other inputs such as limestone, refractories, and other additives

(5) To study the expansion facilities and the availability of infrastructure

a. Plant site and layout for the expansion
b. Various options of technologies for the expansion
c. Prospective products or product-mix and production capacity
d. Availability of appropriate infrastructure facilities, such as gas, power, water, port services and transportation
e. Conceptual design for the expansion facilities

(6) To make an implementation plan for the project

a. Implementation schedule of the project
b. Procurement of construction materials necessary for the expansion of the works
c. Additionally required manpower and organizational function
d. Construction costs and production costs for the expansion of the works

(7) To conduct the financial and economic analysis for the expansion project

a. Total required funds
b. Fund plan
c. Financing
d. Production costs
e. Balance sheet
f. Profit and loss statement
g. Financial statements
h. Internal return rate
i. Sensitivity analysis

In making the implementation plan for the expansion and financial analysis, consideration was given to the following.

- Study on the outlook of future steel demand & supply by taking into consideration the new 5-year economic plan beginning in 1987 F.Y.
- Detailed study on product mix and material flow at the stage of expansion
- Confirmation of land required for the expansion project and the most effective layout
- Consideration to the facilities and operating method for energy saving, yield and quality improvement
- Consideration for maximizing effect of capital investment
- Suggestions for drawing up a plan of the optimum construction method and ensuring safety when the expansion is carried out while the existing plants are kept in operation
- Actual status of technical assistance to the operation and technology transfer

1-3. Process of execution of the study

1-3-1. Field survey

For the purpose of making the F/S for the expansion project of El Dikheila Works, the field survey was conducted mainly in Cairo and Alexandria for 17 days from March 6 to March 22, 1987. (See Table 1-1 Field survey schedule)

In order to investigate whether the expansion project is feasible technically, financially and economically, and to plan product mix, production and also the most suitable facilities, studies were made on general economic condition, steel policy including price and sales channel, steel demand and supply condition in Egypt, and the existing facilities and their operation condition of the Works. For the study, the mission visited not only El Dikheila Works but also such relevant governmental offices as Ministry of Planning and International Cooperation, Ministry of Industry, Ministry of Housing and Utilities, Ministry of Finance, Ministry of Metallurgical Industries, Central Agency for Public Mobilization and Statistics and Electric Power Agency, and other steel mills, related industries, steel-consuming industries, financial institutions, etc.

As shown in Table 1-2, the team members consisted of 13 persons including the leader and experts in the fields of technical coordination, civil engineering and building, DR, steelmaking, rolling, utilities & infrastructure, market research, economic and financial analyses, and in addition, 9 experts joined the team for the analysis work in Japan.

A list of officials and other persons whom the members of the team had the pleasure of seeing and having discussion during the field survey is given in Table 1-3.