Chapter XI. CONCLUSION AND RECOMMENDATIONS

11. Conclusion and recommendation

11-1. 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 11-1 below.

Table 11-1 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.

11-2. 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.

ANNEX

ANNEX I

Outline of Developing Countries' Measures to Foster the Development of Steel Industry

Historically it takes a number of years before a developing country develops a steel industry and the industry obtains international competitiveness. Therefore, it is usual for the government of a developing country to take measures to protect and foster the steel industry for a considerable length of time from the early days of progress of the industry. The general condition of such measures may be illustrated mainly by measures against import of competitive goods from third countries. Namely, the protection and assistance of the industry is given through establishment of regulatory policy and system on competitive imported goods and protective tariffs. Except the case where assembly cost of iron and steel making resources is low, there are often the cases in developing countries, where governmental assistance (low interest loan, development of infrastructure, and others) is indispensable even from the construction stage, and protective and fostering measures (import restriction of competitive goods, exemption from domestic taxes, etc.) are taken in fact for some years after the industry commenced operation. Though this is also true of non-integrated steel makers, such instances are numerous especially where integrated steel mills are involved because the capital invested is so large that it is advisable to take such measures early to facilitate viability of the project. As examples of such cases, there may be cited import restriction on competitive imported goods in Brazil, Venezuela, Malaysia, Thailand and indirect measures of developing infrastructure and supplying public utilities (electric power, etc.) at low cost in South Korea, Brazil and others.

In addition, in Indonesia, the Government granted P.T. Krakatau Steel a function to act as a coordinating body for import of certain rolled steel products, thus opening collective purchasing system, which became a kind of protective measures for that steel enterprise established to promote self-supply of steel in the country.

In developing countries generally, there are in force domestic industry protection laws such as "Industrial Promotion Law", "Pioneer Industry Law", "Steel Industry Promotion Law (Republic of Korea)" and others, under which import restriction measures such as prohibition of import or application of high tariffs and tariff quota system on competitive goods are taken when the problem of competition with imported goods occurs in starting domestic production of designated industries (almost always steel industry is included).

A. Outline of Import Restriction Measures of Major Developing Countries on Bars and Rods

1. Africa and Middle East

Country	Kind of Import Restriction	Year Effected	Description	Object and Background	Other Remarks
Algeria	Collective and central purchasing		Steel products are collectively purchased by SIDER, but from a few years ago, other public corporations began to buy some steel items (subject to approval of Heavy Industry Ministry for direct purchasing), such cases expected to increase.	Emphasis on delivery & quality control of manufacturing corporations themselves in particular	Being a socialistic nation, there are limitations on q'ty and price (budget) of import.
	Preferential purchasing of domestic products		Rolled steels produced by plants of former SNS and SONACOME are used with priority over imported steels (tenders for certain items are issued for domestic goods only). International tenders are issued when import is approved.	Protection of home industry	Under 2nd 5-year plan(1985-89), substitution of import is stressed and will progress further in future.
Kenya	I/L system		Import is restricted of the items which can be produced at home.	Shortage of foreign exchange & protection of home industry	Degree of restriction varies from year to year.
South Africa	Import surcharge	Sep.'85	Import surcharge 10% (on FOB)	Restraint of import and use of the charge as subsidy in unemployment measures.	Degree of restraint varies from year to year.
	Preferential purchasing of domestic products		In projects involving the state, about 12.5% preference is given to domestic products and at tender evaluation, that much is reduced.	Protection of home industry	For cars, local contents of 66%(wt) is obliged.
Saudi	Customs inspection	Rev.,'79	Customs inspection based on Saudi spec. for round bars and bar in coil	Standardization under way of various goods thru quality check & those main products firstly standardized.	
	Preferential purchasing of domestic products		Buy-Saudi policy. Bars and rods of HADEED have priority in buying, in the government construction tender in particular, and also pressure from Job owner/consultant.	Protection of home	

2. Latin America

Country	Kind of Import Restriction	Year Effected	Description	Object and Background	Other Remarks
Columbia	Prior approval system of I/L	End'83	For all imports of rolled steels prior approval system of I/L was effected. (I/L approved for FOB but not for CIF)	Protection of home industry and promotion of use of home products Measures for international payment balance	Import from nations whose trade balance is bad becomes hard.
Venezuela	Prohibition of import		Items prohibited import under I/L system: i) Items SIDOR can produce: Rod, plate & light plate (excl. those for storage tanks of Petroleum Corp.), hot coil & sheet, C.R. coil & sheet, coated sheet, seamless pipe	Protection of home products in connection with start-up of SIDOR (integrated steel mill)	
			ii) Items import prohibited for protection of home industry: G.I. sheet, welded pipe, wire products (wire, G.I. wire)	Protection of home industry	
		Mar.'83	iii) Structural bar & section		
Brazil	Prohibition of import	'76	In principle, items which domestic makers say similar ones are available are prohibited import (except for reexport). If domestic mills OK'ed, if the importer has no import quota, I/L is not issued for the items.	Protection, assistance of home industry and saving of foreign exchange	No major change in the system, but it becomes stricter year by year. Control is strict.

2. Latin America (Cont'd)

Country	Kind of Import Restriction	Year Effected	Description	Object and Background	Other Remarks
Argentina	I/L system	May'82	i) Stricter investigation of I/L by Economy Ministry	Restraint of import (except basic necessities, import prohibited in principle)	
			ii) Investigation of I/L by DGFM	Restraint of import and protection of home mills of bar, etc.	
	Preferential purchasing of domestic products		Investigation by "Buy Argentine" Committee re import by state agencies and enterprises	Protection of home industry	
		Mar.'80	Petroleum Corp. and private oil companies operating under risk contract obliged to use domestic OCTG	Protection of domestic oil country tubular goods	
Peru	I/L system	Apr.'82	I/L system reinstated in April 1982	Rescue of SIDERPERU whose business was hit by surge of imported steel	From Sept. '83, coated sheet and other processed steel sheet added to items covered by the system.

3. Asia

Country	Kind of Import Restriction	Year Effected	Description	Object and Background	Other Remarks
Taiwan	Preferential purchasing of domestic products	H.R.sheet Jul.'82 C.R.sheet Aug.'82	Attaching CSC's agreement obligated in applying for I/L for rod and bars. Import of sizes made by CSC is practically prohibited.	Promotion of sale of H.R. & C.R. sheets in line with start-up of hot rolling mill and cold rolling mill	
Thailand	Prohibition of import		In principle, import of bar and rod (Tariff No.73.10, i.e. ø5.5 -28 mm) is prohibited.	Protection of home mill	Matter of approval of Commerce and Industry Ministry
	Import surcharge		Import surcharge collected	Restraint of import Protection of home mills	
Malaysia	Prohibition of import	Nov. 25, 1982	Prohibition of import of round bar (ordianry steel)	Under aggressive import due to slowdown of world market, to prevent weakening of competitiveness of domestic products and increase of inventory and also to protect domestic mills	
	I/L system	Nov. 25, 1982 Aug. 15, 1985	Wire rod (ordinary steel), bar and rod (alloy steel) Billet		

3. Asia (Cont'd)

Country	Kind of Import Restriction	Year Effected	Description	Object and Background	Other remarks
Indonesia	Collective and central purchasing	'81 – Dec.'82	Collective purchasing of slab, ingot, billet, wire rod, H.R. coil & sheet, plate & light plate - Based on enquiries received from all users, P.P.B.B. (Collective purchasing dept. of P.T.K.S.) issues to each user instruction of imported or domestic products and P.P.B.B. purchases imports collectively.	Protection of state steel mill (P.T. Krakatau Steel) and stabilization of steel prices	Basic policy is to concentrate production of flat products to P.T. Krakatau Steel and non-flat products to electric steel mills.
		Jan.'84	Collective purchasing of C.R. sheet, coated sheet (excl. tinplate), electrical sheet, stainless steel sheet	Protection of P.T. Cold Rolling Mill Indonesia which was started up in 1987 and assistance to its sales activity	
		Apr.'84	Collective purchasing of tinplate, tin-free steel and black plate		
	Import quota	Feb.'83	Expansion of items subject to import quota of steel and designation of importers - Wire products, G.I. products, sections (H steel, sheet pile, angles, channels), tubular goods	Protection of home products, saving of foregn currency (selective import), limitation of import channels (Effective import control - aim to introduce quota system)	

3. Asia (Cont'd)

Country	Kind of Import Restriction	Year Effected	Description	Object and Background	Other Remarks
India	Collective and central purchasing	Apr.'85	Pig iron, semis, bar, section, rod, part of plate, part of hot coil, part of C.R. sheet, strip, black plate, electrical sheet (coil), electrical sheet (non-oriented), part of tinplate, GP sheet, aluminized sheet, other coated sheet, stainless plate, stainless sheet, part of stainless strip cannot be imported if not passed through MMTC, Canalized agency. But if NOC (not objection certificate) of MMTC is obtained or Advance I/L is on hand for promotion of export, direct import is possible.	From the viewpoint that import of steel by SAIL, steelmaker, is not desirable, the canalized agency was shifted from SAIL to MMTC in April '85.	MMTC strongly asks suppliers to export Indian products in return for import of steel (counter-purchase).
	I/L system	Apr.'85	Flat bar, square bar, part of rod, plate, hot coil, H.R. sheet, C.R. sheet, part of C.R. strip, electrical sheet (oriented), tinplate, part of stainelss plate, part of stainless strip, part of alloy steel can be imported if Indian users apply for and obtain I/L.		Part of pig iron, WFB, part of rod, part of plate, part of H.R. sheet, terne plate, plastic & vinyl coated sheet, clad sheet, stainless strip, part of alloy steel which Indian makers cannot produce can in principle be imported freely by open general licence.
	Prohibition of import		Part of alloy steel, part of stainless steel, part of steel casting are items, of which import is prohibited.		

3. Asia (Cont'd)

Country	Kind of Import Restrictioon	Year Effected	Description	Object and Background	Other Remarks
Pakistan	Only direct import by government offices and agencies		Round bar, rod (ø 7.62 cm max), bloom & billet (3.81 cm max), pig iron, ingot, rail, tube blanks	Domestic production became possible with start-up of PASMIC.	

Note: The above table shows major import restriction measures of major developing countries and there are other various regulatory measures in other countries which vary from country to country.

B. Import Tariff on Selected Ordinary Steel Products in Several Countries

		Egypt	Nigeria	Kenya	Venezuela	Brazil	Argentina	
							Tariff	DGFM
Bars:	Small bar	20%	78.75%	20 - 45%	H.R. 30%	37%	48%	26%*
	Others	30%	-	45%	F.S.* 1%	37%	48%	
Sections:	H steel	20%	26.25%	25%	30%	37%	48%	
	Others	20%	-	25 - 45%	1%	37%	48%	
Wire rods		20%	78.75%	25 - 40%	25%+BSI/kg	37%	48%	
Base for duty		CIF	CIF	CIF	CIF	C&F or CIF	CIF	
Remarks		*Nail, bolt and nut - 20% Barbed wire - 50% Needle, pin, spring - 30%			*F.S.= Steel forgings		*Note: Tariff when I/L of DGFM is obtained. The tariff is imposed based on CIF VAL.	

B. Import Tariff on Selected Ordinary Steel Products in Several Countries (Cont'd)

		Iran	Iraq	Saudi Arabia	Kuwait	U.A.E.	EC
Bars:	Small bar	10%	0/6/8%	-	4%	-	4.4%
	Others	10%	0/6/8%	-	4%	-	4.4%
Sections:	H steel	10%	0/6/8%	-	4%	-	4.4%
	Others	10%	0/6/8%	-	4%	-	4.4%
Wire rods		10%	0/6/8%	-	4%	-	4.4%
Base for duty		CIF	CIF	CIF	CIF	CIF	CIF
Remarks			Tariff rate prepared by the government varies case-by-case in application.	Base for duty is specified by the Customs Law to be CIF, but in fact there are cases where duty is imposed only on C&F.	The above tariff is applied when payment term is CIF-KWT. When the term is C&F-KWT, it is increased by 1% to 5%. (From July 1983)	Rolled steels used for construction of buildings & roads and those used in public projects are duty free if copies of contracts are attached. Duties on raw materials used in plants of which 51% or more is GCC own capital are exempted.	Applied to import from non-EC countries. Import from EC members is duty free. The tariff is common to all EC members except Greece.

B. Import Tariff on Selected Ordinary Steel Products in Several Countries (Cont'd)

		Greece		Spain	Taiwan		China	Philippines
		Tariff	Total		General	Reciprocal		
Bars:	Small bar	9.1%	36.1%	9.5%	26.5%	21.5%	15%	20%
	Others	7.9%	34.6%	7.6%	26.5%	21.5%	15%	20%
Sections:	H steel	6.3%	32.6%	8.3%	26.5%	21.5%	9%	20%
	Others	10.3%	36.2%	8.3%	26.5%	21.5%	9-15%	20%
Wire rods		7.2%	33.7%	8.4-9.5%	24%	HC 14% LC 19%	15%	20%
Base for duty		CIF		CIF	CIF		CIF	C&F
Remarks		Total is the sum of import duty including stamp tax and other taxes and imposed on CIF VAL.		Tariff over CIF VALUE will be none on EC products and lowered to common rates on non-EC products during 7 years from admission to EC.	Base for impoort duty is CIFx100%(from Feb. '86, before that it was 105%) Tariff includes port charge.			

B. Import Tariff on Selected Ordinary Steel Products in Several Countries (Cont'd)

		Indonesia		India		
		Tariff	VAT	Tariff	A.Duty*1	C.E.Duty*2
Bars:	Small bar	20%	10%	60%	40%	RS 365/MT
	Others	0-20%*1	10%	60%	40%	RS 365/MT
Sections:	H steel	(S.P.)5% 20%	10%	60%	40%	RS 365/MT
	Others	20%	10%	60%	40%	RS 365/MT
Wire rods		0-20%*2	10%	70%	40%	RS 365/MT
Base for duty		C&F		CIF		
Remarks		Notes: *1 0% for industry use *2 0% for cold heading high carbon 12 mm (S.P.)= Sheet pile		Notes: *1 Auxiliary duty *2 Countervailing excise duty Import duty includes all the above three. Tariff varies partly depending on weight.		

ANNEX II

Production of Re-bar and Its Price Trend in the World

A Production of Re-bar in the World

a) U.S.A.

The newest steel production center in U.S.A. is in the South centering about Texas where a number of mini-mills based on electric arc furnaces were constructed and there is seen an increasing trend to set up steel mills in Texas that faces the Gulf of Mexico in preparation for import of sponge iron produced by direct reduction process (DRI) in future.

Though accurate statistics on the production of bars (mostly reinforcing bars, or re-bars, in U.S.) by type of steel mills are few, it can safely be said that a fairly large part is produced by medium and small enterprises and in particular, mini-mills are mostly to produce bars.

The three factors, (1) low cost scrap, (2) cheap power and (3) suitable market size, are said to be main factors enabling mini-mills to operate competitively and they can compete with big integrated steel mills by using ultra-high power electric arc furnace (EAF) and continuous casting (CC) facilities. In U.S. having many and broad markets, there are a number of factors to contribute toward the existence of mini-mills and continuation of their production activity. For example, labor cost varies considerably by different regions and the advantage of relative low labor cost in the country can be enjoyed by selecting plant locations. Power cost also varies by region and besides, there are cases that interstate movement of scrap is prohibited by interstate highway regulations, which makes EAF steelmaking advantageous in the region where scrap is available easily and at low cost. Steel mills in those regions have annual capacity of 50,000 -500,000 tons and mainly produce re-bars.

Thus in U.S., bars are produced by smaller-scaled steel companies mostly in the fields where big integrated steel companies are not operating or do not want to operate and the mini-mills can exist because of their adaptability in manpower, raw materials availability, production, sales, list price, customer service and regional demand.

Generally speaking, those mini-mills have almost no affiliation with big mills through raw materials or capital and they do not have much interest in integrated steel production. When they have to compete with big steel mills or mills of similar scale, they stress short delivery, specialization or processing of products and if necessary cut price. Also, emphasis is placed on quality rather than quantity and efforts are made not to lose customers. Therefore, they are willing to leave large lot orders to big steel mills and take mainly small lot orders of 10 tons or so. Such mini-mills keep contact with customers calling once a week. As seen from this, products are sold direct to users and the direct sale accounts for about 80% of the total and the sale to wholesalers the remaining 20%.

In general, the mini-mills keep their competitiveness for continuing production by pursuing that products of kind and shape which have largest demand in the region be made, that investment be limited to the minimum required for this, that employees are trained to the highest standard in such specific field jobs and that the plant facilities be used to the maximum.

The so-called "economies of scale" works advantageously to mini-mills also. Production cost per ton (excl. capital cost, but incl. raw material cost) of mini-mills is higher than that of integrated mills. But assuming prices of hot metal and scrap to be same, the operating cost is higher in EAF steelmakers, usually 10% or so because 25% of operating cost is power cost. But if capital cost is included, the total cost is considered almost same in mini-mills and big integrated mills. Therefore it is the most important thing in U.S. to ensure raw materials at lowest cost so as to make the best of the advantage in capital cost and overcome the disadvantage in operating cost. Bar makers keep this in mind and at the same time seek their markets within 100-mile radius from their plants as one of means to compete with big steel makers.

Change in Production Capacity by Product between
Big Integrated Steel Mills and Mini-Mills in U.S.A.

(Unit: 1,000 NT)

	1970	1980	1986
Hot rolled bar			
Integrated mills	7,560	6,870	5,660
Mini-mills	2,720	5,050	5,800
Total	10,280	11,920	11,460
Structural bar			
Integrated mills	3,010	1,630	680
Mini-mills	3,010	6,320	6,525
Total	6,020	7,950	7,205
Bar Sections			
Integrated mills	1,130	310	165
Mini-mills	280	1,240	1,575
Total	1,410	1,550	1,740
Structural section (Small size)			
Integrated mills	2,150	1,490	1,640
Mini-mills	-	540	760
Total	2,150	2,030	2,400
Wire rod			
Integrated mills	6,370	3,750	1,965
Mini-mills	1,270	3,605	4,915
Total	7,640	7,355	6,880
Total of above 5			
Integrated mills	20,220	14,050	10,110
Mini-mills	7,280	17,455	19,575
Total	27,500	31,505	29,685

Source: Richard M. Blassy, Growth Patterns of the U.S. Mini-Mill Steel Industry, Iron and Steel Division, Basic Industries, Trade Development Department of Commerce U.S. Government, December 1986

Original source: Iron Age, April 1984

b) EC countries (Incl. Turkey)

Almost no accurate data about production of bar in EC countries are available. Statistically, simply large and small long products (80 mm being dividing point) are shown. And the general condition can be known about EC only. There are some countries whose demand/supply condition of bar can be known, but it is difficult to grasp the condition in a fairly large number of countries.

In the present EC countries, in particular 6 former member countries and U.K., location of steel plants moved to seaside regions. The reason is the regional change in steel demand in Europe and the shift of raw material sources from Saar (coal) and Alsace-Lorraine (iron ore) to overseas. The weight of seaside steel mills increased from year to year.

The above shift of big integrated steel mills induced new or additional construction of mini-mills based on EAFs and modernization of the existing smaller steel mills in the inland regions of Europe. Those mills are mostly of annual capacity of 600,000 tons or less. In fact, expansion of mini-mills was remarkable from around 1972 mainly in France and Italy and a number of mini-mills are in operation or planned. Those mini-mills have the target on users within 100 km distance and provide many services.

Major small-scaled steel mills belong to European Independent Steelworks Association and their steelmaking capacity in the aggregate totals a little more than 18 million tons, accounting for about 10% of the western European total. Particularly in Italy, emphasis is placed on export to EC member countries and 60 or more steel mills are concentraded in the northern Italy.

In Spain, SIDERINSA is engaged in production coordination and marketing measures of re-bars, but as a result of becoming a member of EC, export subsidy was stopped and the competitiveness was greatly lowered.

c) Asia (excl. Japan)

Except India where integrated production system was established in part many years ago and Republic of Korea and Taiwan where full-scale integrated steel mills began to be constructed in 1970s, the progress of steel industry in Asia was mainly through the so-called backward integration process. Typical type in early days was the mills who produce concrete reinforcing bar or small bars from imported billets or scrap from shipbreaking. This is because demand for the products was biggest in early days of economic development and also because the demand quantity was generally appropriate for production at the initial stage. However, in recent years, production of those products was mostly by mills who engage in both steelmaking and rolling and there is seen a trend to move to this pattern of integrated production. The steel industry in Republic of Korea and Taiwan is now in the stage of progress to full-scale integrated production.

In an early stage of development of steel industry in various countries in Asia, long products were the first to be produced because of demand structure at the time. The major part of the demand depends on building and civil engineering works sector. Since there are not many countries who pay special attention to the damage by earthquake and their buildings are of reinforced concrete or reinforced bricks, consumption of rolled steels is mainly re-bars. And recently consumption and also production of deformed bars is increasing, but still plain bars are mainly used in sizes 8 to 24 mm.

Majority of bar producing companies in ASEAN countries are established by local capitalists (mainly Chinese origin) and some of them receive technical assistance from overseas, but there are a few which are joint venture companies with foreign capital. Moreover, in an early days of economic development, even EAF steelmaking is considered to have equal footing with big integrated steelmaking in developed nations and the EAF mills are established as state companies or joint government-private companies and for some time after their establishment enjoy assistance from the governments under laws such as Industrial Promotion Law, Infant Industry Law, etc.

However, stable availability of iron source is a matter common to EAF steelmakers, rollers and rerollers in this area. Though some makers purchase scrap in the world market competing with OHF and EAF steelmakers in developed nations, there are instances where shipbreaking industry is promoted or DR process introduced (as in Indonesia and Malaysia) as solution of this problem.

Such being the case, though the industry in this area enjoys advantage of low wage rate, because of instability in scrap supply, its cost of bar production is not always lower than that in developed nations. In addition, there are cases as in Indonesia that high repair cost of private power plant, high transportation cost of domestic scrap and low operation technique hinder its competitiveness.

Therefore, there are cases where the government, while considering the limitation of modernization and rationalization of the existing EAF steelmakers, rollers and rerollers, plans to construct state integrated steel mills to supply semi-finished products (mainly billet) to such existing mills in order to modernize the steel industry. Pohang Iron and Steel in South Korea and China Steel Corp. in Taiwan are examples of such case.

d) Middle East and Africa

Steel industry in those areas started with production of mainly steel bars and small dia. pipes after World War II. The first production was by Delta Steel in Cairo who used Egyptian and imported scrap, and then came National Metal Industries and Egyptian Copperworks (both in Egypt). At present, four countries, Egypt, Iran, Algeria and Tunisia, have integrated steel mills and all of them produce mainly non-flat, or long, products. Steelmaking facilities exist in Algeria, Egypt, Iran, Israel, Morocco, Tunisia and Lebanon. Those steelmaking facilities are almost always followed by rolling mills of long products and size of small bars is mostly 30 mm max. (mainly 8 - 13 mm).

The first full-scale (BF) integrated steel mill in the area was completed in Egypt in 1958 and the second one in Tunisia in 1966 and the third in Algeria in 1969. On the other hand, there are numerous rolling mills which produce bars from imported billets. Those mills show a sign of progress, but the full-scale progress of steel industry in the area is expected to come in future.

As regards Arab area, as of early 1973, there were integrated steel mills, steelmaking and rolling mills, and rerollers who produce bars, but because of short supply of scrap and billets, their operating rate is generally lower than 50%. As a result, production of small non-flat products was small and their demand had to be met by import.

In Iran, a new plan showed marked progress and in particulr, there was an ambitious plan to construct integrated steel mill including DR plant. Planned product mix includes steel sheet.

In Qatar, Kobe Steel (Japan) constructed an integrated steel mill based on DR process. The mill has annual production capacity of 400,000 tons of bars, 10 - 32 mm, and began full operation in 1980s.

Demand for bars in those areas are mainly from building and civil engineering construction sector and related oil drilling sector. Though industrialization of the area was promoted with oil dollars, recent decrease of oil prices resulted in decreased foreign exchange income and the demand in the area may not be expected to show a rapid increase as once expected, but it is certain that the demand will show continuing growth in future.

In West Africa area, Niger Steel's bar mill is at Emene close to Engu, Nigeria, and operates as EAF steelmaker and roller. In Ghana, Tema Steel Works Co., Tema, produces some merchant bar and is making efforts to become the central steel mill in Ghana by expansion to an integrated mill.

In Central Africa, an integrated steel mill produces non-flat products and others in Zimbabwe while Steel Corp. of East Africa is EAF steelmaker and has a small capacity to produce small bars at Jinja, Uganda. In Tanzania, National Steel Rolling Mill produces bars and in Ethiopia, a small bar mill operates at Akaki district in the suburb of Addis Ababa.

In South Africa, South African Iron & Steel Industries Corp. (ISCOR) is engaged in full-scale production with BF process and its product mix covers wide range of products.

In the countries in Africa, the majority of steel mills are of small scale, but with a view of effective utilization of iron resources, contemplate BF integrated process. As preparatory steps, development of EAF steelmaking & rolling industry and other processing type industry with backward integration process (started with tinplate, G.I. sheet, and steel pipe, etc.) has been observed and the industry often proceeds gradually to integrated one while the existing one acting as nucleus. As regards EAF steelmakers and rerollers, often availability of scrap and billet is limited, which induces integration to solve the matter. Construction of integrated steel mills requires vast amount of funds. As measures to cope with the problem, a movement to construct joint mills through regional cooperation was seen once mainly at UN Economic Commission for Africa and others. Such plan generally reflects demand pattern in the region and almost all projects included small non-flat products (mainly bars).

B Trend of Price of Re-Bar

Trend of export and import prices of re-bars may be shown by average unit price obtained from external trade statistics or customs clearance statistics of each country in the world. Domestic prices of different countries cannot be compared generally as they are because distribution channel and price system vary from country to country and it is possible to grasp only general trend. In the following will be shown the trend of prices published in Metal Bulletin magazine which is considered as worldwide standard export prices and average price trend in Japan.

Basic General Export Prices on European Continent

	Concrete bar (12 mm min)	Wire rod (5.5 mm)
1984	180 - 205	225 - 255
1985	170 - 215	225 - 235
1986	220 - 230	230 - 250
Jan. 30, '87	240+	250 - 255+
Feb. 27, "	240 - 245+	255+
Mar. 31, "	240 - 245+	255 - 260+
Apr. 3, "	240 - 245+	255 - 260+
Jun. 2, "	245+	255 - 260+
" 30, "	245 - 250+	255 - 260+
Jul. 2, "	245 - 250+	255 - 260+
" 30, "	245 - 250+	255 - 260+
Aug. 17, "	250+	265+

Notes: 1. Annual price shows the highest and lowest during the year.

Date is issuing date of Metal Bulletin and + shows commission included.

2. FOB US$/M.T.

Source: Metal Bulletin

*The above prices are those M.B. editorial dept. gathered from main traders in Europe by telephone and standardized based on such interview on price trend.

Export Tendency from Japan on Deformed and round Bar

	xxxxxxx xxxxxxx	Deformed Bar					Small round Bar				
	Monthly Average Yen/US$	Total Weight	Total Value		US$/M·T		Total Weight (M/T)	Total Value		Unit Price	
		(M/T)	1,000 Yen	US$	1,000 Yen /M·T	US$/M·T		1,000 Yen	US$	1,000 Yen /M·T	US$/M·T
1984		1,732,300	94,894,168	398,855,484	55	230	594,914	35,379,072	148,060,121	59	249
1985		2,323,325	126,085,561	522,727,424	54	225	546,527	32,180,597	132,313,699	59	242
1986		1,320,582	50,789,239	298,036,929	38	226	352,911	15,073,895	88,456,202	43	251
1986/85		57%	40%	57%			65%	47%	67%		
1986.1.	202.01	71,860	3,259,525	16,134,666	45	225	27,182	1,545,751	7,651,474	57	281
6.	169.07	154,829	5,732,021	33,903,243	37	219	44,807	1,823,394	10,784,849	41	241
12.	162.77	24,782	900,215	5,530,594	36	223	17,238	728,933	4,478,301	42	260
1987.1.	158.43	30,686	1,061,008	6,697,014	35	218	9,799	382,185	2,412,326	39	246
2.	152.83	72,243	2,315,902	15,153,452	32	210	9,262	339,898	2,224,027	37	240
3.	153.43	47,545	1,573,301	10,254,195	33	216	25,387	1,196,675	7,799,485	47	307

Source: Ministry of Finance Japanese Government

Note: Price: 1. Based on FOB Price

2. Export price on yen Basis is decreasing strougly (Causes by yen Re-valuation)

ANNEX III

Characteristics and Price Trend of Scrap

A Characteristics of scrap and DRI

1. Return scrap

Return scrap generated within steel works is gradually decreasing as years passed. Needless to say, this reflects the efforts made to improve yield of rolled steels, but the biggest contributing factor is introduction of continuous casting (CC) process and it can be expected that the return scrap will decrease further as CC process gains popularity.

It is generally believed that decrease of return scrap leads to increased purchasing of market scrap, but in fact if production of final rolled steels is constant, the decrease of return scrap only means the quantity of recylced scrap and does not lead to increased purchasing of market scrap. Advantages of return scrap in use are high and pure quality and grade identifiable. High reputation given to scrap sold by BF integrated steel mills may reflect this.

2. Market scrap

Statistics of market scrap in strict sense do not exist even in Japan where many steel statistics are well prepared. This is because scrap is not product but reject and because scrap industry consists of a small number of dealers and a great number of small-scale collectors. The condition of scrap is surprisingly similar in every country and so the unsatisfactory condition of scrap statistics. Consequently the quantity of scrap generated has to be estimated from the statistics of purchased scrap, export and import statistics and the quantity of return scrap sold by BF steelmakers.

Market scrap or purchased scrap may be divided into prompt industrial scrap and dormant scrap. Prompt industrial scrap is generated by steel users in making their products. Namely it is generated in the process of manufacture of cars, ships and electric home appliances in the year that rolled steels are supplied to those manufacturers. In many cases, scrap is pressed at steel-consuming plants and returned to the steel mills.

On the other hand, dormant scrap consists of obsolete, worn out or broken products such as cars, ships, electric home appliances & buildings as their lives (duration) end and they are generated with some time lag from the time when the steel was produced and sold. In Japan, the years of duration is said to be 7.5 years of cars, 8 of electric home appliances and 35 of buildings, but it varies according to the level of economic activities. In the year of economic slowdown as at present, the duration extends and in Japan, it is now considered to be 13 years for all rolled steels included. Automobile scrap which is expected to increase in future includes a variety of materials, but it is shredded to remove foreign matters and processed to shredded scrap containing least foreign matters and recycled to steel mills.

The quantity of industrial scrap generated tends to decrease as process yield at steel consuming industries also is being improved. It decreases also when crude steel production shows slow growth and even if the growth is high, increase in generation of prompt industrial scrap may be not much.

On the other hand, dormant scrap is expected to increase considerably for at least ten years in Japan as full-scale recycling of rolled steels consumed in the past will take place from now on. Generally it is natural that the scrap generation tends to increase in countries who have a long history of steel consumption.

3. Quality of scrap and direct-reduced iron (DRI)

The problem of deterioration of purchased scrap was so far solved mainly by efforts on users' side such as intensified segregation, selective use of scrap by kind of steel, secondary refining in ladle, and dilution of impurities in purchased scrap by addition of return scrap or pig iron. However, common to every steelmaking country is the knowledge that as the demand for rolled steel which is the mother of scrap shifts to that of special steel, coated or thinner products, the scrap will inevitably deteriorate.

BOF can dilute the scrap by highly pure hot metal, but EAF depends on scrap for almost 100% of oxide material and the effect of poor quality scrap is remarkable. Because the demand for high grade steel is increasing, the measures to cope with the problem is very important. Of the conventional measures, use of iron source with least impurities as diluting agent is most important to solve the problem. Then, it can be expected that demand for high grade scrap increases and price differential from ordinary scrap expand further. If it goes too far, it is possible for DRI to substitute the high grade scrap.

DRI is cold oxide source containing solid Fe more than 90% which is directly reduced from iron ore by reformed reducing gas (CO, H_2) of natural gas and used in EAF and other steelmaking furnace. It is virgin oxide source produced from iron ore, and though it contains such gangue as SiO_2, Al_2O_3, it is highly pure cold oxide source containing almost none of detrimental elements such as Cu, Sn, Cr, Ni, Mo, etc.

While DRI's qualitative merits are appreciated, there are also demerits. Availability of low cost and abundant natural gas is essential; it is easily reoxidized and needs special precaution in its storage and transportation (the risk of spontaneous ignition may be avoided by making it hot briquet); and gangue contained results in lower yield, increase in power consumption and operation loss.

DRI is generally consumed in the integrated steel mills where it is produced (the mills consisting of DR plant, EAF and RM) and sold outside only when there is any surplus. Commercial DRI plant specialized in selling its product is liable to be directly influenced by scrap market condition and so, commercialization is rare except in the countries where natural gas can be obtained at exceptionally low price. FIOR in Venezuela which exports hot briquet type DRI which is not easily reoxidized is one of successful examples, but it can be said that availability of abundant and low price scrap hinders growth of DRI trade. It is seen, however, that necessity of DRI as quality oxide source is increasing as available scrap deteriorates. If DRI is traded for reasons of its quality in future, the export from integrated steel mills with DR plant in oil producting countries blessed with abundant natural gas is expected to account for the greater part of such DRI.

Forecast of Dormant Scrap of Ordinary Steel Generated by Sector in Japan

(Unit: 1,000)

	Est. collecting rate (%)	1978 Input (*3)	1978 Uncollectable	1978 Collected	1978 (%)	1985 F.Y. Input	1985 F.Y. Uncollectable	1985 F.Y. Collected	1985 F.Y. (%)	1990 F.Y. Input	1990 F.Y. Uncollectable	1990 F.Y. Collected	1990 F.Y. (%)
Light scrap:													
Tin cans	45.0	884	486	398	4.3	1,438	791	647	4.3	1,769	973	796	4.3
Cars (incl. motorcycle)	90.0	2,555	255	2,300	25.0	3,030	303	2,727	18.0	3,374	337	3,037	16.3
Elec. home appliances	56.0	486	214	272	3.0	800	352	448	3.0	930	409	521	2.8
Home & office utensils	96.9	420	13	407	4.4	1,287	39	1,248	8.2	1,360	41	1,319	7.1
G.I. sheet for building	64.0	875	315	560	6.1	2,188	788	1,400	9.0	2,375	885	1,520	8.2
Sub-total	75.4*2	5,220	1,283	3,937	42.8	8,743	2,273	6,470	42.7	9,808	2,615	7,193	38.7
Heavy scrap:													
Industrial machinery	98.0	1,228	25	1,203	13.1	2,735	47	2,688	17.8	3,143	53	3,090	16.6
Elec. machine	98.8	259	3	256	2.8	600	6	594	3.9	1,100	11	1,089	5.9
Private civil eng. works *4	94.7	133	7	126	1.4	480	24	456	3.0	900	45	855	4.6
Gas & water	70.0	307	92	215	2.3	526	156	368	2.4	1,012	304	708	3.8
Bldg.(Eq.95%)	97.1	204	6	198	2.2	270	8	262	1.7	480	14	466	2.5
Sub-total	93.8	2,131	133	1,997	21.7	4,611	243	4,368	28.8	6,635	427	6,208	33.4
Others:													
Wire products	68.2	1,106	352	754	8.2	1,350	424	926	6.1	1,400	440	960	5.2
Bolt, nut, C.R.bar	90.0	241	24	217	2.4	550	55	495	3.3	650	65	585	3.1
Others	99.2	2,315	18	2,297	24.8	3,003	120	2,883	19.0	3,854	201	3,653	19.6
Sub-total	89.2	3,662	394	3,268	35.5	4,903	599	4,304	28.4	5,904	706	5,198	27.9
Total	83.6 *1	11,013	1,810	9,203 *1 (83.6)	100.0	18,257	3,115	15,142 *1 (82.9)	100.0	22,347	3,748	18,599 *1 (83.2)	100.0

Notes: *1 Figures in parentheses show average collection rate.
*2 Figures in Estimated collecting rate (sub-total) show average collecting rate in 1978.
*3 Input means increment of accumulated stock of steel consumed t years ago assuming the duration of t yrs.
*4 Excl. mining and public works

Source: Tekkokai, JISF September 1983 pp.33

Forecast of Prompt Industrial Scrap Generated by Sector in Japan

(Unit: 1,000 t, %)

	1978 F.Y			1985 F.Y.			1990 F.Y.		
	Q'ty	Generating rate	%	Q'ty	Generating rate	%	Q'ty	Generating rate	%
Ordinary steel:									
Cars (incl. motorcycle)	2,722	29.8	44.5	2,929	28.5	39.5	2,989	27.8	36.1
Industrial machinery	941	20.9	15.4	1,263	19.6	17.0	1,574	19.5	19.0
Elec. home appliances	223	16.0	3.6	286	15.4	3.9	341	15.0	4.1
Elec. industrial equip.	392	22.2	6.4	610	21.3	8.2	827	20.7	10.0
Shipbuilding	206	8.6	11.0	396	8.3	5.3	441	8.1	5.3
Building	674	4.8	3.2	839	4.6	11.3	940	4.5	11.3
Civil eng. works	196	3.3	2.6	217	3.1	2.9	241	3.0	2.9
Wire & bar products	160	4.3	9.9	173	4.2	2.3	180	4.1	2.2
Others	599			697		9.6	753		9.1
Total	6,113	11.1	100.0	7,410	10.5	100.0	8,286	10.3	100.0
Special steel:	1,724	24.0		2,019	23.0		2,240	22.4	
Steel casting & forging	122	16.3		148	15.6		160	15.2	
Iron casting	413	11.1		487	10.7		521	10.4	
Total	2,259			2,654			2,921		
Grand total	8,372	12.3		10,064	11.8		11,207	11.5	

Source: Tekkokai (Monthly Bulletin of JISF) September 1983 pp.30

Steel Scrap Import to Japan by Origin Countries

(Unit : 1,000M.T)

F.Y	U S A	(%)	Hongkong	India	U S S R	Canada	Australia	Others	Total Import	Price/M.T Japanese yen	Price/M.T U S $
1965	2,270	70.0	85	434	81	7	269	96	3,242	15,800	44
1966	3,082	75.4	47	404	132	16	243	163	4,087	15,100	42
1967	2,868	73.8	55	345	75	33	438	73	3,887	14,000	39
1968	4,685	74.6	62	482	169	147	410	328	6,283	16,900	47
1969	4,200	78.5	73	345	124	42	471	95	5,350	16,200	45
1970	4,228	79.0	51	197	143	125	482	94	5,320	21,600	60
1971	1,515	65.7	5	43	372	0	344	27	2,306	15,100	44
1972	3,593	79.5	9	34	286	17	279	43	3,261	14,700	49
1973	3,757	78.2	11	57	280	162	490	50	4,807	22,000	81
1974	2,752	72.3	106	13	153	0	623	158	3,805	43,800	149
1975	1,879	74.9	35	51	116	0	408	19	2,508	32,500	109
1976	1,204	64.2	60	97	179	0	280	55	1,875	30,800	105
1977	988	63.6	27	12	260	0	217	50	1,554	23,000	89
1978	3,200	84.2	53	9	140	16	192	190	3,800	23,300	116
1979	2,302	81.5	29	2	129	19	280	64	2,825	35,800	158
1980	2,462	82.4	31	2	129	17	231	118	2,990	36,500	165
1981	935	60.1	50	..	156	1	234	181	1,557	31,700	141
1982	1,672	64.5	54	1	412	2	286	164	2,592	29,700	120
1983	2,382	59.2	69	..	323	62	280	907	4,023	28,400	120
1984	2,366	63.7	66	..	238	20	264	759	3,714	32,000	133
1985	2,113	59.1	54	1	492	132	281	502	3,575	27,100	122
1986	1,184	43.5	37	..	839	10	180	472	2,722	18,700	115

Source: Ministry of Finance, Japanese Government

Notes: Unit price is C.I.F.
Of "Others" in 1986, U.K. is 81,000 t, Vietnam 71,000 t, South Africa 69,000 t and Saudi Arabia 59,000 t.

B World demand and supply of scrap and U.S. scrap

The regions in the world where scrap is surplus are North America, mainly U.S.A. which has the largest accumulated stock of steel consumed in the past throughout the world, Australia, U.S.S.R. and some countries in East Europe. On the other hand, the countries characterized by shortage of scrap are the countries in the Southeast Asia, Italy and Spain. Japan imports some scrap, but supply of domestic scrap increased recently and the shortage tends to decrease. The country who holds the key position in the world scrap demand/supply condition is the largest exporter, U.S.A. Though further growth of mini-mills who depend on scrap can be expected, rapid recovery of steel production in the whole industry in U.S. may not be expected and the recovery will be very slow or a moderate growth at the best. With the accumulated stock of steel consumed of 2.5 billion tons, it can be expected that U.S. export of scrap will keep the level in the past years. However, with a view of preventing price rise of scrap for domestic EAF steelmakers, the Government often took measures to restrict export of scrap. Such policy measures of U.S. may have an effect on the world scrap demand/supply condition with possibility of adding factors of quantitative instability and price increase.

Supply and Consumption Balance on Steel Scrap in USA

(Unit: 1,000 M·T)

			1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Crude Steel Production	Open Furnace		(26.4) 36,088	(24.4) 32,205	(19.0) 20,104	(18.4) 21,292	(16.0) 18,183	(15.5) 19,332	(14.0) 17,380	(11.6) 11,843	(11.1) 12,204	(8.2) 5,543	(7.0) 5,399	(9.0) 7,562	(7.3) 5,831
	Converter		(55.2) 75,553	(55.9) 73,984	(61.6) 65,138	(62.4) 72,502	(61.8) 70,224	(60.9) 75,736	(61.1) 75,530	(60.5) 61,340	(60.6) 66,435	(60.8) 41,104	(61.5) 47,220	(57.1) 47,920	(58.8) 47,070
	Electric Furnace		(18.4) 25,183	(19.7) 26,009	(19.5) 20,575	(19.2) 22,328	(22.3) 25,295	(23.5) 29,245	(24.9) 30,779	(27.9) 28,274	(28.3) 30,976	(31.0) 21,009	(31.5) 24,145	(33.9) 28,457	(33.9) 27,167
	Total		136,804	132,198	105,817	116,122	113,702	124,313	123,689	101,457	109,615	67,656	76,763	83,940	80,068
Balance	Supply	Prucased Scrap	50,773	54,459	42,169	44,924	43,643	50,212	52,735	47,329	44,008	31,602	37,886	41,330	44,220
		Retern Scrap	(38.3) 52,437	(37.9) 50,123	(39.5) 41,769	(39.1) 45,383	(39.5) 44,920	(38.0) 47,250	(38.3) 47,374	(37.7) 38,289	(35.8) 39,245	(36.4) 24,609	(32.2) 24,718	(31.6) 26,559	(34.5) 27,636
		Import	354	224	338	534	660	757	735	506	510	430	581	555	522
		Total	103,564	104,806	84,276	90,841	89,223	98,219	100,844	86,124	83,763	56,641	63,185	68,944	72,378
	Consumption	for O.F	18,649	17,381	10,687	11,192	10,058	10,676	9,506	6,754	6,802	3,255	2,971	3,378	2,186
		for Converter	24,783	24,144	21,221	23,772	22,711	23,593	24,037	19,830	21,118	12,754	14,714	14,920	13,932
		for E.F	32,072	33,998	27,080	29,303	33,035	37,457	39,513	36,428	35,963	25,214	27,777	30,305	35,300
		for B.F	3,852	4,135	3,566	3,349	3,421	3,797	3,736	3,312	3,670	2,402	2,835	2,471	2,250
		for Cupora	11,837	14,189	10,659	12,103	12,996	12,771	11,589	8,564	8,267	6,648	6,945	7,675	9,213
		for Others	783	1,848	1,478	1,846	1,421	1,722	1,342	1,054	1,379	880	806	855	1,073
		Total	93,976	95,695	74,691	81,565	83,642	90,016	89,722	75,942	77,199	51,153	56,048	59,604	63,954
	Export		10,211	7,888	8,827	7,367	5,602	8,417	10,130	10,173	5,923	6,206	6,843	8,617	9,009
	Inventory (end of each year)		...	...	...	...	8,494	7,509	7,914	7,274	7,365	5,822	5,268	4,773	...

Notes to Table "Supply and Consumption Balance of Steel scrap in USA"

Notes: 1. Figures in ( ) in "Crude steel production" show share of each process (%).

2. Figures in ( ) in "Supply: Return Scrap" show @ against crude steel (%).

Sources: The Japan Iron and Steel Federation, U.S. Bureau of Mines, U.S. Bureau of Census Figures for 1985 from FACTS

Tendency on Steel Scrap Price in USA

(Unit : US$/M·T)

F.y \ Month		4	5	6	7	8	9	10	11	12	1	2	3
1968	F O B	30.00	30.50	29.00	29.75	31.00	33.50	31.25	31.50	31.50	32.50	33.75	32.75
	COMPOSITE	26.20	21.96	23.50	23.24	23.50	23.90	23.50	24.04	24.90	27.25	28.00	26.70
1969	F O B	33.45	38.25	40.50	43.00	44.25	45.75	47.00	46.00	46.00	52.25	58.00	58.00
	COMPOSITE	26.07	29.25	29.43	30.17	32.42	35.83	34.00	33.50	36.76	40.37	46.17	44.50
1970	F O B	55.50	52.50	50.00	19.25	48.00	42.25	44.50	41.00	40.50	40.20	40.00	37.00
	COMPOSITE	41.10	43.08	43.58	40.50	39.71	42.50	40.67	35.67	35.83	40.17	39.50	36.17
1971	F O B	35.00	34.75	32.25	32.50	32.00	33.25	32.50	31.50	31.00	33.00	35.50	35.50
	COMPOSITE	34.17	34.50	33.17	32.17	31.83	33.17	32.17	31.00	30.84	32.84	35.33	34.83
1972	F O B	36.75	36.00	35.25	36.25	41.50	42.00	45.00	49.00	60.00	63.00	65.00	67.00
	COMPOSITE	36.50	36.50	35.17	36.17	37.83	38.50	38.17	36.90	43.83	48.50	50.83	48.17
1973	F O B	69.50	71.00	73.50	78.00	83.00	87.00	93.00	98.00	100.00	125.00	140.00	140.00
	COMPOSITE	47.17	50.50	54.17	53.83	56.50	60.83	69.83	81.83	77.83	92.50	112.50	131.00
1974	F O B	150.00	150.00	155.00	160.00	155.00	155.00	135.00	120.00	100.00	82.00	90.00	95.00
	COMPOSITE	127.71	99.04	110.21	128.21	117.10	114.42	119.16	101.17	80.25	77.76	79.25	85.17
1975	F O B	105.00	95.00	93.00	88.00	85.00	83.00	71.00	69.00	77.00	88.00	97.00	103.00
	COMPOSITE	86.00	82.37	69.08	58.20	60.58	74.83	63.23	58.50	63.70	72.17	78.08	85.09
1976	F O B	103.50	89.00	90.00	91.50	84.50	74.50	64.50	70.00	73.00	75.00	75.00	75.00
	COMPOSITE	92.37	83.75	83.25	87.77	81.00	70.57	64.00	63.17	68.17	72.17	72.17	73.36
1977	F O B	70.00	65.50	63.50	62.00	61.50	60.00	57.00	56.00	70.00	75.00	82.50	86.00
	COMPOSITE	71.92	66.00	62.03	61.25	61.50	59.23	49.92	47.83	59.16	70.33	71.50	74.16
1978	F O B	86.00	82.00	85.00	88.00	88.00	88.00	102.50	107.00	113.00	130.00	136.50	131.00
	COMPOSITE	76.08	72.09	73.50	77.83	86.49	72.92	73.25	82.96	89.91	96.08	108.08	118.76
	C & F	104.00	102.00	106.00	108.50	109.50	110.50	125.00	130.50	136.50	152.50	159.50	157.00
1979	F O B	115.30	111.00	112.00	110.00	107.00	104.00	110.00	119.00	120.00	126.00	129.00	124.00
	COMPOSITE	101.66	98.83	110.83	96.91	90.83	88.09	86.91	91.76	93.41	99.10	105.00	102.08
	C & F	143.50	145.00	150.00	147.00	142.00	139.30	147.20	156.50	158.00	161.00	167.00	163.00
1980	F O B	108.00	96.00	95.00	104.00	110.00	106.50	104.50	104.50	103.50	98.50	96.00	95.00
	COMPOSITE	95.91	78.56	69.33	75.10	84.41	94.00	95.92	98.50	102.08	98.25	99.50	105.09
	C & F	152.00	140.00	137.20	146.00	149.50	145.50	145.50	148.00	146.50	137.00	135.00	133.00
1981	F O B	92.00	89.80	83.00	82.50	81.50	79.00	76.00	79.00	83.00	90.00	91.00	88.00
	COMPOSITE	102.57	95.42	89.17	90.17	95.33	91.33	82.57	75.66	76.23	84.33	82.17	77.75
	C C & F	127.00	125.80	119.00	115.00	111.50	108.00	106.00	105.50	108.00	115.00	113.00	113.00
1982	F O B	83.00	80.00	73.00	76.00	80.00	75.00	70.00	67.00	70.00	73.00	80.00	85.00
	COMPOSITE	71.70	62.67	58.33	56.16	55.74	56.23	52.90	51.25	52.30	59.92	67.91	73.49
	C & F	111.00	108.00	98.00	98.00	98.00	93.00	90.00	88.00	91.00	98.00	105.00	110.00
1983	F O B	81.00	78.00	81.00	82.00	82.00	85.00	87.00	88.00	93.00	100.00	105.00	100.00
	COMPOSITE	71.00	67.00	70.76	71.75	75.03	77.17	77.66	80.09	86.70	93.17	95.17	91.83
	C & F	108.00	103.00	105.00	102.00	102.00	105.00	108.00	110.00	115.00	120.00	126.00	122.00
1984	F O B	97.00	98.00	97.00	96.00	97.00	100.00	97.00	93.00	93.00	94.00	94.00	93.00
	COMPOSITE	90.17	89.24	83.16	82.17	82.10	85.00	82.90	79.08	78.75	80.83	83.16	86.75
	C & F	117.00	119.00	117.00	115.00	117.00	121.00	117.00	114.00	114.00	114.00	113.00	112.00
1985	F O B	89.00	81.00	80.00	85.00	85.00	84.00	85.00	85.00	86.00	88.00	88.00	88.00
	COMPOSITE	80.17	70.97	66.34	68.41	73.57	72.75	71.17	68.83	69.75	73.34	75.50	74.08
	C & F	108.00	100.00	98.00	102.00	101.00	99.00	102.00	103.00	104.00	105.00	104.00	102.00
1986	F O B	87.00	82.00	82.00	83.00	84.00	83.00	80.00	80.00	81.00	80.00	79.00	78.00
	COMPOSITE	73.42	71.50	70.83	71.70	75.08	74.50	73.17	74.17	74.23	76.00	77.09	74.56
	C & F	100.00	95.00	94.00	95.00	96.00	97.00	96.00	96.00	96.00	96.00	94.00	94.00

Source : The Japan Iron and Steel Federation

Note : Price Based on No.1 HMS.

Steel Scrap Export by USA to World

(Unit : 1,000M·T)

C·Y / Country	1969	1970	1971	1972	1973	1974	1975	1976	1977
Japan	3,827 (64.0%)	4,736 (50.4%)	1,587 (24.1%)	2,110 (31.5%)	4,248 (41.6%)	2,703 (34.2%)	2,181 (24.7%)	1,141 (15.5%)	947 (16.9%)
S·Korea	503 (6.0%)	775 (8.2%)	269 (4.1%)	412 (6.2%)	778 (7.7%)	691 (8.7%)	717 (8.1%)	867 (11.8%)	1,397 (25.0%)
Taiwan	89 (1.1%)	137 (1.5%)	392 (6.0%)	399 (6.0%)	745 (7.3%)	495 (6.3%)	276 (3.1%)	276 (3.7%)	405 (7.2%)
Spain	938 (11.3%)	1,047 (11.1%)	554 (8.4%)	659 (9.8%)	1,024 (10.1%)	813 (10.3%)	1,566 (17.8%)	1,695 (23.0%)	715 (12.8%)
Italy	820 (9.9%)	447 (4.8%)	534 (8.1%)	650 (9.7%)	321 (3.1%)	439 (5.6%)	556 (6.3%)	657 (8.9%)	189 (3.4%)
Canada	559 (6.7%)	646 (6.9%)	807 (12.3%)	821 (12.3%)	737 (7.2%)	858 (10.9%)	628 (7.1%)	808 (11.0%)	474 (8.5%)
Mexico	546 (6.5%)	775 (8.2%)	529 (8.0%)	564 (8.4%)	954 (9.3%)	850 (10.8%)	1,187 (13.5%)	540 (7.3%)	311 (5.5%)
Argenchin	–	5 (–)	57 (0.8%)	209 (3.1%)	237 (2.3%)	135 (1.7%)	312 (3.5%)	82 (1.1%)	115 (2.0%)
	1,042 (12.5%)	835 (8.9%)	1,854 (28.2%)	873 (13.0%)	1,167 (11.4%)	904 (11.5%)	1,404 (15.9%)	1,301 (17.7%)	1,049 (18.7%)
Total	(100.0%)	9,403 (100.0%)	6,583 (100.0%)	6,697 (100.0%)	10,211 (100.0%)	7,888 (100.0%)	8,827 (100.0%)	7,367 (100.0%)	5,602 (100.0%)

C·Y / Country	1978	1979	1980	1981	1982	1983	1984	1985	1986
Japan	2,894 (34.4%)	2,651 (26.2%)	2,575 (25.4%)	1,080 (18.2%)	1,388 (22.4%)	2,358 (34.6%)	2,431 (28.2%)	1,915 (21.3%)	1,565 (14.8%)
S·Korea	1,364 (16.2%)	1,287 (12.7%)	1,575 (15.5%)	1,126 (19.0%)	1,381 (22.3%)	1,340 (19.6%)	1,663 (19.3%)	1,795 (19.9%)	2,712 (25.5%)
Taiwan	357 (4.2%)	575 (5.7%)	898 (8.8%)	324 (5.5%)	319 (5.1%)	453 (6.6%)	367 (4.3%)	375 (4.2%)	604 (5.7%)
Spain	675 (8.0%)	1,269 (12.5%)	1,055 (10.4%)	393 (6.6%)	787 (12.7%)	323 (4.7%)	552 (6.4%)	825 (9.2%)	611 (5.8%)
Italy	595 (7.1%)	1,076 (10.6%)	827 (8.1%)	31 (0.5%)	11 (0.2%)	59 (0.9%)	278 (3.2%)	279 (3.1%)	277 (2.6%)
Canada	939 (11.1%)	883 (8.7%)	717 (7.0%)	764 (12.9%)	279 (4.5%)	489 (7.2%)	707 (8.2%)	405 (4.5%)	333 (3.1%)
Mexico	409 (4.9%)	739 (7.3%)	1,052 (10.3%)	820 (13.8%)	344 (5.5%)	380 (5.6%)	439 (5.1%)	541 (6.0%)	288 (2.7%)
Argenchin	–	7 (0.1%)	–	–	–	–	–	–	–
	1,184 (14.1%)	1,643 (16.2%)	1,474 (14.5%)	1,385 (23.5%)	1,697 (27.3%)	1,420 (20.8%)	2,180 (25.3%)	2,874 (31.9%)	4,228 (39.8%)
Total	8,417 (100.0%)	10,130 (100.0%)	10,173 (100.0%)	5,923 (100.0%)	6,206 (100.0%)	6,822 (100.0%)	8,617 (100.0%)	9,009 (100.0%)	10,618 (100.0%)

Source : U.S. Department of Commerce-Mineral industry report

Steel Scrap Export on Grade by USA

(Unit : 1,000M·T)

Grade / Year	1978	1979	1980	1981	1982	1983	1984	1985	1986
Stainless steel scrap	104	102	107	160	119	73	149	163	167
№1 heavy melting scrap	2,143	2,447	2,637	1,457	1,708	1,719	2,279	2,509	2,651
№2 heavy melting scrap	759	1,013	968	561	567	653	797	696	723
№1 baled steel scrap	134	132	108	37	139	187	70	168	141
№2 baled steel scrap	296	591	285	247	164	199	259	277	256
Shredded steel scrap	2,435	2,703	3,015	1,745	1,870	1,841	2,517	2,311	3,170
Borings shovelings and turnings	672	807	698	441	523	483	726	794	663
Other steel scrap	1,480	1,762	1,645	820	763	1,390	1,285	1,487	1,857
Iron acrap	394	573	710	455	353	277	535	604	990
Total acrap	8,417	10,130	10,173	5,923	6,206	6,829	8,617	9,009	10,618

Source : U.S. Department of Commerce

C World scrap prices

There is no data for universal comparison of scrap price in the world. There are many patterns according to scrap grades and distribution channel varies among different countries. Therefore it should be kept in mind that the standard, average price trend shown in attached sheet shows only a general trend.

The trend of import price of semi-finished products is also given in attached sheet, but basically selling price of semis is not determined by the factor including the sum of production cost. It is determined inversely from the price of product which is produced from the semis by taking into consideration the yield of the final products, and so it is characterized by the fact that the price so determined will not necessarily be higher than the production cost of the semis.

Likewise, export price is naturally affected greatly by international market price level and there are many cases where export is viewed as coordinating factor or buffer of overall production flow (material balance) of steelmakers in many countries.

Steel Scrap Price on Selected Countries

Country / C・Y	Japan Average price Japanese yen	Japan Average price $	Japan High Low Japanese yen	U S A $	W-Germany $	United Kingdom $	Italy $	France $
1955	19,850	55.1	24,300 ~ 15,100	39.6	34.4	21.8	—	—
1956	29,180	81.1	35,300 ~ 23,500	53.0	40.5	27.2	—	41.0
1957	25,630	71.2	34,900 ~ 14,300	46.0	42.5	29.9	—	43.0
1958	17,010	47.3	18,500 ~ 15,200	37.5	44.1	31.5	—	34.0
1959	20,230	56.2	20,700 ~ 19,100	39.9	37.4	31.5	—	36.0
1960	19,220	53.4	20,300 ~ 18,500	32.4	42.0	31.5	—	41.0
1961	20,960	58.2	23,700 ~ 18,800	35.7	39.0	31.5	44.0	39.0
1962	14,430	40.1	18,100 ~ 11,100	27.8	36.0	31.5	43.0	34.0
1963	15,940	44.3	17,100 ~ 14,800	26.7	29.0	31.5	38.0	30.0
1964	16,270	45.2	17,350 ~ 15,200	33.1	29.0	31.0	40.0	26.0
1965	17,230	47.9	18,090 ~ 15,790	33.8	29.0	31.0	47.0	28.0
1966	16,690	46.4	17,500 ~ 15,630	30.4	31.0	31.4	41.0	26.0
1967	17,630	49.0	19,170 ~ 15,470	27.2	29.0	31.0	40.0	23.0
1968	14,430	40.1	15,420 ~ 12,990	25.4	31.0	31.0	41.0	25.0
1969	16,920	47.0	19,060 ~ 14,020	30.3	31.0	31.0	36.5	28.0
1970	19,730	54.8	24,250 ~ 15,010	40.5	38.0	31.6	44.8	34.8
1971	13,310	37.0	16,230 ~ 9,560	33.6	30.0	33.7	41.6	33.0
1972	13,700	44.5	16,250 ~ 12,590	36.3	41.9	31.0	39.6	22.5
1973	24,500	89.8	34,530 ~ 17,830	57.0	56.2	33.5	37.8	40.2
1974	38,600	132.5	46,100 ~ 26,640	106.8	112.1	53.1	96.4	78.1
1975	24,200	81.6	29,900 ~ 16,200	70.7	64.8	52.2	126.6	84.9
1976	26,300	88.5	29,200 ~ 21,600	76.6	84.7	57.4	71.4	54.1
1977	21,000	77.6	25,300 ~ 16,900	62.2	83.1	49.0	76.6	51.4
1978	23,400	110.3	25,200 ~ 19,700	77.4	90.3	67.3	72.7	58.9
1979	27,300	124.6	32,500 ~ 25,300	96.3	120.0	106.7	114.3	83.4
1980	30,900	135.6	36,900 ~ 25,500	89.9	132.0	89.3	169.1	92.4
1981	24,000	108.8	26,100 ~ 22,800	90.1	79.6	69.8	121.2	71.7
1982	23,600	94.8	25,400 ~ 22,100	62.4	94.8	60.9	91.2	62.4
1983	23,600	99.4	24,100 ~ 22,900	72.7	70.5	65.4	55.6	38.0
1984	24,800	105.0	26,900 ~ 22,900	84.8	91.3	65.2	81.1	…
1985	23,600	98.5	27,100 ~ 20,000	73.2	…	…	…	…
1986	14,300	82.2	18,800 ~ 12,000	72.3	…	…	…	…

Notes: Japan — Average of price of prime grade ordinary carbon steel for melting delivered to plants in Tokyo, Osaka and Nagoya areas. (Source: Japan Scrap Importers' Association)
U.S.A. — Annual average of price of No.1 heavy melting scrap delivered to plants in Pittsburgn, Chicago and Philadelphia areas. (Source: Iron Age Annual Issue)
W. Germany — Statiches Jahrbuch, Class 03 from '72, Class 0 from '74 and Class 02 from '77
U.K. — Heavy melting scrap, delivered to plants on the northeast coast, 500 t or more (UN Monthly Bulletin of Statistics)

Figures up to 1984 are those collected by JISF based on statistics of respective countires.

Semi-Products Import to Japan by Years and its Price Trends

(Unit:M·T 1,000J. yen)

F·Y	Bloom		Billet		Slub		Total Import
	Import	Price	Import	Price	Import	Price	
1972	29,703	23	3,958	31	140	81	33,801
1973	15,008	58	4,632	43	3,589	47	23,229
1974	24,034	69	9	171	0	—	24,043
1975	19,944	52	27,343	50	60	101	47,347
1976	128,374	42	109	62	0	—	128,483
1977	95,065	38	1,023	36	36,763	47	132,851
1978	52,221	36	119,755	46	45,770	35	217,746
1979	170,279	54	193,030	59	133,427	50	496,736
1980	89,854	61	73,966	59	237,692	56	401,512
1981	0	—	53,269	55	124,608	53	177,877
1982	3	—	30,746	49	63,906	53	94,655
1983	7,427	49	91,599	46	20,749	48	119,775
1984	37,721	47	42,805	50	161,131	47	241,657
1985	28,744	41	43,785	44	347,108	42	419,637
1986	51,420	28	18,893	37	206,312	30	276,625

Source : Ministry of Finance of Japanese Government

Note : Unit Price (Semi-Product/M·T) is CIF Price.

ANNEX IV Development Patterns and Their Features of Steel Industry in Developing Countries

Development stage	Pattern	Feature	Remarks	Actual Examples
I	Import satisfies steel demand.	Import of finished steel products	As the economy progresses, steel demand increases in quantity and kinds. Import acts as market study and when it reaches a level, it motivates home production.	Majority of developing countries up to a certain period after the second World War and Guatemala, Honduras, Nicaragua, Nepal, Singapore, Costa Rica, Malaysia in 1950s.
II-1	Import and partly home production satisfy demand.	Start of production of final (processed) products and rerollers lead to EAF & rolling mills.	Production begins of tinplate, G.I.sheet, small pipe, wire drawing, re-rolled bars (some flat bars) and progresses to EAF & rolling mills making mainly bars. Import of cold pig for EAF and pencil ingot for rolling begins. Also import of black sheet (for tinplate and G.I. sheet)	Nepal, Indonesia, Thailand, Philippines Malaysia in 1960s.
II-2	Import and production of major steel products in demand (Full scale production of crude steel)	Time is ripe for selection of backward method or forward method for expansion of basic steel industry. If forward method, EAF, DR or B.F. based process to be selected. Primary object is substitution of import.	It is difficult to distinguish II-1 from II-2. Pattern varies according to demand level, forecasted growth and available domestic resources. At this stage, developed steelmaking countries begin competitive proposal for assistance and projects materialize and continue.	Indonesia, Philippines, Mexico, Venezuela in 1970s and Saudi Arabia from end of 1970s to early 1980s.

ANNEX IV Development Patterns and Their Features of Steel Industry in Developing Countries (Cont'd)

Development stage	Pattern	Feature	Remarks	Actual Examples
III	Import and expansion of home production in kind and quantity, and start of pig iron sponge iron production.	Construction of integrated steel mills, its object changing from substitution of import to export (if iron & steel resources available at home). Basically to fill home demand and add value to home resources (Tubarao) One mil.t.(crude steel) demand forecasted in the near future.	By progress from II to III, selection of forward or backward method intensifies. Natural gas and other factors enable DR based steel mill. Generally success of construction depends on availability of favorable fund form abroad. Economic progress takes from seen in developed countries with takeoff period already behind.	S. Korea: Pohang Steel Taiwan: China Steel Brazil: 3 major state-owned steel companies Venezuela: DR based steel mill Argentina: B.F. based steel mill Mexico: B.F. based steel mill
IV	High grade products imported, but other grades are in full production with gradually moving to high grades.	Export of steel products (incl. semis) begins to the world market. Integrated steel mills with optimal capacity scale appear and home demand is mostly covered.	Expansion of integrated steel mills is now possible domestically and rate of domestic equipment rises condiserably.	South Korea: Kwangyang project Taiwan: 3rd phase expansion of China Steel Co. Brazil: 3 major state steel companies and CST

ANNEX IV Development Patterns and Their Features of Steel Industry in Developing Countries (Cont'd)

Development stage	Pattern	Feature	Remarks	Actual Examples
V	All grades of steel products produced as in developed steel-making countries	Full-fledged steel industry based on integrated steel mills. Competition likely from developing countries who are late comers in steel.	Technologically, much progreas in catch-up with existing technologies, but problems facing developed steel-making countries (environmental, labor, and market) (export friction) appear and difficulty in export-dependent expansion, necessity of developing own technology. With progress of the economy, home demand diversifies and needs high quality. Export difficult to markets in developed countries as they become protective.	Most integrated steel mills in newly industrialized developing countries fall in this pattern. South Korea: Pohang & Kwangyang China: Baoshan

Note: The above historical development patterns show standard model patterns in the past, and some oil-producing with ample fund available directly enter into the stage of construction of an integrated steel mill based on DR process without treading the above stages.

Sources: H. Toda, Steel Industry in Asia, 1970; Steel Industry in Latin America, 1972; Steel Industry in Africa, Aug. 1972; Institute of Developing Economies, and author's experience and results of interviews with local officials when he participated in study missions such as Southeast Asia Steel Study Mission and West Asia Steel Study Mission of UN ECAFE (now ESCAP) and various studies by the Japanese Government (JICA)

ANNEX V Cold Drawing Plant

Introduction

A study was made about products which can be added to the present product mix by the expansion project of ANSDK's El Dikheila Works.

At present, ANSDK produces bar and rod (re-bar). Therefore, any kind of products which can be added to the present product mix is confined to that produced by using the existing facilities, or the so-called secondary processed products of wire rod.

Sufficient data on demand structure, needs and market price of the secondary processed products of wire rod could not be obtained by the F/S mission. Therefore the product mix indicated in this ANNEX is only a base for discussion and does not reflect the market condition. The price of the product is assumed on sliding scale based on Japan's market price. Economic analysis shows the result of such analysis according to the above premises.

Therefore, decision on the construction of the wire drawing plant should be made based on the full-scale market research prior to the basic engineering study.

(1) Premises

In studying a wire drawing plant for ANSDK, the following conditions were made premises in the study.

1) Kinds of products produced by ANSDK

Generally, the secondary processed products of wire rod (drawn wire) are often closely related to the production of subsequent processed products (final products).

Though the secondary processing is of relatively mass-production type, the subsequent processing is small-lot production and requires special equipment.

Table 1 shows the production flow of wire rod products. The products to be produced by ASNDK are to be mainly the secondary processed products ((A) Process) with the subsequent processed products ((B) Process) excluded so that they can be produced by simple manufacturing method.

As mentioned above, Table 2 shows recommendable steel grade of ANSDK and gives the problems in improving the quality of steel.

2) Ladle furnace and low oxygen and Si control

In order to prevent blow holes on the surface of billet, the total oxygen in steel needs to be kept below 50 ppm. In addition, si is an element to decrease drawability. For this reason, it is desirable to hold si content in low carbon steel at 0.10% or less.

For this composition control, ladle furance must be installed.

3) EMS (Electromagnetic stirrer) for CC-Mold

Mold EMS is effective for preventing surface blow holes of billets; namely, by rotating molten steel horizontally in a mold, occurrence of blow holes is reduced.

4) CC-Seal casting

CC-Mold size is of small cross section of 130x130 mm. Therefore it is difficult to use submerged nozzle for the mold. When submerged nozzle is not used, shrouded casting should be employed to prevent oxidation of molten steel during casting.

5) Low nitrogen and impurities control

Nitrogen is a detrimental element to lessen drawability. Nitrogen in molten steel which is produced in EAF from 100% scrap charge is 90-100 ppm, which makes the steel poor in drawability.

Therefore, elements such as Al, Ti and B are added to change free nitrogen to stabilized nitrogen (AlN, TiN or BN), thus reducing free nitrogen to 40-50 ppm.

Besides, existence of impurities such as Cu, Ni and Cr, if high percentage, is detrimental and in general scrap with least impurities is selected and used.

When DRI is used 80% or more in EAF of ANSDK, the pure chemical contents as shown below has been obtained.

Such figures should be kept for rod for cold drawing in future as well.

- Total nitrogen = 50.5 ppm (n=12)
- Cu = 0.035 % (n=282)
- Ni = 0.019 % (ditto)
- Cr = 0.012 % (ditto)

n = Number of data
Study period = 1987

6) Billet surface conditioning

It is desirable to avoid installation of large equipment for billet surface conditioning.

As such facilities, torch gas scarfing instrument (hand scarfing) is to be installed and simple sampling inspection through check scarfing should be comployed for inspection.

Namely, of about 35 pieces of billets (70 t/heat divided by 2 t/billet = 35 billets/heat), 4 billets are sampled and inspected for blow holes by check scarfing.

The result is used for determining quality of billets cast from the heat, and the billets from rejected heat are directed for re-bar production.

The reason why such simple inspection is employed is that the use of the product, billet, is confined to rod for general use. If the product is used for wire rod and bar (diameter 20 mm or more) with severe specification, then full-scale billet conditioning equipment must be installed. Namely, shot blast, magnetic particle inspection facility, and machine grinding facility must be installed on-line and also a building for those facilities built.

7) Installation of descaler in Rod mill line

A descaler should be installed between the reheating furnace and No.1 stand of roughing train to remove scale.

8) Cold drawn minimum size

Cold drawn minimum size is to be 2 mm. Wire with diameter smaller than this is considered to cause breaking during drawing operation.

9) Control cooling on Stelmor conveyor

For coil of C content 0.4% or more, proper controlled cooling should be applied on Stelmor conveyor.

10) Study of literature of other companies

The following literatures will provide significant information to ANSDK.

a) Wire Journal International - Sept. 1982
"Raritan Rivers approach to producing quality rods"
EAF = 140 t, CC-Billet = 130 x 130 mm
AISI = 1006 - High carbon Dia. = 5.5 - 17 mm

b) Iron and Steel Engineer - March 1987
"Laclede Steel - A resilient special steel producer"
EAF = 225 t, Ingot & CC-Billet = 180 x 180 mm
AISI = 1008 - 1080 Size = 5.5 - 15 mm ø

(2) Market research

Secondary processed products of wire rod involve rather complicated processing and the kind of final products is many and varied. Namely, it is necessary to conduct market research on names of users, uses, quantity, price, kind of steel and required quality (specification) of the final products.

Also it is necessary to study actual condition of their production including processing companies, their production, cost, processes employed, kind of steel, level of quality and suppliers of material (import or domestic production).

Those information could not be obtained during the F/S this time. They should be fully studied in considering construction of the facilities.

(3) Production plan

1) Product mix

Table 2 shows the product mix.

As mentioned before, the product mix may not conform to the market demand and it is necessary to conduct detail study of the market and revise Table 2.

2) Annual working time

Table 3 shows annual working time.

In principle, the plant is to be operated on 3 shifts with meal time concurrent for all the workers.

3) Calculation of production capacity

Capacity of each equipment is calculated and shown in the following table.

3-1 Coil surface treatment facilities
3-2 Wire drawing machine
3-3 Pot annealing furnace
3-4 Galvanizing line
3-5 Nail machine
3-6 Barbed wire machine

(4) Plant layout

Fig. 1 shows the layout of plant.

(5) Construction cost

Outline of the construction cost is as follows:

5-1) Equipment cost (CIF)	$5,529,450
5-2) Inland transportation & installation cost	$1,122,000
5-3) Civil eng. & building works cost	$3,500,000
5-4) Engineering cost	$ 500,000
5-5) Contingency cost	0
Total	$10,651,450

(6) Personnel

Table 5 shows the number of personnel required.

(7) Estimation of cost

1) Base consumption units of operation (Consumables)

Table 6 shows unit consumption of operation.

2) Production cost

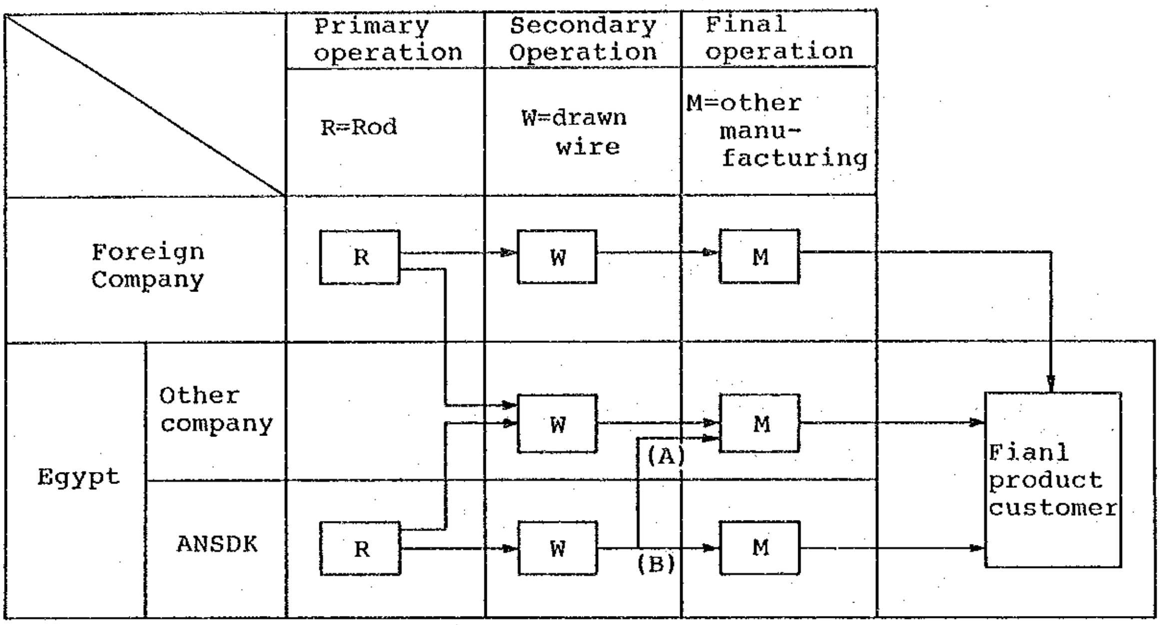
Based on the study, the production cost will be estimated as follows. (full operation base, 1993)

Cold drawn wire	$233.2/ton
Annealed wire	$266.5/ton
Wire for spring, rope	$239.9/ton
Nail	$270.2/ton
Galvanized wire	$320.2/ton
Barbed wire	$333.5/ton

3) Selling price

The selling prices in Egypt could not be obtained. For reference the selling prices of the products are shown on Table 7.

Table 1. Production flow of wire rod products



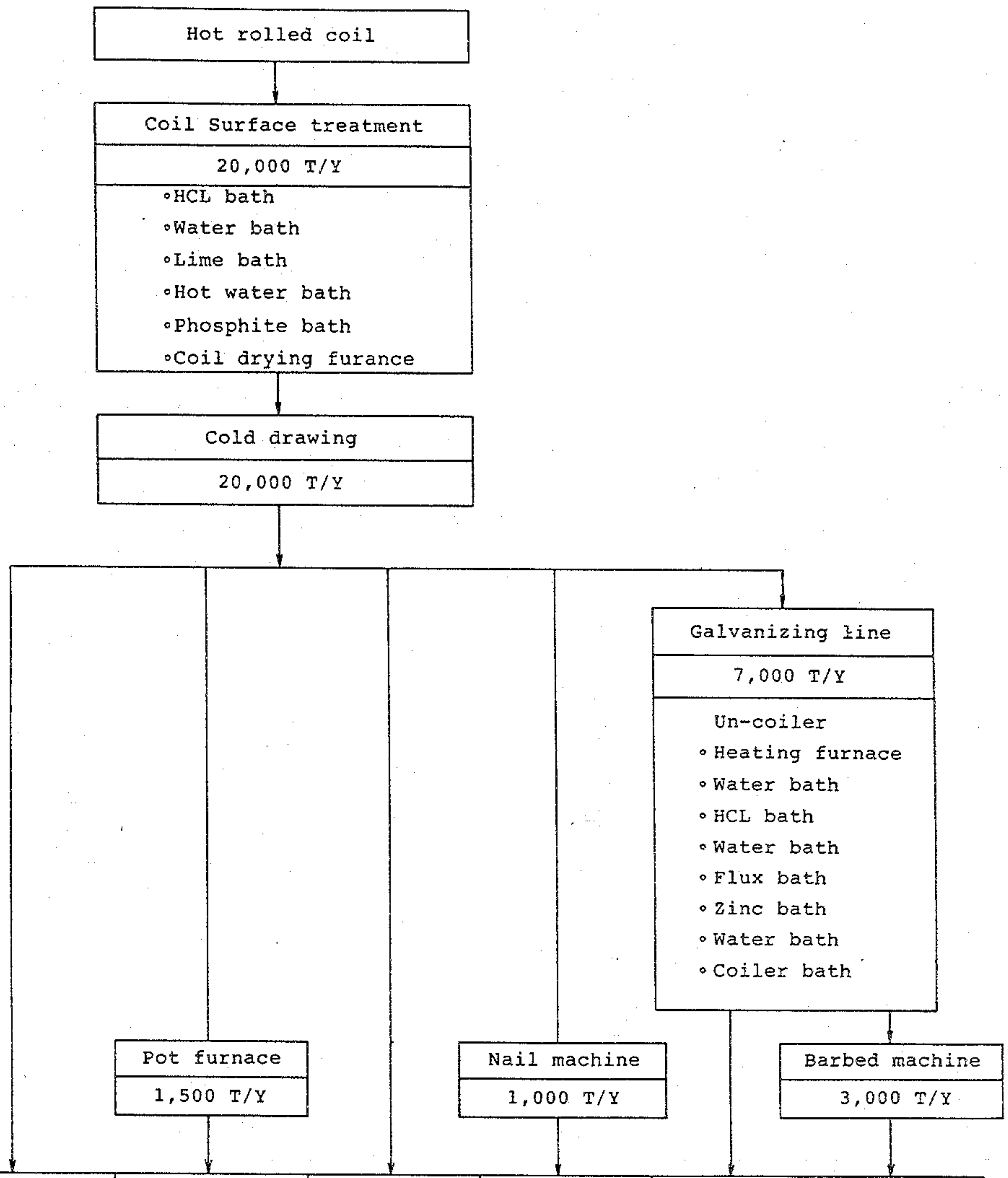
Products of (A) process

1) Cold drawn low C% wire
2) Cold drawn high C% wire
3) Galvanized wire

Products of (B) process

1) Annealed wire
2) Nail
3) Barbed wire

Table 2 Product Mix



Wire	Cold drawn wire	Annealed wire for binding	Wire for spring, rope	Nail	Galvanized wire	Barbed wire
C% content	≒ 0.07%	≒ 0.07%	≒ 0.60%	0.07 0.20%	≒ 0.07%	≒ 0.07%
Quantity (T/Y)	9,500 2ϕ = 3,000 2ϕ = 3,000 4ϕ = 1,500 5ϕ = 1,000 6ϕ = 1,000	1,500 2ϕ = 800 3ϕ = 700	1,000 2ϕ = 1,000	1,000 2ϕ = 300 3ϕ = 300 4ϕ = 200 5ϕ = 200	4,000 2ϕ = 1,000 3ϕ = 2,000 4ϕ = 1,000	3,000 2ϕ = 3,000
Final Usage (⊙ = final product)	• General structual • Welded chain • Electrode • Bolt, Nut	⊙	• Bed, chair car seat spring • Wire rope	⊙	• Fence net, • Barbed wire	⊙
Price (LE/T)						
		(80,000)		(70,000)	(80,000)	(160,000)

Table 3 Annual working time

No.	Item			Remarks
①	Calender time	Hr	8,760	365D x 24H
②	Scheduled shut-down time			
	Weekly maintenance	Hr	1,248	52D x 24H
	Annual maintenance	Hr	312	13D x 24H
	Meal	Hr	900	300D x 3H
	Total		2,460	
③	Working time	Hr	6,300	① - ②
④	Effective working ratio	%	70	
⑤	Effective working time	Hr	4,410	③ x ④

Table 4.1 Coil surface treatment

		HCL bath	Water bath	Lime bath	Hot Water bath	Phos-Phate bath	Drying furnace
Capacity	T/bath	2	2	2	2	2	2
Unit Working Time	Min/ bath	40	3	5	10	10	20
Number of Facilities	No	2	2	1	1	1	1
Productivity	T/H	6	40	24	12	12	6
Production	T/Y	20,000	20,000	20,000	20,000	20,000	20,000
Total Working Time	H/Y	3,333	500	833	1,666	1,666	3,333
Total Working Day	D/Y	300	300	300	300	300	300
Number of Shift Required	Shift	3,333÷ (7x300) =1.6 ⇒ 2	2	2	2	2	2

Table 4.2 Wire Drawing Equipment

Diameter Product	Diameter Material	Sectional Area	Number of Pass	Drawing Speed	Efficiency T/H	Production	No. of Machine Calculation		By Type of Machine
mm	mm	mm^2	(*)	m/min.		T/Y			
		(1)		(2)	(1) x (2) x K(**) = (3)	(4)	(4) ÷ ((3) x 4,410))		
2.0	5.5	3,141	9 (H.C)	600	$3.141 x 600 x 471 x 10^{-6} = 0.887$	9,100	9,100÷(0.887x4,410)=2.37		A(H.C)x1
3.0	5.5	7.065	7 (L.C) 5 (L.C)	400	$7.065 x 400 x 471 x 10^{-6} = 1.331$	6,000	6,000÷(1.331x4,410)=1.02	4	B(L.C)x3
4.0	5.5	12.56	3 (L.C)	250	$12.56 x 250 x 471 x 10^{-6} = 1.478$	2,700	2,700÷(1.478x4,410)=0.41		
5.0	6.0	19.62	2 (L.C)	100	$19.62 x 100 x 471 x 10^{-6} = 0.924$	1,200	1,200÷(0.924x4,410)=0.29	1	C x1
6.0	8.0	28.26	2 (L.C)	95	$28.26 x 95 x 471 x 10^{-6} = 1.264$	1,000	1,000÷(1.264x4,410)=0.18		
						20,000		5	5

Notes: (*) H.C = High carbon steel, L.C = Low carbon steel

(**) K = Sectional area of product (mm^2) x drawing speed (m/minute) x specific gravity (T/mm^3)

= 1 (mm^2) x 60 x 10^3 (mm/hour) x 7.85 x 10^{-9} (T/mm^3)

= 471 x 10^{-6} T/H

Table 4.3 Pot annealing furnace & slow cooling furnace

No.	Item	Specification
1	Capacity	2 T/pot
2	Hours/cycle	8 hours
	∘ Heating	2.0 hours
	∘ Soaking	4.0 hours x 780°C
	∘ Slow cooling	1.5 hours
	∘ Transfer to slow cooling pot & next coil charging	0.5 hours
3.	Working efficiency	2 T/pot ÷ 8 h/pot = 0.25 t/h
4	Annual working time	4,410 h/y
5	Products Q'ty	1,500 t/y
6	Number of pots required	1,500 t/y ÷ (0.25t/hx4,410t/y) = 1.4 = 2 pots
7	No of slow cooling pits	2 pits

Table 4.4 Galvanizing Line

Number of running wires = 50 wires

Dia	Area		Running speed		Productivity	Quantity	Working hours
	Single wire	50 wires					
mm	mm²	mm²	m/Min	mm/H	T/H	T/Y	H/Y
		①		②	③=①x②xG	④	④÷③
2	3.141	157.0	19	1140x10³	1.404	4,000	2,849
3	7.065	353.2	11	660x10³	1.830	2,000	1,092
4	12.56	628	8	480x10³	2.366	1,000	422
						7,000	4,363

$G = 7.85 \times 10^{-9}$ T/mm³

No of line

4,363(T/Y) ÷ 4,410(T/Y) = 0.99 → 1 line

Table 4.5 Nail Machine

(1) Nail Machine

Dia mm	Production T/Y	Productivity T/H	Number of Nail Machine: Calculation	Number of Nail Machine: Total	
	①	②	① ÷ (② x 4,410H)		
5	200	0.160	200÷(0.16x4,410)=0.3	1	MTG-F
4	200	0.120	200÷(0.12x4,410)=0.4	1	MTG-D
3	300	0.070	300÷(0.07x4,410)=1.0	1	MTG-C
2	300	0.020	300÷(0.02x4,410)=3.4	3	MTG-B
Total	1,000			6	

(2) Polishing Machine 1

2.5 Hr/bbl ÷ 1.4 T/bbl = 1.8 T/Hr

1,000 T/Y ÷ (1.8 T/Hr x 4,410 Hr/Y) = 0.1

Table 4.6 Barbed wire machine

1.	Production rate	150 kg/h (2.0 mm)
2.	Products Q'ty	3,000 t/h
3.	Annual working time	4,410 h/y
4.	No of machine	3,000 t/y ÷ (0.15t/h x 4,410h/y) = 4.5 = 5 machine

Table 5 Number of Personnel Required

No.	Job	Per shift	No of shift	Relief	Sub-total
1	Rod surface cleaning line, (1 line) Receiving & stock control Pickling (HCl bath) Water bath Lime bath Phosphate bath Drying	2	2		4
2.	Wire drawing equipment (5 units)	5	3		15
3	Annealing furnace (2 pots)	1	3		3
4	Galvanizing line (1 line)	5	3		15
5	Nail machine (6 units)	3	3		9
6	Barbed wire machine (5 units)	4	3		12
7	Product shipping & stock control	2	3		6
8	Foreman	1	1		1
9	Relief			2	
	Sub-total	25		2	69
	Total				71

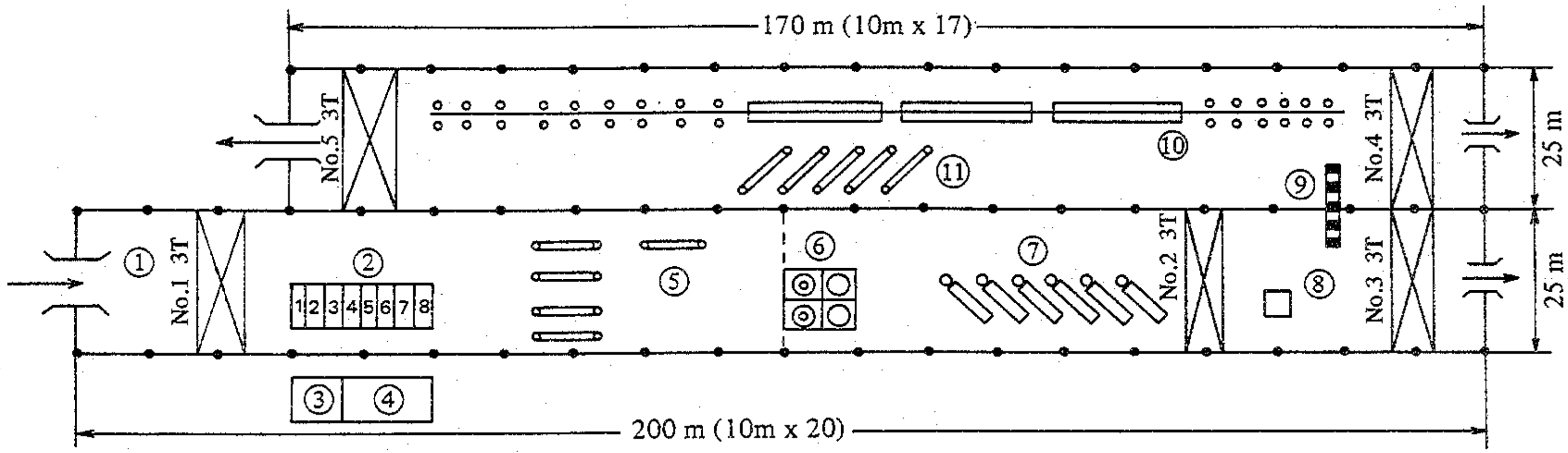
Table 6 Consumable

No.	Item	Unit Comsumption		Unit Price	Product-ion Q'ty	Consump-tion Q'ty
		Unit/t		¥/Unit	t/y	1,000 ¥/y
		1		2	3	1 x 2 x 3
1	Rod surface treatment					
	∘ Hydrochloric acid	25	kg	17	20,000	8,500
	∘ Water	3	m^3	14	20,000	840
	∘ Lime	1.5	kg	39	20,000	1,170
	∘ Phosphate	4.0	kg	250	1,000	1,000
	∘ Heavy oil for rod drying	15.0	ℓ	25	20,000	7,500
	∘ Lime (for waste neutralization)	5	kg	39	20,000	3,900
2	Wire drawing					
	∘ Electric power	100	kWh	17	20,000	34,000
	∘ Water	1	m^3	14	20,000	280
	∘ Lubricant (dry)	0.5	kg	400	20,000	4,000
3	Pot annealing f'ce					
	∘ Heavy oil for combustion	85	ℓ	25	20,000	4,250
4	Galvanizing line					
	∘ Heavy oil for wire heating	45	kg	25	7,000	7,875
	∘ Water	3	m^3	14	7,000	294
	∘ Hydrochloric acid	20	kg	17	7,000	2,380
	∘ Flux					
	∘ Zinc	62	kg	140	7,000	8,400
5	Electric power in common	50	kWh	17	20,000	17,000
	Total					101,389 = 675,927 $/y

Table 7 Products price in Japan

	Japan	
	Ex-mill Price	Delivered Price
Data source	Hearing to mill Sales Dept. A	Tekko shinbun August-6-87
	¥/t (Ave)	¥/t
Defomed bar SD30 10 mm	36,000 - 37,000 (36,500)	39,000 - 40,000
Drawn wire 4.0 mm	65,000 - 75,000 (70,000)	81,000 - 82,000
Annealed wire 3.2 mm	64,000 - 67,000 (65,500)	77,000 - 79,000
High carbon steel C=0.60 3.0 mm	120,000 - 125,000 (122,500)	187,000 - 195,000
Nail N75=75x3.40	67,000 - 70,000 (68,500)	85,000 - 87,000
Galvanized wire 3.2 mm	84,000 - 85,000 (84,500)	121,000 - 124,000
Barbed wire 2.0 mm	114,000 - 115,000 (114,500)	164,000 - 168,000

Fig. 1 General Layout of Cold Drawing Plant



① Rod Storage Yard [20,000 TPY]

② Pickling Line [20,000 TPY]

- HCLx2, • Water x 2, • lime x 1
- Hot water x 1, Phosphate x 1, drying f'ce x 1

③ New HCl Tank

④ Neutralizer for Waste Hcl

⑤ Drawing machine [20,000 TPY]

⑥ Annealing pot furnace & slow cooling
Pot 1,500 TPY 4 pots

⑦ ⑧ Nail machine [1,000 TPY]
6 machines
Polishing machine [1,000 TPY]

⑨ Coil transfer car [80,000 TPY]

⑩ Galvanizing line [7,000 TPY]

⑪ Barbed wire [3,000 TPY]
5 machines

Plant Area = 9,250 m^2

ANNEX VI Results of Study on the Memorandum

The results of study with respect to the memorandum of discussion between JICA Mission and the Egyptian counterparts which took place during October 18 to 21, 1987, (See Chapter 1) are enumerated in the following. Item numbers correspond to those of the memorandum..

1. Market demand

The basis of estimation was incorporated in Chapter 3 of the Report.

2. Expansion plan

(1) Excess DRI

If another 600 module DR plant is installed, ANSDK will have surplus DRI for sale as shown in material balance sheet in Fig. 6.2.2-1.

It is expected that demand and supply of domestic scrap in Egypt will be tight in future, resulting in increase of scrap price. Assuming the scrap price to rise close to the present price of imported scrap, US$100/ton, it is possible to gain profit of about 1 million dollars a year by selling about 100,000 t/y of DRI.

In the climate of Egypt, except a certain winter period, it is considered possible to transport DRI by truck, rail and others. But as ANSDK already has the facilities for cold briquetting, it is advisable to sell the briquets produced by the facilities. Since briquets have higher bulk specific gravity, are more solid and less susceptible to powdering than DRI, the briquets are superior to DRI in transportation and use in EAFs.

As the capacity of ANSDK's briquetting facilities and ANSDK's surplus DRI available for outside sales are almost equal, it is believed advantageous to consider selling briquets instead of DRI.

(2) & (8) Alternative plan of 4 EAFs and 2 LFs

As regards the merits of production increase through introduction of ladle furnaces, as discussed in Section 6-1-3 (2) 2) of the Report, ANSDK's EAFs are designed originally for production of steel for rebars and a big reduction of tap-to-tap time cannot be expected. But referring to the recent operation records of ANSDK and the data provided by ANSDK, the production which can be expected will be calculated in the following. In the calculation, the following formula will be used.

$$\text{Liquid steel (t/heat)} \times \frac{1440\ \text{(min/d)}}{\text{Tap-to-tap time (min/heat)}}$$

$$\times\ \text{Net working days (d/y)} \times 4\ \text{EAFs} = \text{Annual liquid steel production (t/y)}$$

(a) Liquid steel (t/heat)

The average production of liquid steel during the latest six months, namely from April to September, 1987, was 72.8 t/heat and so the figures of 73 t/heat is used.

(b) Tap-to-tap time (min/heat)

In Fig.-1 is shown a diagram of On-to-tap time by DRI blending ratio from the start-up of SMP, namely May 1986, to September 1987. Tap-to-on time could not be obtained due to the unavoidable irregular operation at the start-up, but is considered to be about 30 minutes and the steelmaking time (tap-to-tap time) is calculated to be about 140 minutes.

However, this is the case where a LF is not used. It is planned to reduce the steelmaking time by use of a LF, but the reduction is through refining time.

The refining time during the six months (April to September, 1987) was 25.5 minutes. Assuming that about 10 minutes is required for attaining a certain tapping temperature and adjustment of chemical composition in the EAF, the refining time may be cut by 15 minutes. In other words, when a LF is utilized, the steelmaking time is estimated to be 125 minutes.

(c) Net working days (d/y)

Net working days in a year is 314 d/y as calculated by ANSDK.

(d) Annual liquid steel production (t/y)

Consequently, annual liquid steel production will be

$$73 \text{ (t/heat)} \times \frac{1440 \text{ (min/d)}}{125 \text{ (min/heat)}} \times 314 \text{ (d/y)} \times 4 \text{ EAFs}$$

$= 1,056,246 \doteqdot 1,056,000$ (t/y) and this alternative plan is not appropriate for production of 1,200,000 t/y of liquid steel, which is 50% more than the present production of 840,000 t/y.

(e) Scrap handling facilities

In addition to the inadequate capacity of production with the existing 4 EAFs and new 2 LFs, the capacity of the existing scrap handling facilties also is not adequate for handling scrap required for production of 1,200,000 t/y of liquid steel (with scrap blending ratio being 35%).

(f) Material balance

As the above study showed that production of liquid steel under the alternative plan to use the existing 4 EAFs and new 2 LFs is 1,056,000 t/y and the plan is not practicable, the calculation of material balance in the plan is omitted.

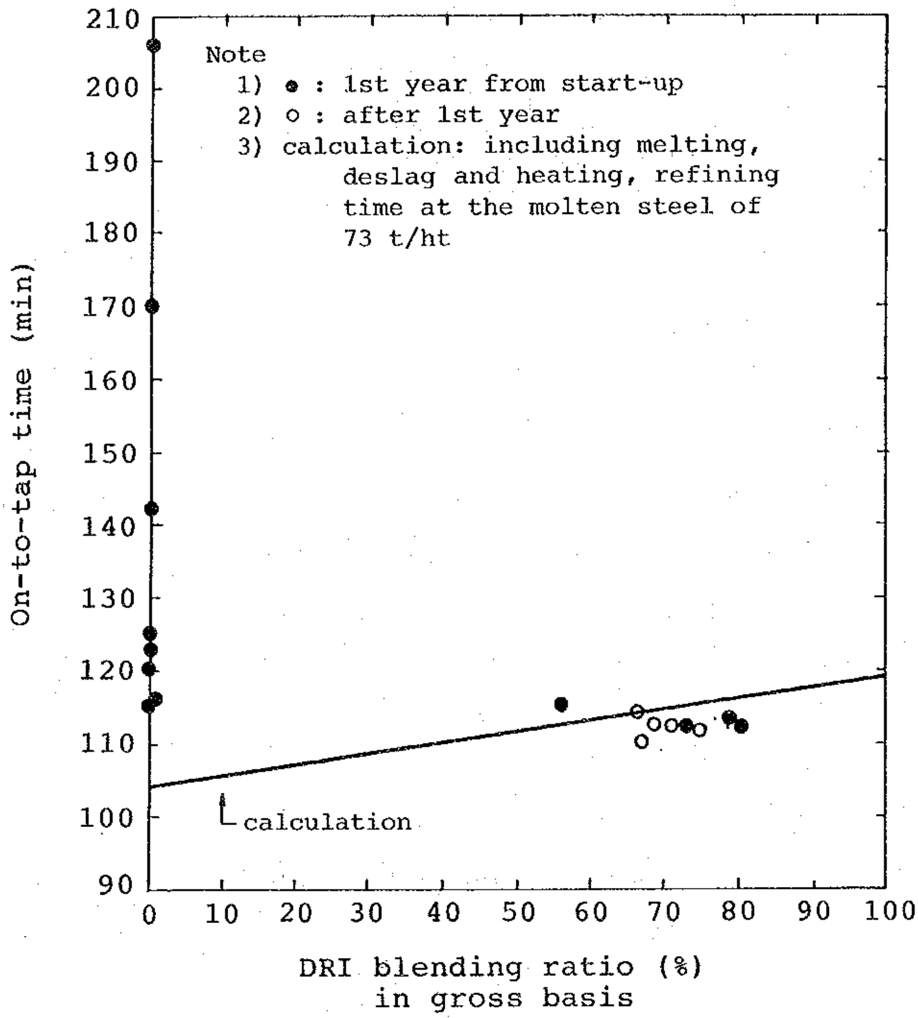


Fig.1 On-to-tap-time

(3) Scrap ratio of 50% for new EAFs

If scrap ratio is made 50%, scrap consumption per heat will be about 39 tons and about 800 tons of scrap will be used a day, for which installation of 2 new scrap cranes is adequate as in the Report.

When 39 t/heat of scrap is used, one bucket charging is difficult and two bucket charging is necessary, which means moving about 40 buckets a day. Since the capacity of two scrap transfer cars in the existing indoor scrap yard is about 45 buckets a day, two more scrap transfer cars will have to be installed. This is one unit more than the plan in the Report. In addition, it will be necessary to extend the building by one span both at the indoor scrap yard and the furnace yard. Three more scrap buckets are also necessary.

As a result, the construction cost of scrap handling facilities will be increased by about US$1.6 million as compared to that in the Report.

(4) Changeable mould of new CCM

In Section 6-1-2 of the Report, it is concluded that mainly because the size of billet is 130 mm square, production of such products as low carbon steel wire rods for cold heading, PC wire, piano wire, high carbon steel wire rods for valve spring, carbon steels for machine structural use and structural steel with specified hardenability bands is not recommended. In the following, a study will be made on changeable mould type CCM which can produce large billets for sale used for the above products in addition to conventional 130 mm square billets. The billets length are to be 16 m long in this case.

In order to produce billets with sound internal and surface quality as discussed in Section 6-1-2 of the Report, it is necessary not only to give large cross sectional area to the billet of course but also to make bending radius of secondary cooling zone of a CCM as large as possible so as to prevent occurrence of inner cracks at the straigtening point. On the premise that the height and span of building, the level of casting floor and billet transfer line, and position of billet cutter are to be same as those of the existing facilities, the bending radius of the CCM will be about 7.5 m and it is desirable to make the cross sectional size of the billet 180 mm square. By increasing the billet size, it is possible to use a submerged nozzle in a mould and taking reduction ratio of 6 it is possible to produce maximum 80 mm ϕ finished products.

Therefore the CCM will be of curved mould bending type with bending radius of 7.5 m. The outline of facilities is as follows:

To prevent metal stream from picking up oxygen during casting, a long nozzle is installed to a ladle and a submerged nozzle to a tundish. The tundish is equipped with a stopper to facilitate smooth start of casting of the tundish with submerged nozzle. Of course they are used exclusively for casting 180 mm square billets. Different No. 1 apron and dummy bar are necessary for 180 mm square billets and 130 mm square billets, but No. 2 and 3 aprons, withdrawal straightening roll and billet cutter can be used in common though adjustment according to size is required. Billet transfer and subsequent facilities are used in common. As regards EMS, it is provided to M and F for production of higher grade steel billets of 180 mm square.

The construction cost of the above CCM facilities is about US$2.5 million higher than that of CCM facilities planned in the Report.

Incidentally this study does not include facilities for surface conditioning and inspection of billets because such conditioning and inspection of billets are usually performed by users in accordance with their optimal standard which is set up by considering their rolling facilities and the needs of the final users.

(5) Further information obtained in the meeting

They are reflected in the Report.

(6) Possibility of quality steel production

Please see Section 6-1-2, ANNEX 5 and ANNEX 6 2 (4).

(7) DRP capacity

Please see Section 6-1-3 of the Report.

(9) Personnel requirement

It is incorporated in the Report.

(10) Utilization of excess capacity

It will be required to consider in detail the utilization of excess capacity of the existing facilities at the time of implementation of the expansion project.

3. Financial Analysis

(1), (3) through (11)

They are incorporated in Chapter 9 of the Report.

(2) Unit consumption of DRP

(a) Unit consumption of raw material for DR

Base consumption unit of raw material which is generally expected of Midrex DR plant is 1.43-1.45 t/t of DRI. Actual unit consumption of raw material at ANSDK from December 1986 to September 1987 is higher than the above figures, but it is considered that this results from production of semi-finished product called "remet" and high powder rate of raw material.

The reason why so much remet is produced may be explained by the fact that operation of ANSDK's DR plant was commenced only in November 1986 with high frequency of plant shut-down and start-up resulting in remet.

The high percentage of fines in raw material is considered to reflect the condition of raw material being purchased by ANSDK at present.

Once the above unfavorable factors are eliminated, the unit consumption of raw material may be improved to at least 1.45 t/tDRI. Therefore in this F/S, the unit consumption of raw material of 1.45 t is used.

(b) Unit consumption of electric power for DR plant

The actual operation result of ANSDK DR plant from December 1986 to September 1987 shows an average unit power consumption of 118 kWh/t, which is higher than 110 kWh/t adopted in the Report. This reflects that not many days passed since the start-up of the DR plant with inevitable results of low operating rate and high frequency of repeated shut-down and start-up. Incidentally, the average of unit power consumption in April, July and September, 1987, that showed relatively high operating rate is 108.7 kWh/t and the figures below 90 kWh/t was already achieved at the time of high production.

Though continued operation with the consumption less than 110 kWh/t can be expected in future, the figure of 110 kWh/t will be adopted in this F/S as before.

(c) Unit consumption of natural gas for DR plant

The actual operation result at ANSDK DR plant from December 1986 to September 1987 shows the average unit consumption of natural gas was 294 Nm^3/t which is higher than 270 Nm^3/t adopted in the F/S Report. This is caused by low operating rate and frequent occurrence of shut-down and start-up of the plant as it began operation only last year.

Once the operation becomes more stable, much lower unit consumption than at the present can be expected and already the operation with a little more than 240 Nm^3/t has been achieved for a short period.

On the presumption of stable operation for a long period, this F/S adopts 270 Nm^3/t.

4. Others

(1) Comments submitted by Counterparts

Except the following, they are incorporated in the Report.

Layout of LF, dust collecting system for LF and Junction points

Casting yard will be extended by one span to provide space for repair and handling of roof and lance of LF and ferro-alloys. In addition, a dust collecting system for fine dust occurring at the LF and junction points of DRI transportation will be installed. The construction cost therefor is about US$1.9 million.

(2) Local procurement

(a) Domestic raw material ore

Request had been made to ANSDK for information about domestic raw material ore in Egypt, but it was said that it is difficult to provide such information. Therefore the F/S team had to use the information it obtained by itself, namely "Survey of World Iron Ore Resources" prepared by United Nations.

According to the data, in Egypt there are three ores in Aswan, Bahariya and Eastern Desert with estimated reserves of (20-158) x 10^6 tons, 195 x 10^6 tons and 80 x 10^6 tons, respectively.

Use of those iron ores in the DR plant, if possible, is very desirable for saving of foreign currencies and promotion of domestic industries. But according to the above data, iron content of the above ores is

47% Fe, 49-59% Fe and 43% Fe, respectively, and the iron content is much lower than the raw material (65-68% Fe) usually used in DR plant, and use of the above ores as it is does not bring any merits to ANSDK.

(b) Local fabrication and installation

This is incorporated in Chapter 8 of the Report.

ANNEX VII Recent trend of natural gas prices

Export price of natural gas from producing countries in the Middle East is showing a declining trend. For example, export price of LNG to Europe from Algeria, the biggest gas producer in the Middle East, was US$3.81/Million BTU at the beginning of 1986, but dropped to US$1.30∿1.95/Million BTU at the beginning of 1987. The price includes liquefaction cost. (The price is of FOB in both cases and CIF price is assumed to be about one dollar higher.)

In general, natural gas price is determined on the basis of thermal equivalent with crude oil price, but recently the price seems to be lowered to the marginal cost to cope with the market condition.

The price of industrial gas in major oil producing countries (for DR plant) in the world is estimated as follows:

Qatar	US$ ∿0.3/Million BTU	
Venezuela	0.3∿0.4	-"-
Saudi Arabia	0.5	-"-
Indonesia	0.7	-"-
Trinidad & Tobago	1.0	-"-
Nigeria	0.7	-"-

And the gas sent by Iran to Kuwait through pipeline is US$1.0/Million BTU on FOB basis.

For more information, please refer to MEED dated on March 21, 1987.

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Natural gas production increases

Production Output of gas from the Middle East's 10 principal producers in 1986 rose by more than 7 per cent, to 115,950 million cubic metres. The 10 accounted for 1.3 per cent of world production, which rose by only 1-2 per cent, to an estimated 18,000 million cubic metres.

Algeria is the region's largest producer. Its 1986 production of 36,100 million cubic metres was unchanged from 1985, suggesting that protracted discussions about price with European consumers did not lead to a loss of export volumes. Saudi Arabia increased its gas production by 20 per cent in 1986. Unlike most of the region's other producers — with the notable exception of Algeria — all the kingdom's gas is associated with oil. The rise in production in 1986 reflects the kingdom's 50 per cent increase in oil output, to 4.8 million barrels a day.

Iran has the region's largest reserves; they could last up to 600 years at 1985 production rates. Marketed output in 1986 was 15,200 million cubic metres — 4 per cent more than in 1985.

Iran uses all its production locally, and flares as much again. Prospects for a revival of exports improved in August 1986, when Oil Minister Gholamreza Aqazadeh visited Moscow. Discussions included a possible resumption of gas supplies along the 10,000 million-cubic-metre-a-year IGAT-1 pipeline, disused since the February 1979 revolution. Aqazadeh later said supplies could start in mid-1987.

Price Natural gas prices weakened in 1986, thanks to the abrupt fall in the oil price. The time lag of up to three months between oil and gas price movements means the gas price has yet to recover fully. The low prices increased competition between producers and fuels. As a result, Algeria was obliged to renegotiate contracts with its clients in Italy, France, Belgium and Spain.

The price weakness led to the introduction of more flexible formulas, notably linkages with crude oil netback yields and spot prices. The intrafuel competition aroused by low oil prices was most visible in the US, where utilities in 1986 switched from gas to cheaply priced heavy fuel oil.

Reserves and consumption Compared with the region's oil reserves, gas reserves are modest. Middle East and North African producers possess almost 28 per cent of the world total; nearly half the total lies in Iran, which has 13.3 million million cubic metres of gas. At present rates of consumption, the region's reserves will last more than 100 years.

About 85 per cent of world gas production is consumed locally, because export costs are prohibitive. This is why so much gas is flared if there is no local use for it. In 1975, flaring accounted for 60 per cent of the natural gas produced by the Organisation of Arab Petroleum Exporting Countries (OAPEC), figures from the Kuwait-based organisation show.

Consumption rates have increased sharply since 1975 because of increased industrialisation and the development of gas re-injection techniques. In 1984 — the most recent year for which figures are available — only 15.7 per cent of total OAPEC production was flared. The highest rate was in Saudi Arabia, which flared 51 per cent of production.

Outlook The discovery rate for natural gas reserves is likely to slow as oil field development is curtailed. One recent exception has been North Yemen, where the opening of the Marib/Jawf basin has led to the discovery of gas reserves said to be sufficient for 100 years' local consumption.

Given the difficulty of exporting natural gas, most growth in demand will be generated domestically. The bulk of the rise in local consumption has comprised increased demand for industrial feedstock, followed by wider use of fuel gas. OAPEC estimates that its members will account for 5.2 per cent of world demand by 1995, compared with 3.5 per cent in 1985.

Gas prices for selected Middle East producers, 1986-87

Producer	Client	Gas	$/million BTUs				
			1986 Q1	Q2	Q3	Q4	1987 Q1
Abu Dhabi	Tokyo Electric Power Company (Japan)	LNG[1]	4.85	na	3.60	na	na
Algeria	SNAM (Italy)	Natural[2]	3.49	2.80	na	2.0	na
	Gaz de France	LNG[3]	3.81	3.07	2.32	1.95	na
	Distrigaz (Belgium)	LNG	3.81	na	2.32	1.95	1.30-1.40
	Enagas (Spain)	LNG	3.81	3.18	2.32	1.95	1.95
Iraq	Kuwait	Natural[4]	1.00	1.00	1.00	1.00	na

[1] cif price; based from September 1986 on netback yields. Price fell in October 1986 to $3.18 a million BTUs

[2] Price is fob Tunisian border. Estimated cif price in Italy in first-quarter 1986 was $4.30-4.50 a million British thermal units (BTUs). Price from September 1986 is understood to be based on spot prices of crudes in a three-year agreement between SNAM and Algeria's Sonatrach

[3] LNG prices are fob Algeria. Sonatrach renegotiated price with Gaz de France, Distrigaz and Enagaz from April 1986. These are at present based on netback yields. From the beginning of 1987, Sonatrach is invoicing the three companies at $2.12 a million BTUs. Negotiations are under way that will lead to a price retroactive to 1 January

[4] Estimate; fob price

Source: Cedigaz, Paris

Middle East natural gas production, 1985-86[1]

('000 million cubic metres)

	1986	1985
Abu Dhabi	10.19	9.67
Algeria	36.10	36.47
Bahrain	5.28	4.54
Dubai	2.30	2.13
Egypt	5.46	4.93
Iran	15.20	14.60
Iraq	1.32	0.85
Kuwait	4.90	4.20
Libya	5.40[2]	5.20
Qatar	5.60[2]	5.41
Saudi Arabia	24.00[2]	20.28
World total	1,800.0[2]	1,770.0

[1] marketed output; excludes volumes flared and reinjected, and refining losses
[2] Provisional

Source: Cedigaz, Paris

Middle East proven natural gas reserves, end 1985

	million million cubic metres	reserves production ratio (years)
Abu Dhabi	0.6	88
Algeria	3.0	86
Bahrain	0.2	47
Dubai	0.1	100+
Egypt	0.2	43
Iran	13.3	100+
Iraq	0.8	100+
Kuwait	0.9	100+
Libya	0.6	100+
Qatar	4.2	100+
Saudi Arabia	3.4	100+

Source: BP Statistical Review of World Energy, 1986

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