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APPRAISAL OF

THE LAS TRUCHAS STEEL PROJECT

MEXICO

August 10, 1973

Industrial Projects Department

CURRENCY EQUIVALENTS

Except where otherwise indicated, all figures are quoted in Mexican Pesos (M$) and U.S. dollars (US$) of June 1973

M$1.00	=	US$0.08
M$12.50	=	US$1.00
M$1,000,000	=	US$80,000

WEIGHTS AND MEASURES

1 Metric Ton	= 1,000 Kilograms (kg)
1 Metric Ton	= 2,205 pounds
1 Kilometer	= 0.62 miles
1 Meter (m)	= 39.3 inches

ABBREVIATIONS AND ACRONYMS

AHMSA	Altos Hornos de Mexico, S.A. (Government-owned steel company)
AISI	American Iron and Steel Institute (U.S.)
B.O.F.	Basic Oxygen Furnace
BSC	British Steel Corporation
C & F	Cost and Freight
CIF	Cost, Insurance, Freight
CNIHA	Camera Nacional de la Industria del Hierro y Acero (Iron and Steel Manufacturers Association)
db	Decibel
DWT	Dead Weight Tons
EC	European Community
Fe	Iron
FOB	Free on Board
Fundidora	Fundidora de Fierro y Acero, S.A. (Private steel company)
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
HYLSA	Hojalata y Lamina, S.A. (Private steel company)
IDB	Inter-American Development Bank
IISI	International Iron and Steel Institute
JISF	Japan Iron and Steel Federation
Marina	Secretaria de la Marina (Navy Ministry)
NAFINSA	Nacional Financiera, S.A. (National development bank)
ODA	Overseas Development Administration (U.K.)
SICARTSA	Siderurgica Lazaro Cardenas - Las Truchas, S.A. (Project Company)
SITC	Standard Industrial Trade Classification
TAMSA	Tubos de Acero de Mexico, S.A. (Private steel company)

MEXICO

APPRAISAL OF THE LAS TRUCHAS STEEL PROJECT

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This report has been prepared by Messrs. Pigossi, Jaffe, Thadani and Parker of the Industrial Projects Department and Mr. Hutcheson of the Mexico Division, Latin American and Caribbean Region.

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MEXICO

APPRAISAL OF THE LAS TRUCHAS STEEL PROJECT

SUMMARY AND CONCLUSIONS

(i) A Bank loan of US$70 million equivalent has been requested to help finance an integrated iron and steel works on Mexico's Pacific coast, with Nacional Financiera, S.A. (NAFINSA), the Government development bank, and Siderurgica Lazaro Cardenas-Las Truchas, S.A. (SICARTSA), a Government-owned company, as joint borrowers and the Government as guarantor. In its first stage, to which the Bank loan would apply, the works will have an annual capacity conservatively rated at one million tons of light non-flat finished steel products, with provision made for later expansions to over 5 million annual tons. Construction is now beginning and the completion target for Stage I is mid-1976. The works will be located near iron ore reserves sufficient for at least 25 years of steel production at the Stage I level. Coal supplies will be imported through an adjacent deep-water port that is being financed and constructed separately by the Government. A new city to house SICARTSA's employees similarly is being constructed by a Government trust fund.

(ii) The Government's objectives for the project are twofold: first, to meet projected increases in domestic non-flat steel demand with a modern steel works that later can be expanded to produce a full range of steel products at costs competitive with world standards; and secondly, to further the goal of directing public investment towards under-developed areas of Mexico and away from the concentrated wealth and economic activity of the nation's center. These have proven to be compatible objectives. Even without the inclusion of regional benefits or the economies to be expected with later expansions, the project's viability can be demonstrated, and the Bank's analysis has been carried out from this perspective. Nevertheless, institutional aspects of the steel industry's growth and its relationship to the Las Truchas project, as well as regional planning needs, have been central to the Bank's discussions with the company and Government throughout this appraisal. The Bank's involvement also has led to improvements in project design and planning and has provided a basis for Mexican equipment suppliers to participate in procurement under international competitive bidding.

(iii) Total financing required for the project is an estimated US$679 million, comprising US$636 million for the iron ore mine, steel works, and related facilities, US$32 million for interest during construction, and US$11 million to cover initial operating cash losses. It is proposed that the total be met by US$300 million in equity from the major shareholders (the Government, NAFINSA, and Altos Hornos de Mexico, another Government steel company), the US$70 million Bank loan, a parallel loan of US$54 million from the Inter-American Development Bank (with which the Bank's appraisal has been closely coordinated), parallel credits totalling about US$180 from the bilateral financing agencies of nine industrial countries (Austria, Belgium, Canada, France, Germany, Italy, Japan, the United Kingdom and the United States), and residual loans totalling about US$75 million from yet-unidentified

sources. The Government has guaranteed provision of the residual loans, as well as any additional financing needed to guarantee project completion or to cover cost overruns.

(iv) The project has been designed by SICARTSA's Operating and Technical Adviser, British Steel Corporation (BSC), and comprises facilities for mining, ore beneficiation and pelletizing, blast furnace iron making, basic oxygen steel making, and finished product rolling. The latest pollution control technology has been incorporated, and SICARTSA has shown a commendable attitude towards environmental protection issues. BSC staff have been placed at various management and specialist levels throughout the organization and in many cases fill functional positions due to the comparative inexperience of most of SICARTSA's engineers. The arrangement is running smoothly and a good project team has been assembled.

(v) SICARTSA steel products will be transported primarily by rail, and a new railway link will be constructed between the plant site and Nueva Italia, where it will connect with the national railway system. Because this link will not be completed until 1978, road transport will be used during the early operating period and additional resources will be committed by the Government to upgrade the existing road infrastructure.

(vi) Mexico's consumption of finished steel products has grown at an annual rate of 8.3 percent over the past decade, reaching 3.1 million tons in 1972. Apparent consumption of light non-flat products was 1.2 million tons in 1972, representing a 6.8 percent annual growth rate over the previous decade. By 1980, demand for these products is expected to grow at a faster 9 percent rate and reach 2.8 million tons, of which SICARTSA will supply just over a third. Exports by SICARTSA are not contemplated, and imports play only a minor role in the non-flat market. Prices are subject to Government ceilings, and the Bank's financial projections therefore have assumed conservatively that real prices in 1976, when SICARTSA comes into production, will remain at late-1972 levels and will decline thereafter at 1 percent per annum. On this basis the project still shows a financial return of 11 percent.

(vii) The company's projected long-term financial position is strong, but liquidity problems will be encountered during the first year or two of operations, when debt amortizations begin to fall due before full production is reached. The risks are not great, however, and will be covered adequately by the completion and cost overrun guarantees given by the Government. Loan restrictions on dividends, additional borrowings and new investment above certain minimum levels will provide adequate long-term security without impinging upon effective management of the company. Cumulative cash generation after debt service and dividends through 1985, the tenth year of operations, is projected at US$325 million, providing a substantial input to new investment and expansion.

(viii) As part of this appraisal, a world steel study was conducted by consultants to the Bank and projections made of future world steel price trends. It has been concluded from this work that SICARTSA will be able to produce steel economically without protection from imports. The project's

economic return is projected at 12-13 percent based on the projected cost of imported steel to Mexico over the 1976-91 period. The return is not greatly sensitive to possible transport cost variation or to the rate of production and sales buildup. It is most sensitive to possible increases in production costs or a startup delay and cost overrun. In no case, however, does the return drop below 8 percent for the projected range of possibilities, and even that level would result only from a combination of unlikely events. An acceptable economic return exceeding 10 percent therefore is very probable. Net foreign exchange savings are projected at a minimum of US$111 million per year, so that the foreign exchange component of capital costs will be covered in less than three years of full operation.

(ix) The Las Truchas project is judged the best of various alternatives for the next step in Mexico's steel expansion program, but its maximum value to the economy will be achieved only when the project moves into its second stage, which will roughly double product capacity and show considerable economies of scale, as soon as market growth allows. This implies a need for industry-wide planning that is only beginning in Mexico and has yet to be firmly established. A national steel coordinating Commission was formed by the Government late in 1972 and has authorized a study of the industry now being carried out by a foreign consulting firm, with results due in late 1973. Subsequently, a Government strategy for steel development is needed. The Government has given the Bank assurances that it will take all reasonable action to coordinate expansion in the industry and that it will neither approve nor support future expansions or new steel works until market demand and economic justification have been considered -- with the effect on SICARTSA's second stage included in such consideration. Furthermore, the Government has agreed to review steel prices in Mexico from time to time and use its best efforts to maintain them at levels reasonable related to production costs and world prices, while sharing increased production efficiency with steel consumers through lower prices to the extent possible.

(x) The project provides a suitable basis for a Bank loan of US$70 million equivalent for a term of 15 years, including 5 years of grace.

I. INTRODUCTION

1.01 The Mexican Government development bank, Nacional Financiera, S.A. (NAFINSA), and Siderurgica Lazaro Cardenas - Las Truchas, S.A. (SICARTSA), a Government-owned company, have applied to the Bank for a loan of US$70 million equivalent to help finance the construction of the first stage of an integrated iron and steel works and associated iron ore mine on the nation's Pacific coast. The loan will be guaranteed by the Mexican Government. The Las Truchas project, as it is commonly known, will be carried out in several stages likely to stretch over 15-20 years, the first comprising plant and infrastructure needed to produce and ship one million tons 1/ of light non-flat steel products (wire rods and light bars and shapes). Provision has been made in planning for a technically-matched second stage to produce steel plate, beginning perhaps 4-5 years after Stage I startup in 1976. Later expansions into other flat steel products (coil, sheet, etc.) will yield an ultimate capacity exceeding five million tons of raw steel 2/ per annum.

1.02 The Bank's appraisal has been predicated upon the need to demonstrate the technical, financial, and economic viability of the initial stage alone. Nevertheless, because the later expansions will need to be planned carefully as part of a rational strategy for growth of the entire Mexican steel industry, one of the primary objectives of the Bank's involvement has been, and should continue to be, to encourage the Government to establish such a strategy. Bank participation also has led to improvements in project design and planning, and will facilitate a wider participation of Mexican equipment suppliers in procurement than otherwise would be possible.

1.03 The appraisal has been carried out in close cooperation with the Inter-American Development Bank (IDB), which is preparing a parallel loan to SICARTSA for US$54 million equivalent. The project has been discussed with the two banks for several years, but formal applications for financing were not made until late-1971. Several project preparation missions visited Mexico between December 1971 and August 1972, followed by appraisal missions in November 1972 and April and June 1973.

1.04 The appraisal was conducted and this report prepared by Messrs. Pigossi, Jaffe, Thadani, and Parker of the Industrial Projects Department and Mr. Hutcheson of the Mexico Division, Latin American and Caribbean Region.

1/ Metric tons are used throughout.

2/ "Raw" or "crude" steel is defined as steel in the first solid state after melting and includes ingots and continuously cast semi-finished products -- the latter applying to Las Truchas.

II. THE COMPANY

A. History

2.01 In 1948, a Mexican Government commission began to study the possible construction of an integrated steel works that would exploit the iron ore deposits of Las Truchas, adjacent to the Balsas River delta on the Pacific coast (see maps). A project based on direct reduction of the ore and electric furnace steelmaking was developed in the 1950's but never carried out, and little further progress was made until 1969, when SICARTSA was created by the Government and charged with formulating a specific plan for a modern steel plant. Overseas consultants were hired and a detailed feasibility study was produced in 1971. The project, as defined therein, was formally approved by the President of Mexico in September 1971, and the present project has evolved therefrom.

B. Capital Structure

2.02 SICARTSA is constituted as a "Sociedad Anonima" under Mexican law. The company's authorized capital as of April 1, 1973, was M$500 million (US$40 million) and will be increased to a minimum of M$3,750 by December 31, 1976 (US$300 million) to provide a sound equity base for the project. All but a small percentage of the shares are held by the Government and Government agencies and companies, with the present and likely future ownership split as follows:

SICARTSA OWNERSHIP

	Present		Future	
	US$ million	%	US$ million	%
Federal Government of Mexico	20.4	51.0	153.0	51.0
Nacional Financiera, S.A. (NAFINSA)	10.0	25.0	75.0	25.0
Altos Hornos de Mexico, S.A. (AHMSA)/1	4.8	12.0	36.0	12.0
Federal Government - Trust Fund	4.3	10.8	35.5	11.8
Mr. Bernardo Quintana (Private Industrialist)	0.5	1.2	0.5	0.2
	40.0	100.0	300.0	100.0

/1 Half of these shares are held by Minas de Hierro La Perla, S.A., a wholly-owned mining subsidiary of AHMSA.

2.03 The shares held by the Government are not transferable, guaranteeing its continued majority ownership. The NAFINSA shares can be subscribed by other Mexican parties, but no plans exist for any to be sold off. Instead, it is intended that the Trust Fund shares -- which NAFINSA holds on behalf of the Government -- will be offered to the general public at some future date. According to SICARTSA's by-laws, AHMSA, the existing Government-owned steel company, and its mining subsidiary together must subscribe

12% of SICARTSA's authorized capital. Since it was not possible to examine the financial condition of either of these companies during the appraisal, agreement was reached during negotiations that the Government would guarantee the obligations of all shareholders to subscribe and pay in capital as required by SICARTSA.

III. THE MEXICAN STEEL INDUSTRY, MARKET AND PRICES

3.01 A detailed analysis of Mexican steel supply, demand, and prices is contained in Annex 1.

A. Existing Producers

3.02 Over 80% of Mexico's present crude steel capacity is confined to three fully-integrated producers: AHMSA in Monclova, Fundidora de Fierro y Acero, S.A. (Fundidora) in Monterrey -- a private company with Government and IFC participation -- and Hojalata y Lamina, S.A. (HYLSA) -- a private company with plants in Monterrey and Puebla. The balance of production is split amongst a small integrated seamless pipe producer in Veracruz and six semi-integrated plants located mainly in Mexico City. The industry's total raw steel capacity is about 5.2 million annual tons and will rise to 5.7 million tons when Fundidora completes an expansion planned to precede SICARTSA start-up. Historical data of capacity utilization, however, indicate that the above nominal capacity will yield only about 4.6 million tons of actual output due to technical limitations. The effective rolling capacity of the Mexican industry substantially exceeds current steel making capacity and is estimated at about 5.0 million tons of finished steel products (2.4 million tons of flat and 2.6 million tons of non-flat). To fully utilize this capacity would require about 6.7 million tons of raw steel input so that the industry still will be short, in nominal terms, by about one million tons of raw steel following Fundidora's expansion.

B. Historical Consumption

3.03 Apparent consumption 1/ of steel products in Mexico has increased at an average annual rate of about 7.1% over the past 20 years and 8.3% over the past decade, reaching an estimated 3.1 million tons in 1972 -- equivalent to 4.2 million raw steel tons. The product split for 1972 was as follows:

APPARENT DOMESTIC STEEL PRODUCT CONSUMPTION: 1972

Product Type	000 Tons	%
Light Non-Flats	1182	39
Heavy Structurals and Rails	130	4
Seamless Pipe	191	6
Flats	1552	51
Total	3055	100

1/ Domestic production plus imports minus exports.

The product category of primary interest to SICARTSA is light non-flats which, together with heavy structurals, grew at an average annual rate of 6.8% between 1962 and 1972.

C. Projected Demand

3.04 Numerous projections of domestic steel demand have been prepared in recent years, first by the Bank of Mexico, NAFINSA, and the Iron and Steel Manufacturers Association (CNIHA), and subsequently by SICARTSA, which has taken the previous work into account but concentrated on the products of the proposed project. The SICARTSA projection has been based on assumed growth patterns for various sectors of the economy using estimated 1972 consumption figures as the projection base. Total product demand is projected to increase to 6.7 million tons by 1980, or an average growth rate of 10.4% from the 1972 base, and non-flat demand to grow at an average rate of 9% to 2.8 million tons in 1980. Expected buoyancy in the construction industry is the primary reason for the projected increase in the non-flat growth rate from the 6.8% that prevailed during the previous decade. This is based on expectations that the Government will continue the very substantial housing and public works programs that began when the present administration came into office in 1970.

D. Estimated Market for SICARTSA

3.05 The present effective rolling capacity for light non-flat products is estimated at 1.8 million tons per annum; this possibly will rise to 2.1 million tons by 1980. Present supply, however, is at a rate of only about 66% of effective capacity, and it is expected that expansions will be implemented as much to achieve rationalization of existing facilities as to increase rolling capacity itself. Assuming (i) that half of the expansions will be in place by 1976 and the balance by 1980, and (ii) that capacity utilization will increase from 66% in 1972 to 85% by 1976 and 90% by 1980, a projection of demand/supply balance for the 1976/80 period has been made as follows:

PROJECTED DEMAND/SUPPLY BALANCE
FOR LIGHT NON-FLAT PRODUCTS: 1976-80
(000 tons)

	1972 (actual)	1976	1977	1978	1979	1980
Projected Demand (1)	1182	1816	2022	2251	2506	2791
Projected Supply without SICARTSA	1182	1640	1690	1725	1775	1850
SICARTSA Supply	-	150	500	800	1000/1	1000/1
Total Supply (2)	1182	1790	2190	2525	2775	2850
Excess (Deficit) (2)-(1)	-	(26)	168	274	269	59

/1 100% of capacity.

The excess supply shown for 1978-79 represents about one year's growth in consumption at that time. Given the conservative assumption of increased capacity utilization in the existing industry, as well as the marginal nature of some of the existing rerollers (accounting for about 270,000 tons of capacity), the projected phasing of SICARTSA's entry into the market is justified, and SICARTSA's sales growth should not be limited by market size. 1/ This, of course, will require an effective marketing program.

E. Steel Prices

3.06 Prices of steel products in Mexico are subject to Government ceilings which, for non-flat products, have not been raised since 1956. Actual market prices have been below ceiling levels until comparatively recently; but, because of recent production cost increases, substantial pressures now exist for raising the ceilings. It has been assumed for this appraisal that some increase will be allowed before SICARTSA begins production in 1976 and that real (uninflated) prices at that time will be about 2-3% above present price levels -- which are virtually at the ceilings. On this basis, the average price (in 1973 currency) for the assumed SICARTSA product mix will be about US$186 per ton delivered Mexico City. The price assumptions beyond 1976 are discussed in para 6.05.

3.07 During negotiations, agreement was reached that the Government would review steel prices in Mexico from time to time and use its best efforts to maintain prices at levels that (i) are reasonably related to Mexican production costs and world price levels and (ii) are such as to allow steel consumers in Mexico to share in any decline in production costs through reductions in steel prices.

F. Comparison of Mexican and World Prices

3.08 A world steel study was carried out by consultants to the Bank early in 1973 in part to determine the likely level of delivered prices that Mexico would have to pay if it chose to import steel instead of producing it at Las Truchas. An abridged version of the consultants' study, together with the Bank's conclusions, is contained in Annex 2. European export prices have been taken as the primary future influence on world prices, as they have been in the past, and a projection of the likely real levels they might reach in 1985 has been made, based on projections of real production cost increases that the European producers will have to bear by that time. It has been concluded that the average list price that prevailed in Europe during 1970/71 for a product mix similar to that of SICARTSA would be the minimum long-term European export price (F.O.B.) that

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1/ Imports and exports of the types of products SICARTSA will produce have been negligible in the past, and no change is expected for the future. Hence, they have been ignored in the supply/demand projections.

could be expected to prevail, in real terms, over the 1976-91 SICARTSA projection period. This is a conservative judgment, based (i) on the fact that this average price yielded low profits to European producers under the cost structure during 1970/71 and (ii) evidence that long-term real costs will rise, not fall, so as to erode that low profitability even further if real prices do not increase. For the maximum long-term price, projected real production cost increases up to 1985 have been superimposed on the 1970/71 price level to yield an average price that would approximate the Europeans' desired average price level at that time (based on full-cost pricing). The range of prices that results, following the above logic, is US$156-191 per ton F.O.B. Europe, expressed in constant 1973 dollars and based on early 1973 exchange rates. For purposes of the Bank's economic analysis, however, it has been assumed more conservatively that the most likely average European F.O.B. price over the 1976-91 period -- and therefore the average price that Mexico would have to pay for large volumes of imports on a continuing basis -- would fall within the lower third of this range, or US$156-168 per ton. To these prices must be added US$32 per ton for transporting the steel from Europe to the primary market, Mexico City, giving a probable average delivered price of US$188-200 per ton (1973 prices and exchange rates). This range exceeds the average present Mexican price ceilings for SICARTSA's product mix by 3-10%. Hence, it can be concluded that a fair economic return based on these prices implies the Las Truchas project's ability to produce steel economically without import protection. This will be seen to be the case in para. 7.02.

G. Future Steel Development Policy

3.09 During 1972, and following extended discussions with the Bank, the Mexican Government formed an Iron and Steel Coordinating Commission to plan for the long-term development of the steel industry. A translation of the decree establishing the Commission is contained in Annex 3-1. The Commission's primary function is to serve as an advisory body to the Government in the formulation of production programs and expansion plans for the steel enterprises in which the Government participates. It does not, however, have executive power, except through the various Government ministers who make up its membership. A Technical Committee comprising representatives of the industry, serves in an advisory capacity to the Commission, and a technical staff has been formed to carry out the Commission's work.

3.10 It is still too early to assess the Commission's effectiveness and likely long-term impact on industry planning and decision-making. It has, however, taken the major step of hiring Battelle Institute of the U.S. to carry out a comprehensive study of the industry and recommend a plan for future capacity expansions and price structures. The Terms of Reference for the study, which is scheduled for completion in late 1973, are contained in Annex 3-2.

3.11 It is imperative that the Commission's work not stop with the Battelle study and that an actual Government strategy for steel evolve from it. Without this, there is no guarantee that new or expansion projects will not be undertaken unilaterally and that the industry will not be faced with overcapacity in the late 1970's. Pursuant to this objective, agreement was reached during negotiations that the Government (i) would take all reasonable action required for coordinating the expansion of steel production capacity in Mexico and (ii) that before approving or supporting the further expansion of existing steel companies or the establishment of new steel companies, it would consider the market demand and economic justification for each, as well as the impact on the second stage of the project.

IV. THE PROJECT AND ITS EXECUTION

A. Technical Description

4.01 A detailed technical description of Stage I of the project is contained in Annex 4-1 and of Stage II in Annex 4-2.

Technical Concept for Stage I

4.02 The project comprises the establishment and operation of a non-flat steel products plant with an initial capacity of about 1.1 million tons of raw steel per annum and 1.0 million tons of finished products. The plant has been designed by SICARTSA's Operating and Technical Advisor, British Steel Corporation (BSC), on the basis of a detailed project review carried out between May and September 1972. All facilities have been laid out (see Annexes 4-3 and 4-4) in a manner that will permit easy expansion and diversification of production capacity to more than 5 million raw steel tons per annum. The process route adopted for Las Truchas is based on the most modern technology available and is considered appropriate. The main elements will be:

(i) Mining and beneficiation of the Las Truchas iron ore works, with transport of concentrate by slurry pipeline to the steel works;

(ii) Agglomeration of the iron ore fines to form self-fluxing pellets;

(iii) Conventional coke making based on imported coals;

(iv) Blast furnace iron making;

(v) Basic oxygen (B.O.F.) steelmaking;

(vi) Continuous casting of billets;

(vii) Rolling of rod, bar and light sections in two finishing mills.

4.03 The iron and steel making facilities, comprising 64 coke ovens, a 3,300 tons-per-day blast furnace, two B.O.F. vessels, three six-strand continuous casting machines, and their ancillary facilities, have been matched in size to meet the billet requirements of 1.1 million tons per year into the two rolling mills, each of which is rated at 500,000 tons annual capacity -- the maximum economic size for such mills by world standards. The design has been conservative, however, to ensure reliability in the Mexican context; and, as experience is gained, it should be possible to increase crude steel (billet) output to about 1.3 million annual tons. This would allow direct sale of some 200,000 tons of billets to rerollers in Mexico or elsewhere, a possibility that has not been taken into consideration in the Bank's financial projections for the company. The rolling mills have been designed to allow sufficient flexibility for the product mix to be modified to meet the full range of likely market requirements.

Stage II

4.04 Tentative plans for Stage II envisage the duplication of the Stage I coke ovens, pelletizing plant, and blast furnace, and the addition of a third B.O.F. vessel and a heavy plate mill matched to the doubled steelmaking capacity. Preliminary technical and financial studies have been carried out, but their primary purpose has been to aid the design of Stage I.

Iron Ore

4.05 The Las Truchas iron ore is located in three primary deposits (Ferrotepec, El Volcan and El Mango) and a number of smaller ones, all in close proximity and roughly 20 km from the plant site (see map). The primary ores are magnetite (Fe_3O_4), but the northern deposits have been weathered and exposed to variable depths, the effect of which has been to convert much of the magnetite in the upper layers to hematite (Fe_2O_3). The iron ore exploration program has not yet been completed; but, as of the end of July, 1973, 76 million tons of "measured" and 12 million tons of "indicated" reserves had been verified 1/. These are estimates of geological, not economically recoverable reserves, but there is ample indication that most of the geological reserves will be recoverable within the range of costs that have been used in financial planning. This would be sufficient for over 30 years of Stage I operation, or, alternatively, would allow a significant portion of Stage II production to be based on Las Truchas iron ore. Chemical analyses of the ore have shown an average soluble iron (Fe) content of about 51%. The main impurities are iron and copper sulphides, which largely disappear in the beneficiation process to yield a high quality concentrate of 67-68% Fe content. This in turn has been shown in semi-industrial tests to yield a high quality pellet. Overall, the iron ore picture is very satisfactory, and it is anticipated that recoverable reserves will increase to as much as 100 million tons by the end of the exploration program.

1/ See Annex 4-5 for definitions.

Other Raw Materials

4.06 Coal will be entirely imported since no suitable coking coals are available in the vicinity of the project, and transporting Mexico's relatively low-quality coals from the northern part of the country would be uneconomic. BSC is assisting SICARTSA in the selection of long-term overseas coal sources (most likely Australia and/or Canada), and no supply problems are anticipated. Limestone will be obtained from quarries within 50 km of the plant and, although no firm decisions have been made as to the final location, problems are not anticipated. Manganese ore, bentonite, and minor raw materials will be purchased from Mexican sources and no difficulties are foreseen as to their quality or availability.

B. The Port of Lazaro Cardenas

4.07 The port, described in detail in Annex 5, is being constructed by the Ministry of the Navy (Marina) at the mouth of the Balsas River and comprises a dredged channel of 14 meters depth to accommodate 50-80,000 DWT bulk coal vessels, deep water berths, and ancillary facilities. The Government intends this to become a general purpose port and plans to construct 600 meters of quay in the first phase, of which 200 meters are required for handling initial SICARTSA traffic -- imports of plant and equipment during the construction phase and coal from 1976 onwards, and outward movement of roughly 10% of steel product output for coastwise shipment to the north and south of Mexico. The port plans have been reviewed by the Bank and are considered technically and economically sound. Construction is well underway and expected to be completed in time to meet SICARTSA's needs.

C. Transport of Finished Products

4.08 About 90% of SICARTSA's output, or 900,000 tons per year beginning in 1979, will need to be moved inland to the principal markets of Mexico City, Guadalajara and elsewhere. A number of road, rail and sea alternatives exist, requiring varying levels of investment for new facilities or improvements to existing infrastructure (see Annex 6). Following a study undertaken by consultants to SICARTSA, the Government has decided to construct a railway link from the plant site to Nueva Italia, where it will connect with the national railway system and give SICARTSA access by this mode to most of its major markets. Because the link will not be completed until 1978, however, road transport will be utilized for the first two years of SICARTSA's production -- unless studies still in progress demonstrate that it is preferable to ship part of the steel by sea to Manzanillo during this period for onward transport by rail. No technical problems are foreseen and the Government has given the Bank appropriate assurances that resources will be committed as needed to upgrade the road to Nueva Italia and to complete the railway link at the earliest possible date. SICARTSA also has committed itself to submit to the Bank for comment by September 1974 its own detailed plans for steel product transport, including organizational arrangements.

D. The City of Lazaro Cardenas

4.09 A new City, described in detail in Annex 7, will be constructed to provide residential and commercial facilities for SICARTSA's 4,000-man Stage I workforce and their families and, later, to serve as the urban core for a possible 90,000 persons who will populate the Las Truchas area by the year 2000 (Annex 17). Planning for and construction of the city, to be located on 696 hectares adjacent to the steel works, are under the supervision of a Government Trust Fund formed for this purpose. SICARTSA is represented on the Fund's Board of Directors, but will have no financial obligation to the city. Detailed construction plans for housing and infrastructure are not yet completed, but the Bank has reviewed the general scheme and found it satisfactory. The implementation schedule, however, is tight. The Bank obtained the Government's assurances during negotiations that adequate support would be given to the city's construction program.

E. Environmental Protection

4.10 The steps being taken by SICARTSA to minimize the adverse effects of the mine and steel works on the surrounding environment are above average for a project of this type, and the company's positive attitude towards this subject should be commended. Plant design has been directed at restricting aggregate levels of water, air and noise pollution from the main problem areas -- the mine, pellet plant, blast furnace, steel plant, rolling mills, power plant, and oxygen plant -- and the works layout will reduce the impact of residual pollutants remaining after cleaning and control measures. Water pollution is of the greatest concern, given the coastal location of the plant and the recreational and commercial potential of nearby beaches and off-shore waters. To minimize discharge problems, most process water will be recirculated, limiting the plant offtake to less than 1% of Balsas River flow past the plant. The sea's proximity also will simplify drainage and reduce the cost of effective disposal of treated effluents. Descriptions of the specific pollution control devices being incorporated into the steel works are contained in Annex 4-1, and the general objectives for pollution control are outlined in Annex 8. The total capital cost of identifiable pollution control steps is estimated at US$15 million and the addition to operating costs at about US$2 per ton of steel product.

4.11 During negotiations, SICARTSA gave assurances to the Bank that it would continue to carry out the project with due regard to environmental factors.

4.12 More general environmental problems are associated with development of the port, new city, and regional infrastructure. These are beyond the direct control of SICARTSA and are effected by a variety of Government and private agencies involved in their development. A consulting ecologist visited the project region for the Bank in August 1972, and conducted a general survey of the problems presented by the above infrastructure development, as well as the general ecological effects of building a huge steel works in this heretofore undeveloped area. From his report, it can be concluded that there is little chance of any adverse effect on the Zihua-

tanejo tourism project, 100 km down the coast, which the Bank is helping to finance. In the project area, however, the consultant identified a number of possible hazards, including the destruction of mangrove estuaries through land-fill operations, upsetting certain natural systems that provide natural waste treatment and nutrients for off-shore marine life, and possible eutrophication of the waters within the new port because of inhibited natural flushing action.

4.13 The latter problem seems now to have been resolved through changes in the port design, but others will remain. Longer-range planning is needed, and the Bank therefore will encourage the Government to prepare a master land-use plan for the Michoacan/Guerrero coastal region. Insofar as the Bank is involved in the Las Truchas project and Zihuatanejo tourism development, and possibly will participate in a proposed forestry project in Guerrero, a Bank offer of assistance to the Government in drawing up this plan will be forthcoming.

F. Project Organization and Management

4.14 Responsibility for project execution rests with SICARTSA, under its Director General, former cabinet member Ing. Adolfo Orive Alba, and Project Manager Ing. Carlos Molina, a man with many years of experience in the Mexican construction industry. (A chart of SICARTSA's present organization for the construction period is shown in Annex 9.) They are receiving substantial assistance from BSC in all technical, financial, marketing and organizational aspects of the project. 1/ BSC at present has about 65 resident specialists in Mexico, and will continue at this general level of assistance throughout the construction period and into the initial period of operations. BSC counterpart staff are assigned at various levels throughout the organization, including the general management of the company, and most technical areas have BSC staff in functional, not merely advisory capacities. The arrangement appears to be running smoothly and a good technical team has been put together.

4.15 Overall, SICARTSA's organizational arrangements are considered appropriate to the company's needs. The major weakness has been that the important financial planning and marketing functions have been contained in the Economics and Finance Division, where they have not received adequate attention as commercial (versus economic) subjects. During negotiations, however, SICARTSA informed the Bank that this division would be split into separate economic planning, financial planning/control, and sales divisions, with the latter two headed by qualified executives. These arrangements are considered satisfactory, as are the procedures SICARTSA has indicated it will follow to inform the Bank of the professional qualifications of appointees to these posts, and other executive positions.

1/ The BSC group includes sub-contracted staff from W.S. Atkins & Partners and McLellan and Partners, both of the United Kingdom. Specialized assistance in pelletizing has been sub-contracted to Koninklijke Nederlandsche Hoogovens en Staalfabricken NV of the Netherlands, and in iron ore exploration and mine planning to Societe Francaise D'Etudes Minieres (SOFREMINES) of France.

G. Employment and Training

Labor Force

4.16 By the end of 1973, approximately 1,750 persons will be working on construction of the steel works. The work force will increase to about 7,000 by the end of 1974 and peak at 9,300 in 1975. The operational labor force will total about 3,700 persons, excluding head office and sales personnel (Annex 10). Of these, about 7% will be associated with the iron ore mine and related ore processing and transport facilities. Operating labor will comprise roughly half of the labor force and maintenance employees a third. The balance will be supervisory, administrative, and other salaried staff. The total implies a labor productivity of about 8 man-hours per ton of finished product, which is very good by world standards for plants of this type.

Training

4.17 Training of the above labor force will be carried out by a new Training and Development Department as outlined in Annex 10. The program has been discussed in detail with the Bank and is considered consistent with the goal of facilitating successful start-up and initial operation of the plant. A new training center will be financed in part by a grant of US$500,000 equivalent from the British Overseas Development Administration (ODA), which also will be applied towards the cost of training senior Mexican personnel in U.K. steel works.

H. Project Schedule

4.18 Project completion is planned for mid-1976 in accordance with the schedule shown in Annex 11. The schedule is tight but achievable if the momentum established over the past year can be maintained. This will require Government cooperation in expediting the registration of purchase contracts and issuance of import licenses, and appropriate assurances in this respect were given by the Government during negotiations. Civil works are already underway and initial letters of intent to place orders for major equipment packages are beginning to go out. It is expected that the first firm orders (with escape clauses) for items the Bank has been asked to finance (para. 5.10) will be placed prior to consideration of the project by the Bank's Board. In view of the necessity to maintain project schedules, the Bank has agreed to recommend to the Executive Directors retroactive financing of up to US$3 million (4.3% of the loan) to cover the maximum projected expenditures prior to Loan signing.

V. CAPITAL COST FINANCING PLAN AND PROCUREMENT

A. Capital Cost

5.01 The project cost estimate is detailed in Annex 12-1 and summarized below:

CAPITAL COST OF THE PROJECT

	M$ Million			US$ Million			
	Foreign	1/Local	Total	Foreign	1/Local	Total	%
Plant, Equipment and Spares	2060	949	3009	164.8	75.9	240.7	37.9
Services	57	104	161	4.6	8.3	12.9	2.0
Freight and Insurance	153	63	215	12.2	5.0	17.2	2.7
Erection & Commissioning	123	666	789	9.8	53.3	63.1	9.9
Civil Works	-	995	995	-	79.6	79.6	12.5
Structures	100	210	310	8.0	16.8	24.8	3.9
Design & Engineering	111	225	336	8.9	18.0	26.9	4.2
Physical Contingencies	192	234	426	15.4	18.7	34.1	5.4
Total Fixed Assets	2796	3445	6241	223.7	275.6	499.3	78.6
Pre-Operating Expenses	247	628	875	19.8	50.2	70.0	11.0
Initial Working Capital	100	250	350	8.0	20.0	28.0	4.4
Price Contingencies	195	284	479	15.6	22.7	38.3	6.0
TOTAL PROJECT COST	3339	4606	7945	267.1	368.5	635.6	100.0
Financial Charges During Construction	399	-	399	31.9	-	31.9	
Refinancing of Early Debt Maturities & Operating Interest	138	-	138	11.0	-	11.0	
TOTAL FINANCING REQUIRED	4264	4217	8481	341.1	337.4	678.5	

5.02 The equipment estimates were prepared by BSC in August 1972, based on budget quotations from suppliers; modified in March 1973 to reflect the effects of currency realignments in February; and totally revised in June

1/ Direct foreign exchange component.

1973 to obtain the above figures, which are to be used for project cost control purposes. Civil works and structures have been based on quantities derived from design drawings, supplemented by BSC's experience on similar projects and unit rates quoted by Mexican contractors. Physical contingencies to cover unforeseen needs during construction have been taken at 7.5% of fixed capital, based on BSC's experience with similar projects. Pre-operating expenses include training costs and BSC fees, as well as the administrative costs projected for the pre-operating period. Price contingencies have been determined on the basis of expected price escalation at 6% per annum for internationally-bid equipment and related items and 5% p.a. for civil works, structures, design and engineering, and pre-operating costs -- a composite reflection of recent Mexican price trends. Approximately US$155 million in equipment, for which fixed price bids already have been received by SICARTSA, are excluded from the price contingency calculation. The initial working capital estimate is that portion of total working capital that cannot be financed by internal cash flow, i.e., through the end of 1977, 18 months after scheduled start-up. Overall estimating methods have been conservative and the assumptions made are considered reasonable.

5.03 The direct foreign exchange component of total project costs (excluding financial charges) is estimated at 42%, based on BSC's assessment of the likely competitiveness of Mexican equipment suppliers.

B. Adequacy of Capital Cost by World Standards

5.04 This issue is addressed fully in Annex 12-2. If the unescalated project cost estimate is adjusted to eliminate the iron ore mining and processing components, thereby making it more comparable with published international figures, the modified total implies a capital cost for Las Truchas of about US$395 per achievable annual ton of raw steel, in 1973 dollars. This compares favorably with world standards for non-flat steel plants (which do not lend themselves as easily to the great economies of scale possible with flat products plants of the type now being constructed in Japan and Europe).

C. Financing Plan

5.05 The table in para. 5.01 shows a total project financing requirement of US$678.5 million equivalent, of which 46% is foreign exchange. The total includes US$31.9 million for interest and financing charges during construction, and US$11.0 million to refinance debt maturities and interest due between the start of operations and 1978, when the company is expected to begin showing a positive net cash flow (see para. 6.06). The financial plan is as follows:

FINANCING PLAN

Source	Amount	%
IBRD Loan	70.0	10.3
IDB Loan	54.0	8.0
Foreign Bilateral Credits	178.6	26.3
Other Loans	75.4	11.1
Total Long-Term Debt	378.0	55.7
U.K. Grant (O.D.A.)	0.5	0.1
Equity	300.0	44.2
Total Financing	678.5	100.0

5.06 The Bank, IDB and Bilateral loans and credits together constitute a parallel financing scheme, in which each lender finances separate lists of goods and services and disbursements are handled independently. Together, the Bank and IDB have been asked to provide almost a third of external financing, and this has been sufficient to give the two institutions a key role in project planning.

5.07 The Bank loan would be for 15 years, including 5 years of grace, at the prevailing interest rate of 7-1/4% plus a NAFINSA guarantee fee of 1-3/4%, bringing the total cost to the company to 9%. The IDB loan would be on similar terms, but at 8% interest with a single 3/8% payment made to NAFINSA as a service fee. Bilateral credit agreements have been finalized or are being negotiated with Austria, Belgium, Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States on the basis of preliminary commitments made in 1971/72. There is no danger that adequate bilateral financing will not be available. The terms vary somewhat, but on average provide for the credits to cover 90% of the c & f value of equipment from suppliers in the respective countries, plus 15% of this value for Mexican currency expenditures, for an average of 15 years with 4 years of grace (or 11 years repayment beginning 12-18 months after commissioning of the equipment) at an average cost to SICARTSA of 7%. The company's equity requirement of US$300 million will be met in Mexican currency by the existing shareholders as described in paragraph 2.03. The equity will be made available during the construction period, according to a schedule agreed with the Bank during negotiations. Together with the above loans and credits, this yields total financing of US$603.1 million, or US$75.4 million short of total requirements, through the construction and initial operating periods. The residual amount will not be needed until 1976 and 1977, as the financial projections in Annex 16 indicate, and the source of this financing has not yet been identified. Its provision will be adequately covered by the Government's completion and overrun commitments described below.

5.08 During negotiations, the Bank obtained an unlimited Government guarantee to provide project completion and cost overrun financing, on terms satisfactory to the Bank, so as to ensure project start-up under any eventuality (subject to a maximum 60/40 debt/equity ratio). This includes coverage of SICARTSA's working capital position (minimum current ratio of 1.5:1) until production and sales over six continuous months at 90% of rated capacity have been achieved.

D. Procurement and Disbursement Under the Bank and IDB Loans

5.09 The Bank loan is intended to finance approximately $62 million (c & f costs) of equipment, spare parts and building structures acquired through international competitive bidding, in accordance with the Bank's guidelines, and about US$8 million of interest during construction thereon. A two-stage bidding process (technical proposals followed by separate price proposals) similar to that used with the Brazilian Steel Projects is being followed. The selection of items for Bank finance and specific procurement procedures have been based on the desire (i) to broaden SICARTSA's supply base beyond the nations offering bilateral financing so as to increase competition, and (ii) to enable Mexican manufacturers to participate in equipment supply on an internationally-competitive basis beyond the limits of local financing available through bilateral lenders. In meeting these objectives, a bidding and preference system has been adopted which recognizes that much of procurement for the project must necessarily comprise large packages with single contractor responsibility -- i.e. the blast furnace, pellet plant, etc. Since no Mexican supplier could meet prequalification criteria for such overall responsibility, an incentive to use Mexican resources is given to non-Mexican bidders by way of a 15% margin of preference 1/ on the clearly identified Mexican components of non-Mexican bids. For this purpose, a component is defined as being of Mexican origin (i) when supplied by a company incorporated in Mexico and (ii) when the costs of local materials, labor and services used in its manufacture are not less than 50% of the total value of the component. In those cases where Mexican companies can prequalify to bid directly, and not simply as sub-suppliers, their bids are considered entirely Mexican when Mexican value added reaches 50%. Procurement under the IDB loan will follow similar principles.

5.10 A list of the items proposed for financing by the Bank is contained in Annex 12-3. Assuming a 20% foreign exchange component for goods originating in Mexico, the likely final allocation of the Bank's loan is as follows:

LIKELY ALLOCATION OF BANK'S LOAN

	US$ Million	% of Total
Foreign Equipment, Components and Spares	33	47
Mexican Equipment, Spares and Structures	29	42
Interest During Construction	8	11
Total Bank Loan	70	100

1/ Or the prevailing import duty in Mexico, if lower than 15%.

The Bank will disburse the full c & f cost of equipment for all items, irrespective of the origin of the goods (excluding non-Bank members).

5.11 The loan is expected to be fully disbursed by the end of 1977 according to the schedule shown in Annex 12-4.

E. Other Procurement

5.12 Bilaterally-financed equipment items are being procured under the same general principles of international competitive bidding as those followed for the Bank and IDB lists, except that credit terms are taken into consideration during bid evaluations. Mexican sub-suppliers are receiving a similar 15% margin of preference in bid evaluation to encourage bilateral lenders to allow suppliers in their respective countries to maximize the use of Mexican resources. About US$30 million of additional equipment has been reserved for procurement in Mexico. These are smaller items, such as cranes, motors, pumps, etc. for which adequate competition can be obtained in Mexico, and the arrangements are judged satisfactory. Civil works and all structures, except for the large rolling mill buildings contained in the Bank list, are being procured competitively in Mexico and, like the Mexican equipment, are being financed by equity and the local components of bilateral credits. The same is true for most of the erection and commissioning contracts. The lack of international competitive bidding is not judged likely to raise prices artificially for any of these items. The Mexican construction industry is large enough to absorb the project without overheating, and no problems are anticipated in obtaining necessary labor skills.

VI. FINANCIAL ANALYSIS

A. Projected Revenues

6.01 The assumed buildup of revenues is shown in Annex 13 and is based on SICARTSA's projected commissioning period of 2-1/2 years from startup in mid-1976 to full production in 1979. This is considered realistic for a plant of this type and is achievable if the training and commissioning programs are carried out as planned. In accordance with the conclusions in para. 3.06, the average sales price delivered Mexico City is US$185.5 per ton of steel product (in constant 1973 currency). After sales costs, taxes, and discounts, the average net yield to SICARTSA becomes US$176.3 per ton. Escalation is then applied as shown in para. 6.05.

B. Operating Costs

6.02 Operating costs have been estimated on the basis of BSC estimates of fixed and variable consumptions of raw materials, labor, fuel and energy, consumables, maintenance materials and sundries for each cost center. Labor costs have been based on detailed manning schedules, projected minimum wage rates in the project area following plant completion, and analyses of the payroll cost structures of other steel companies in Mexico. Materials and energy prices have been taken at prevailing unit rates in Mexico and adjusted for possible changes prior to start-up -- except for the assumed coal import price of US$22 per ton CIF (1973 currency) which is based on a worldwide study of future coal prices conducted in early 1973. The estimating methods have been reviewed by the Bank and are considered acceptable.

6.03 Total operating costs, excluding depreciation, interest, and finished product transport, are estimated at US$59.1 per ton of finished product, of which fixed costs constitute US$15.6 per ton (27%) and variable costs US$43.5 per ton (73%). These also are subjected to escalation as shown in para. 6.05. A full breakdown is shown in Annex 14 and summarized below:

UNIT OPERATING COSTS AT FULL PRODUCTION

	1973 US$ per Ton of Product	% of Total
Wages and salaries	12.7	22
Raw Materials - Coal	15.6	26
Other	5.5	9
Fuel and Energy	3.8	6
Maintenance Materials	12.1	21
Consumables/Sundries	8.4	14
Plant Insurance	1.0	2
Total	59.1	100

The total is low by world standards, but is considered realistic in view of the savings to be obtained by basing the project on local iron ore. The projected full cost of iron ore pellets into SICARTSA's blast furnace is about US$10 per ton, which is at least US$7 below comparable costs to European and Japanese producers. This implies a total operating cost savings of US$11-12 per ton of finished product, or about 17% of what total unit operating costs might be if SICARTSA had to import iron ore.

C. Transport Costs

6.04 It has been assumed for the financial analysis that road transport will be used to all markets -- the most conservative alternative cost-wise. The cost from Las Truchas to Mexico City is estimated at US$13.6 per ton and is considered an appropriate average based on prevailing rates in Mexico. Since SICARTSA needs to absorb transport costs for only the 60% of its output actually destined for Mexico City (Annex 1), its true road transport cost would be only US$8.2 per ton of total plant output.

D. Escalation in the Financial Projections

6.05 To provide a reasonably accurate picture of SICARTSA's liquidity position during the early years of operation, the Bank's financial projections have been based on operating costs escalated at 3% per annum, representing a composite of expected rates of increase for the various plant inputs. With prices it has been assumed that 1976 levels in real (uninflated) terms would be about 2-3% above those prevailing in mid-1973 and that, subsequently, current prices would increase about 2% per annum, or roughly 1% below the rate of increase for operating costs. Depreciation and financial charges are not escalated since they relate to capital costs that remain on the books at historical values. The price assumption is conservative and is intended to demonstrate (i) that SICARTSA can remain financially viable even if its prices rise at a lower rate than the general rate of inflation in Mexico and (ii) that SICARTSA thereby can be expected to exert a positive restraining influence on future Mexican steel price increases under competitive conditions.

E. Future Profitability

6.06 Detailed income and cash flow forecasts for the first 10 years of operation are shown in Annexes 15-1 and 15-2, and selected items are summarized below:

SELECTED PROFITABILITY INDICATORS
(US$ million)

	1976	1977	1978	1979	1982	1985
Sales Volume (000 tons)	150	500	800	1000	1000	1000
Net Revenues	30	101	165	210	223	236
Operating Profit	(14)	9	55	86	91	97
% of Revenues	(47)	9	33	41	41	41
Net Income after Taxes	(25)	(22)	24	58	90	57
% of Revenues	(83)	(22)	15	28	40	24
% of Equity	(9)	(9)	9	17	19	10
Cumulative Net Income	(25)	(47)	(23)	35	276	465
Net Cash Generation	-	-	16	61	61	28
Cumulative Net Cash Generation	-	-	16	77	219	325

The projections show losses for the first 18 months of operation, followed by a profit of US$24 million, or 9% of shareholders equity, in 1978. From 1979 through 1983, annual net income is a very adequate 15-19% of shareholders equity, but it drops subsequently to about 10% after income taxes come into full effect in 1984. Prior thereto, SICARTSA will have the benefit of accelerated tax depreciation given to new enterprises in specially-designated development regions, the effect of which is to enable the company to avoid paying taxes until its assets are fully depreciated on the tax books. Cumulative losses are covered by 1979 and cumulative

profits reach US$465 million at the end of 1985, the tenth year of operations. Net cash generation after debt service and assumed dividends rises rapidly after 1977, and cumulative net cash generation is projected at US$325 million over the 1976-85 period, providing a substantial input to new investment and expansion. The financial rate of return on total capital using constant prices (net of assumed inflation) is about 11% and on shareholders equity about 10%.

F. Financial Position

6.07 Balance sheet projections for 1976-85 are contained in Annex 15-3 and significant indicators are given below:

SELECTED INDICATORS OF FINANCIAL POSITION
(US$ million)

	1976 (6 mo)	1977	1978	1979	1982	1985
Current Assets /1	34	50	79	81	87	93
Current Liabilities	12	26	42	43	45	47
Net Working Capital /1	22	24	37	38	42	46
Current Ratio	2.9	1.9	1.9	1.9	1.9	2.0
Quick Ratio	1.3	1.0	1.4	1.0	1.0	1.1
Long-Term Debt/Equity	36/44	59/41	56/44	48/52	30/70	13/87
Times Debt Service Covered	0.6	1.4	2.2		(over 2.2)	

/1 Excluding Surplus Cash for Investment.

Satisfactory net working capital figures are shown for 1976 and 1977 only because the company will continue to draw down long-term debt during the first 18 months of operation, in part to refinance maturities and interest on earlier debt. From 1978 onward a positive net cash flow is projected and a sound current ratio of 2:1 or greater results, together with an equally healthy quick ratio of 1.4:1 or more. The debt/equity ratio peaks at 59/41 in 1972 and drops below 50/50 in 1979, the first year of full production. This is considered adequate, so the projected minimum equity base of US$300 million is acceptable. Debt service coverage during the first 6 months of operation is low, consistent with SICARTSA's projected need for outside financing during 1976 and 1977 and justifying the Bank's extension of its grace period to five years. By 1977, the company begins to cover its interest and principal obligations and, subsequently, a healthy coverage of two times or greater is projected.

G. Sensitivity Analysis

6.08 An analysis has been carried out to determine the sensitivities of the projected rate of return and various indicators of SICARTSA's financial position to changes in basic assumptions. Two sets of tests have been run, the first pertaining to the projected production and sales buildup period of 2-1/2 years (the "A" cases) and the second assuming an extended 5-1/2 year buildup period (the "B" cases) that could result if plant commissioning were not to proceed as fast or the market were to grow slower than expected. The former is considered more probable and therefore was chosen for the preceding financial projections. The results of the sensitivity analysis are shown in Annex 15-5 and summarized below:

SENSITIVITY TESTS

		Rate of Return (%)	Debt Service Cover 1977 (Times covered)	1978	1979	Net Cash Accum. to 1980 (US$million)
(1) Base cases	A	11	1.2	1.8	2.0	118
	B	10	0.8	1.7	1.9	67
(2) 1% slower price increase	A	10	1.2	1.8	1.9	108
	B	9	0.8	1.6	1.8	57
(3) Capital costs down US$60 million	A	13	1.7	2.4	2.7	131
	B	12	1.2	2.2	2.5	92
(4) Capital costs up US$60 million and 1 year startup delay	A	9	0.1	0.7	0.8	20
	B	8	0.1	0.5	0.6	3
(5) Operating costs up 15%	A	9	0.9	1.5	1.7	80
	B	9	0.5	1.3	1.5	31

The primary effect of the slower buildup is to reduce surplus cash generation over the 1976-80 period, and, therefore, the internal resources that would be available for Stage II expansion. It does not greatly affect the rate of return or the early liquidity picture, as shown by debt service coverage in 1977-78. A further cost/price squeeze of 1% per annum (beyond the 1% squeeze already implicit in the base cases) reduces the rate of return by about 1% and has a marginal effect on liquidity and cash accumulation. A reduction in capital costs of US$60 million, or about 10%, would yield significant benefits in all areas with the opposite true for an equal increase in costs and a one-year startup delay. Operating costs are important, but not found to be critical within the 15% range of error assumed in Cases 5 A and B. This is considered the most probable of all the sensitivity cases.

6.09 As Annex 15-6 shows, the sales plan lags behind the cash break-even sales level throughout the first 18 months of operation but the two coincide by 1978 and subsequently diverge, with sales increasing and the break-even level falling. By 1980, the company could break even on cash account at 58% of projected sales.

H. General Project Risks and Sensitivity Implications

6.10 The conclusion to be drawn from the above sections is that the company's long-term financial position is strong, but that the first year or two of operations present liquidity problems having important implications for lender security. This risk should be covered adequately by the completion and overrun guarantee recommended in para. 5.08. Once the project reaches full production, financial risks from a lender's viewpoint will be low. Therefore, although it might be argued that Government ownership of SICARTSA would justify an ongoing working capital guarantee for the life of the Bank loan, it is felt preferable to cut this direct link with Government in the interest of maintaining a level of financial and commercial independence for the company. Nevertheless, because the Government will retain the right to control steel price ceilings, the Government's agreement to review steel prices from time to time, as described in para. 3.07, is very important from the standpoint of SICARTSA's future financial performance. The agreed consultation clause in the Guarantee Agreement will allow the Bank and the Government to exchange views in this regard as necessary.

6.11 It was further agreed during negotiations (i) that no dividends be allowed until the debt/equity ratio has dropped below 50/50 and/or if the result thereof would be to lower the current ratio below 1.5:1; (ii) that cumulative dividends at any point in time be restricted to one-half of SICARTSA's cumulative net income from the time of plant start-up; (iii) that SICARTSA be restricted from undertaking any further long-term debt if the result thereof would raise the debt/equity ratio above 60/40; and (iv) that capital investment exceeding US$15 million per annum be allowed only after prior agreement between the Bank and SICARTSA.

I. Further Expansion (Stage II)

6.12 As noted previously, SICARTSA plans to move into its second stage of development soon after successful start-up of Stage I. Construction might be expected to begin around 1978, with the first production about 1981. The projected capital cost of Stage II is US$400-450 million at 1973 prices, including fixed assets, working capital and pre-operating expenses. This is roughly 70-80% of the estimated cost for Stage I, implying considerable economies of scale. Preliminary estimates indicate an incremental financial return from the expansion of 13-15%.

VII. ECONOMIC JUSTIFICATION OF THE PROJECT

A. Las Truchas Versus Alternative Steel Expansions

7.01 This issue is addressed in detail in Annex 16-1. The Las Truchas project has been chosen from amongst several alternatives for the next major step in Mexico's steel expansion, among which have been (i) importation of semi-finished steel products for domestic rolling into finished products; (ii) production of steel in electric furnaces, based on sponge iron and imported scrap; and (iii) fully-integrated steel production schemes, either as expansions of existing Mexican plants or as new projects adjacent thereto. The first route would be impractical as a means of meeting future demand growth insofar as supplies of semi-finished steel on world markets would be difficult to obtain on a reliable, long-term basis and, even if obtainable, would be expensive. The second alternative also is unattractive as a major production route given Mexico's position as a net importer of scrap, the unreliability of imported scrap supplies and prices, and the high opportunity cost of electricity in the country. The third route implies a number of separate alternatives which basically are less attractive than Las Truchas because of restraints imposed by their locations. SICARTSA's location adjacent to its iron ore supply and a deep water port facility will give it raw material advantages unmatched at any of the locations of the existing integrated producers. The coastal site is in keeping with the world-wide pattern in recent years to place new steel works at sites where they can utilize high-quality imported raw materials transported from distant locations in large bulk carriers. In the long run Mexico will need to import iron ore, and when the Las Truchas reserves are depleted, SICARTSA will be in a position to import it at far less cost than the present inland producers. SICARTSA also is about 30% closer to the main Mexico City steel market than its major competitors; and, although the project will hasten the need for improvements in the regional transport system, the long-term economic costs of moving its finished products should be lower than those of the existing producers.

B. Economic Return

7.02 Steel import prices used in the economic return calculation are those discussed in para. 3.11. Costs have been based on the financial estimates, with adjustments made for taxes and higher energy, port, and transport costs, as shown in Annexes 16-2 and 16-3. Labor costs have not been shadow-priced. All economic projections have been made on a constant-price basis. A graphical representation of the economic return calculations is found in Annex 16-4. The basic return is 12-13% for the likely range of import prices, assuming the probable 2-1/2 year production buildup period, and from 11-12% for the slower 5-1/2 year buildup. At the maximum possible long-term price, the return rises to 15-16%. Increasing the assumed transport cost by 50% -- a level considered sufficient to take in virtually any transport cost contingency --

lowers the economic return by only 1%, so that it can be concluded that transport is not a serious economic issue. Combining a 15% increase in operating and port costs with the above transport increase yields an economic return range of 8-11%, similar to the 8-10% range that results from a one year startup delay and capital cost overrun of US$60 million. In no case does the return drop below 8%, and even that level would result only from a combination of unlikely events. If full shadow pricing had been utilized, it is likely that these returns would have been higher. It therefore is concluded that the probability of an economic return exceeding 10% is very high, making the project economically viable in the Mexican context.

C. Foreign Exchange Savings

7.03 The direct foreign exchange (FE) effects of the project are shown in Annex 16-5. Indirect FE effects have been ignored. Over the 1976-91 operating period, net FE savings are projected at US$1,714 million, or an average savings of US$111 million per year. The annual figure implies that the FE component of capital investment in the project, US$292 million, will be covered in less than three average years of operation. The above estimates are felt to be conservative insofar as the benefit stream is based on the minimum steel import price used in the preceding economic analysis and therefore reflects the minimum projected gross FE savings to Mexico through import substitution.

D. Regional Impact of the Project

7.04 Regional or secondary benefits of the project have not been taken into account in the preceding economic analysis. Nevertheless, as described in Annex 17, the project's impact on the surrounding region should be considerable. The regional employment effect most likely will be through SICARTSA's generation of demand for supplies and through the demand of its employees for consumer goods and services -- so-called "backward" linkages. "Forward" linkages to new industries in the area that will use SICARTSA's products are not likely to be large, particularly in the first stage. An analysis has been carried out of the actual impact the AHMSA steel plant had on the city of Monclova following its construction in the 1940's and the results have been transferred to the Las Truchas case. If this is any guide -- and there is reason to believe it is -- the urban population in the Las Truchas area is likely to rise from the present 15,000 persons to over 90,000 by the end of the century. It could well be higher, given the other resources in the region.

VIII. AGREEMENTS REACHED DURING NEGOTIATIONS

8.01 During negotiations, the following principal agreements were reached with the Government, NAFINSA, and the company:

Steel Development Policy

(a) The Government will take all reasonable action required for coordinating steel expansion in Mexico, and will not approve or support further expansion of existing steel plants or new steel works without considering market demand and economic justification, including in the latter, consideration of the impact on the viability of Stage II of Las Truchas (para. 3.12);

(b) The Government will review steel prices in Mexico from time to time and use its best efforts to maintain prices at levels that (i) are reasonably related to Mexican production costs and world price levels and (ii) are such as to allow steel consumers in Mexico to share in any decline in production costs through reductions in steel prices (para. 3.07);

Infrastructure

(c) The Government will provide the transport infrastructure needed by SICARTSA and allocate the resources necessary towards this objective (para. 4.08);

(d) SICARTSA will submit to the Bank for comment by September 30, 1974, detailed plans for steel product transport, including organizational arrangements (para. 4.08);

(e) Adequate Government support will be given to the construction program for Lazaro Cardenas City (para. 4.09);

Organization

(f) The company's present Economics and Finance Division will be reorganized into separate economic planning, financial and sales functions, with the latter two under commercially-oriented managers (para. 4.15);

(g) The Bank will be informed as to the professional qualifications of the financial and sales managers, and has been assured that any future appointments or changes at similar levels of management will be determined by the same high standards of recruitment (para. 4.15);

Financial

(h) The Government will guarantee the provision of a minimum of US$300 million in equity according to an agreed schedule (paras. 2.03 and 5.07);

(i) The Government will provide an unlimited project completion and cost overrun guarantee (subject to a 60/40 debt/equity restriction and with all financing on terms satisfactory to

the Bank) including provision of working capital to maintain a current ratio not lower than 1.3:1 until 90% of rated production and sales capacity is reached over six consecutive months (para. 5.06);

(j) Dividends will not be allowed until the debt/equity ratio drops below 50/50 and/or if the result thereof would be to lower the current ratio below 1.3:1, and cumulative dividends at any point in time will not exceed one-half of cumulative net income from the beginning of operations (para. 6.11);

(k) No further long-term debt will be incurred by SICARTSA if the result would be an increase in the debt/equity ratio above 60/40 (para. 6.11);

(l) No additional capital investment above US$15 million per annum will be incurred without prior agreement between the Bank and SICARTSA (para. 6.11);

Ecology

(m) The project will be carried out with due regard to environmental factors (para. 6.11);

General

(n) The Government will cooperate to the fullest extent possible in expediting the registration of SICARTSA's purchase contracts and the issuance of import licenses (para. 4.18).

8.02 Based on the foregoing, the project provides a sound basis for a loan to SICARTSA of US$70 million equivalent for 15 years, including 5 years of grace.

Industrial Projects Department
August 10, 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

THE MARKET AND PRICES FOR STEEL IN MEXICO

A. The Market

Introduction

1. The Mexican steel industry traces its modern history back to 1900, when the first integrated iron and steel plant was established at Monterrey by Fundidora de Fierro y Acero, S.A. (Fundidora), with capacity for 90,000 tons of ingot steel per year, and a rolling mill for shapes and rails. It produced 11,000 tons of steel in 1903, the first year of production, and by 1911 output had risen to 72,000 tons. The next major development took place in 1941, when Altos Hornos de Mexico, S.A. (AHMSA) was formed to set up an integrated steel mill for flat products at Monclova. The plant was conceived as a wartime measure, to achieve a measure of independence from imports, and was given special facilities for procuring new and used equipment from the U.S.A.; it was commissioned for production only in 1945. Since then the industry has grown considerably, and Mexico's present annual capacity for raw steel production is estimated at 5.2 million tons, distributed among the various companies as shown below:

MEXICAN CRUDE STEEL CAPACITY DISTRIBUTION

Company	Capacity (000 tons)
AHMSA	2,500
Fundidora	950
Hojalata y Lamina, S.A.- Monterrey (HYLSA) and Puebla	750
Tubos de Acero de Mexico, S.A.- Veracruz (TAMSA)	280
Others 1/	670
Total	5,150

Fundidora is expected to increase its capacity to 1.5 million tons before SICARTSA begins production in 1976, so the total industry capacity for this exercise can be taken at about 5.7 million tons.

2. Actual raw steel production in 1972 was 4.2 million tons, up 7.2% from the previous year. Historical data of capacity utilization suggests that technical limitations restrict actual output in the integrated units to about 90% of installed capacity, and in the semi-integrated units to about 80%. On this basis, total output from the nominal capacity of 5.7 million tons would be about 4.6 million tons, which can be taken as the

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1/ Six small semi-integrated plants. The bulk of this capacity is located in the Mexico City area.

effective raw steel capacity of the industry.

3. The installed capacity for rolling finished products is substantially in excess of the industry's current steel making capacity. SICARTSA has estimated the effective rolling capacity of the industry at about 2.4 million tons of flat products, 1.8 million tons of light non-flat products, 0.6 million tons of heavy sections, and 0.2 million tons of seamless pipes, for a total of about 5.0 million tons. This estimate assumes the effective rolling capacity of the integrated mills at 90% of nominal capacity, the semi-integrated mills 80%, and the non-integrated units 70%. These percentages are considered reasonable as measures of true capabilities, although they exceed actual performance to date by any of the major categories of producers. Since five million tons of finished products would require about 6.7 million tons of raw steel input, and the existing raw steel capacity is only about 5.2 million tons, the country is nominally short about 1.5 million tons. This gap will be reduced to about 1 million tons after Fundidora's expansion to 1.5 million tons.

Recent History of Steel Consumption

4. Apparent consumption[1/] of steel products in Mexico has increased during the past 20 years at an average annual rate of about 7.7%, though it has fluctuated substantially from year to year. Apparent consumption exceeded 1.0 million tons equivalent for the first time in 1956, and by 1965 had risen to 2 million tons, despite four years during which consumption declined or showed no appreciable growth. The average annual growth rate for 1952-62 was 7.1%; and the record for the following decade was somewhat better, with apparent consumption increasing from 1.4 million tons in 1962 to 3.1 million tons in 1972, or an average annual growth rate of 8.3%. During the 1971 recession, apparent consumption dropped to 2.8 million tons. For details see Table 1-1.

5. From 1953 onwards, the Iron and Steel Manufacturers Association (CNIHA) has maintained continuous detailed records of consumption by product group (see Table 1-2). They indicate that from 1962 to 1972 apparent consumption of non-flat products increased from 680,000 tons to 1,312,000 tons (6.8% annual rate) while that of flat rolled products increased from 566,000 tons to 1,552,000 tons (9.9% annual rate). During the same period, the apparent consumption of seamless pipe increased very little: from 130,000 tons in 1962 to 191,000 tons in 1972 (3.9% annual rate). The apparent growth of flat rolled products consumption at a faster rate than non-flat products is in keeping with the experience of other countries during similar stages of development.

Projections of Demand for Steel through 1980

6. Several projections of domestic steel demand have been prepared

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1/ Domestic production plus imports minus exports.

in recent years. First the Bank of Mexico attempted a projection for the period 1967-76, based on its experimental input-output model for the Mexican economy (45 sectors). This was part of a large exercise for forecasting development of the Mexican economy, and was superseded by studies undertaken by Nacional Financiera, S.A. (NAFINSA), which has a substantial interest in the two largest steel companies, AHMSA and Fundidora, as well as SICARTSA. NAFINSA prepared an independent long-term forecast in 1969 which was updated in May 1971. CNIHA also prepared demand forecasts for the period 1971-80 in 1969 and again in 1971. Finally, taking these studies into account, SICARTSA prepared its own forecasts, focusing on demand for the non-flat products of the proposed project.

7. NAFINSA's projection of steel demand (1969) was derived from a linear programming model of the industrial sector. It estimated growth of demand at an annual average rate of 9.5% through the decade, and was based on the assumption that GDP would grow at 7.1% annually during the period. The revised 1971 estimate also assumed growth of GDP at 7.1% annually, but projected growth of demand for steel at 8.9% per year for 1970-75, and 8.7% per year for 1976-80. The changes in the second estimate were not fully explained; they appear to have been influenced to some extent by the actual record of growth in 1969 and 1970, and by the analysis undertaken by SICARTSA.

8. CNIHA's 1969 forecast envisaged growth of demand at an average annual rate of 11.4% for 1971-75 and 10.5% for 1976-80. The revised 1971 forecast offered two projections: a low rate of 6.5% annual growth through the decade, and a high rate of 9.0%. The differences between the two forecasts, and the assumptions on which the low and high growth rates of the 1971 forecast are based, were not explained. However, CNIHA depends to a large extent upon forecasts made by member firms, and changes in their expectations have a direct bearing on the Association estimates for the future. It should be mentioned that a forecast made by CNIHA staff in the mid-60's, which estimated raw steel demand in 1970 at 3.84 million tons, turned out to be very close to the actual figure -- 3.89 million tons; but it was based on an assumption that GDP would grow at 6% annually in the years 1965-70, or about 1% below the actual. In the end, the wide gap between the low and high projections for the decade of the 70's detracted somewhat from the usefulness of the CNIHA forecasts.

9. SICARTSA's first estimate of demand for steel in Mexico, made in 1971, followed the pattern of earlier studies by NAFINSA, and was based on broad assumptions regarding the rate of growth of GDP, the proportion of gross fixed capital formation (GFCF) in GDP and changes therein through time, the correlation of steel consumption to GFCF and GDP, and changes in the indirect consumption of steel, which is related to imports of capital goods. It projected growth of demand in the period 1972-75 at about 10.1% per year and for 1976-80 at 8.6% per year. A second SICARTSA projection, made in the light of consumption data for 1971 and part of 1972, envisaged growth of demand in the first half of the decade at somewhat less than 9% per year, and for the second half of the decade (1976-80) at 8.5% per year. In terms of product tons, Mexico's demand was estimated at 4.9 million tons for 1976, rising to 6.9 million tons in 1980.

10. In March 1973, SICARTSA revised its market projections using 1972 instead of 1970 as the base year and, thereby, reflecting the delay in demand growth caused by the 1971 recession. This third SICARTSA forecast is slightly lower than the second one and shows a total demand for 6.2 million tons of raw steel in 1976, rising to 9.2 million tons in 1980. Demand for non-flat products of the type SICARTSA will produce is projected at 1.8 million tons in 1976 and 2.8 million tons in 1980, or an annual growth rate of 9% from the 1972 level. These estimates appear to be based on realistic assumptions, and are used for the Bank market assessment.

11. The increase in the non-flat growth rate to 9% from the 6.8% that prevailed during the previous decade is justified in view of the expected continuation of the Mexican Government's housing and public works programs that grew very substantially with the coming of the present administration in 1970. A comparative statement of SICARTSA's three projections and those which preceded them is shown in Table 1-3. The estimated split of the aggregate projections into product types is shown in Table 1-4.

Supply of Non-Flat Steel Products

12. As mentioned in paragraph 2, Mexico's current effective capacity for rolling light non-flat products is estimated at 1.8 million tons. This is distributed among the various types of producers as follows:

ESTIMATED NON-FLAT PRODUCTION CAPACITY

	Current (000 tons)
Integrated Mills	1,015
Semi-integrated Mills	480
Re-rollers	270
Total	1,765

If current plans of existing mills for expansion of capacity are carried out, the total rolling capacity may rise to about 2.1 million tons by 1980. It should be noted, however, that the existing capacity for 1.8 million tons at present is being utilized at a level of only about 66%. Therefore it is expected that expansion plans would be implemented as much to achieve rationalisation of existing facilities as to increase rolling capacity itself.

Supply/Demand Comparison for Non-Flats

13. To forecast the supply/demand balance for 1976-80, it has been assumed that the expansions discussed above will be completed by 1980, with half of the additional capacity in place by 1976 when SICARTSA begins production. Moreover, actual supply has been assumed to build up more slowly, with capacity utilization improving from the 1972 level of 66% to about 85% by 1976 and 90% by 1980. The results, using the demand projections discussed

in paragraph 10, are shown in Table 1-5. The estimated excess rolling capacity of 583,000 tons in 1972 is projected to fall to about 255,000 tons in 1976, and actual supply more or less to balance against total demand. Thereafter, supply may exceed demand by quantities ranging up to about 275,000 tons per year in 1978 and 1979; but by 1980 demand is expected to catch up with supply. The excess supply anticipated for 1977-79 represents about one year's expected growth in consumption at that time. Therefore, given the conservative assumption of increased capacity utilization in the existing industry, as well as the marginal nature of some of the existing rerollers, there appears to be sufficient justification for SICARTSA coming into production as scheduled. The possible excess of supply between 1976 and 1980 nevertheless emphasizes the need for SICARTSA to build up an effective marketing program if it is to secure the 35% market share represented by its projected output in 1980 (1.0 million tons out of an expected demand for 2.8 million tons).

14. Imports and exports in the past of the types of products SICARTSA will produce have been negligible and are not expected to be significant in the future. Therefore, they have been ignored in the above supply/demand projection.

B. Prices

Present Status

15. Prices of steel products in Mexico are controlled by the Price Commission, an agency of the Ministry of Commerce and Industry. In practice, however, this control has been nominal until recently since ceiling prices have been fixed at levels seldom achieved in the marketplace. Ceiling prices for non-flat rolled steel products were fixed in 1956 and have not been revised for the past fifteen years. Moreover, market prices as late as January 1972 for the most important categories of products -- reinforcing bars -- were substantially lower than the permissible ceiling prices. They were almost at ceiling level in 1969, but declined in 1970 and continued to be depressed in 1971. More recent (1973) prices have climbed back to ceiling level, and the positive outlook for demand, together with rising production costs in Mexico (as everywhere), indicate strongly that they will not fall substantially in the future. Indeed, there are substantial pressures from the major producers to have non-flat price ceilings raised by about 15%, but no action is anticipated until completion of the Steel Commission study of the industry (see Annex 3).

16. Prices of flat-rolled products, also originally fixed in 1956, were revised in 1969, when the two principal producers, AHMSA and Fundidora, demonstrated that their costs had risen sharply and that they would incur heavy losses at the old ceilings. An average increase of 15% was allowed by the Government.

17. Official price lists are based on ex-factory terms, and additional charges are levied for packing and handling. Apart from the base price, there is the usual range of "extras" for size and quality variations. Turnover tax is levied at 4%, but this is paid by the customer only on flat pro-

ducts, and for non-flat products normally is absorbed by the producer. Similarly, the cost of transport, which is nominally payable by the customer, is borne by the producer wherever competitive conditions make this necessary -- particularly in the Mexico City area where local rerollers tend to dictate prices. In practice, therefore, steel prices in Mexico are not fixed and are affected directly by competitive conditions, causing net ex-factory realization often to be lower than the permissible limit. This is particularly true for sales in the Federal District of Mexico City and surrounding area, which account for over 60% of total steel sales in the country. In the smaller markets of other regions, steel producers are more often able to charge full prices, plus transport costs as well; but sales in these areas are limited, and the cost of sales is higher on account of distributor's commissions, etc.

18. For purposes of making financial projections for the Las Truchas project (see Annexes 13 through 15), it has been assumed that 1976 prices will be about 2-3% above present levels in real (uninflated) terms. After 1976, real prices are assumed to decrease about 1% per year, reflecting SICARTSA's capability to influence the market under competitive conditions. This is simply a hypothesis intended to demonstrate (i) that SICARTSA can remain financially viable even if its prices rise at a lower rate than the general rate of inflation in Mexico (i.e. fall relative to costs in real terms) and (ii) that SICARTSA can exert a positive restraining influence on Mexican steel price increases.

C. Imports and Import Tariffs

19. Mexico imports a considerable quantity of steel scrap and re-rollable materials, as well as some steel products. Scrap is imported principally from the U.S.A. for use in the semi-integrated steel plants, which have electric furnaces; and in the past 10 years annual imports have ranged between 450,000 and 800,000 tons, averaging about 600,000 tons per year. Re-rollable materials, mainly rails, slabs, etc. have been imported to the extent of about 160,000 tons annually during the past five years. Imports of finished steel products amounted to about 150,000 tons annually in the early 1960's rose to about 230,000 tons per year in the mid 60's, and then have leveled off to about 180,000 tons per year in recent years. Tin plate, special purpose sheets, special steel bars and wire rods, and rails and railtrack accessories are the most important items, accounting for over 60% of the total. Table 1-7 indicates imports by product type during the years 1965-70.

20. All imports into Mexico are subject to physical licensing. The Ministry of Industry and Commerce has advisory committees, consisting of representatives of Government departments, industry and trade to consider applications for import licenses. The committees function within the framework of guidelines indicating objectives and procedures; and they are generally well regarded by the trade.

21. Imports of scrap attract only an ad-valorem duty of 3%. Rails and axles imported for rerolling attract somewhat higher tariffs, but the total charge does not exceed US$10 per ton. Steel products are subject to quite high levels of tariffs, intended to protect the domestic industry. A selected list of tariffs is at Table 1-8. It will be noticed that the levels of protection available to the Mexican steel industry are very considerable.

Industrial Projects Department
August 1973

TABLE 1-1

MEXICO - LAS TRUCHAS STEEL PROJECT

APPARENT DOMESTIC CONSUMPTION OF STEEL PRODUCTS
IN MEXICO 1950-1972
(000 tons)

Year	Product Tons Consumed	Percent Growth	Equivalent Raw Steel Tons Consumed	Percent Growth
1950	568	-	788	-
1951	771	-	1070	-
1952	730	5.8	1021	5.7
1953	650	-5.8	906	-10.5
1954	655	0.8	903	-0.3
1955	796	21.5	1139	26.1
1956	1096	37.7	1490	30.8
1957	1242	13.3	1713	15.0
1958	1155	-7.0	1622	5.3
1959	1114	-3.5	1519	6.4
1960	1411	26.7	1901	25.1
1961	1370	-2.9	1869	1.7
1962	1376	0.4	1879	0.5
1963	1524	10.8	2086	11.0
1964	1893	24.2	2579	23.7
1965	2057	8.6	2780	7.8
1966	2259	9.8	3077	10.7
1967	2393	6.0	3259	5.9
1968	2597	8.5	3537	8.5
1969	2725	4.9	3711	4.9
1970	2948	8.2	4021	8.3
1971	2816	-4.5	3846	-4.3
1972 1/	3055	8.5	4155	7.2

% Growth Rates: 2/

	1952-1962	1952-1972	1962-1972
Raw Steel tons	6.9	7.6	8.2
Product tons	7.1	7.7	8.3

Source: Camara Nacional de la Industria del Hierro y del Acero (CNIHA).

1/ Estimate by CNIHA.

2/ An average of the years 1950-1952 was taken as the figure for 1952.

Industrial Projects Department
June 1973

TABLE 1-2

MEXICO - LAS TRUCHAS STEEL PROJECT

APPARENT DOMESTIC CONSUMPTION OF STEEL PRODUCTS IN MEXICO

(000 Tons)

Year	Non Flat Products	Percent Growth	Flat Products	Percent Growth	Seamless Pipe	Percent Growth
1953	369	---	240	---	41	---
1954	301	-18.4	267	11.3	87	112.2
1955	397	31.9	319	19.5	80	-8.0
1956	570	43.6	447	40.1	79	-1.2
1957	682	19.6	461	3.1	98	24.1
1958	627	-8.8	407	-8.9	121	23.5
1959	535	-14.7	465	14.3	114	-5.8
1960	679	26.9	592	27.2	139	21.9
1961	645	-5.0	600	1.4	125	-10.1
1962	680	5.4	566	-5.8	130	4.0
1963	741	9.0	649	14.8	134	3.1
1964	916	23.6	837	28.9	140	4.5
1965	1,035	13.0	908	8.6	113	-19.3
1966	1,058	2.2	1,053	15.9	148	31.0
1967	1,121	5.9	1,112	5.7	160	8.1
1968	1,215	8.4	1,226	10.2	157	-1.9
1969	1,310	7.9	1,256	2.5	159	1.3
1970	1,372	4.7	1,402	11.7	174	9.4
1971	1,275	-7.1	1,374	-2.0	160	-8.0
1972	1,312	2.9	1,552	13.0	191	19.4

% Growth Rates:

	1953-1962	1953-1972	1962-1972
Non-Flats	7.0	6.9	6.8
Flats 1/	10.8	10.3	9.9
Seamless Pipe	13.7	8.4	3.9

Source: CNIHA

1/ Average 1961-63 used for 1962.

Industrial Projects Department
June 1973

TABLE 1-3

MEXICO - LAS TRUCHAS STEEL PROJECT

PROJECTED DEMAND FOR STEEL PRODUCTS: 1976-80
(000 Tons)

			1976	1977	1978	1979	1980
NAFIN	(1971)		4992	5451	5909	6376	6841
CNIHA	(1971)	Low	4300	4580	4878	5195	5533
		High	4943	5388	5873	6402	6978
SICARTSA	(1971	Low	5089	5511	5968	6463	6983
		High	5516	6001	6529	7103	7735
SICARTSA	(1972)		4867	5299	5771	6291	6860
SICARTSA	(1973)		4528	5000	5523	6103	6746

Industrial Projects Department
June 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

PROJECTED DEMAND FOR STEEL PRODUCTS (1972 Base)
(000 Tons)

	1972 (Estimated)	1973	1974	1975	1976	1977	1978	1979	1980
Reinforcing bars	559.2	624.6	697.7	779.3	870.5	972.4	1,086.2	1,213.3	1,355.2
Merchant bars	119.3	1 133.7	149.9	168.0	188.3	211.1	236.6	265.2	297.5
Light sections	184.9	205.4	228.2	253.5	281.7	313.0	347.7	386.3	429.2
Wire rod	318.8	352.3	389.3	430.2	475.4	525.3	580.4	641.4	708.6
Total non-flats	1,182.2	1,316.0	1,465.1	1,631.0	1,815.9	2,021.8	2,250.9	2,506.2	2,790.5
Plate	383.3	424.3	469.7	520.0	575.6	637.2	705.4	780.9	864.4
Hot roll	277.8	300.8	325.8	352.9	382.2	413.9	448.2	485.4	525.7
Cold roll	644.1	719.4	803.6	897.7	1,002.7	1,120.0	1,251.0	1,397.4	1,506.9
Tinplate	246.8	267.8	290.5	315.2	342.0	371.1	402.6	436.9	474.0
Total flats	1,552.0	1,712.3	1,889.6	2,085.8	2,302.5	2,542.2	2,807.2	3,100.6	3,425.0
Heavy structuals	129.8	143.2	157.9	174.2	192.1	211.9	233.7	257.8	284.4
Seamless pipe	191.3	197.4	203.7	210.2	217.0	223.9	231.1	238.1	246.1
Total product tons	3,055.3	3,368.9	3,716.3	4,101.2	4,527.5	4,999.8	5,522.9	6,103.1	6,746.0
Total raw steel tons	4,155.2	4,581.7	5,054.2	5,577.6	6,157.4	6,799.7	7,511.1	8,300.2	9,174.6

Source: SICARTSA (1973 estimate)

Industrial Projects Department
May 1973

TABLE 1-4

TABLE 1-5

MEXICO - LAS TRUCHAS STEEL PROJECT

NON-FLAT PRODUCTS (EXCLUDING HEAVY STRUCTURALS)

DEMAND-SUPPLY COMPARISON (BANK PROJECTION)
(000 tons)

	1972	1976	1977	1978	1979	1980
Demand (1)	1182	1816	2022	2251	2506	2791
Rolling Capacity without SICARTSA	1765	1910	1945	1980	2015	2055
Rolling Capacity including SICARTSA	1765	2060	2445	2780	3015	3055
Supply without SICARTSA	1182	1640	1690	1725	1775	1850
SICARTSA Supply	-	150	500	800	1000	1000
Total Supply (2)	1182	1790	2190	2525	2775	2850
Excess/(Deficit) (1) - (2)	-	(26)	170	274	269	59

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TABLE 1-6

MEXICO - LAS TRUCHAS STEEL PROJECT

STEEL IMPORTS INTO MEXICO
(000 Tons)

	Product	1965	1966	1967	1968	1969	1970
i)	Scrap	791	731	706	459	494	722
ii)	Rerollable Materials	59	93	195	210	159	138
iii)	Steel Products	231	230	203	171	186	183
	- Plates	2	2	5	10	9	8
	- Sheets	20	16	15	11	14	21
	- Tin plates	11	15	10	11	12	43
	- Hoops, strip & skelp	5	6	8	9	11	12
	- Merchant bars	14	17	20	15	14	13
	- Wire rods	6	7	7	6	9	8
	- Rails & accessories	116	89	55	29	57	22
	- Tubes	9	11	23	16	18	16

Source: CNIHA

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MEXICO - LAS TRUCHAS STEEL PROJECT

IMPORT DUTIES IN MEXICO
(Selected List)

	(Mexican Pesos) Official Price Per Ton	Specific Duty	Ad-Valoren Duty %	Total Tariff (243)
Scrap - Wheels of railway wagons, & unclassified bundled scrap	400	-	3	12
- Unbundled unclassified	560	-	3	17
Re-Rollable Materials				
Rails and axles	1,000	70	5	120
Ingots	1,500	150	25	525
Plates	1,300	250	25	575
Steel Products				
Plates, various qualities	4,000-14,700	200-1,500	5-10	400-2,235
Sheets, " "	2,100-31,000	100-5,000	2-60	120-4,700
Reinforcing bars	4,000	500	20	1,300
Merchant bars, various qualities	6,000	600	8-25	605-1,535
Wire rods - Com. quality	9,000	60	5	510
- high ressistance	5,800	150	50	3,050
Rails (for railway)	1,600	10	30	490
Tubes-diameter less than 35 cms.	2,000	160	50	1,150
" " more " 35 cms.	1,900	50	7	183
Seamless tubes	7,600	150	10	910
High structurals - angles	2,400	150	7	318
- Angles with perforations and special sections	2,800	200	50	14,200

TABLE 1-7

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ANNEX 2

MEXICO - LAS TRUCHAS STEEL PROJECT

WORLD STEEL TRENDS AND PRICES

Introduction

1. In order to evaluate the opportunity cost of steel to the Mexican economy and judge the relative efficiency of SICARTSA by world standards, the Bank retained consultants (Hans Mueller and Kiyoshi Kawahito) to study the world steel market. The consultants' work was carried out during the period February-April, 1973 and a draft of their report[1/] is available for review by anyone interested in the details of their findings. This Annex is based on an abridged version of the Mueller/Kawahito report, supplemented by the Bank's own conclusions in specific areas relating to the Las Truchas Project.

Global Steel Production and Trade Patterns in Recent Years[2/]

2. World production of raw steel in 1961 and 1969-72 is given in Table 2-1[3/]. The 1971 figure of 582 million tons was 64% higher than the 355 million tons turned out in 1961, which corresponds to an annual growth rate during the 1961-1971 period of 5.1%. The growth rate varied substantially among individual countries; it was 2.1% in the United States, 5.5% in the USSR, 12.1% in Japan, 3.5% in the European Community, and 0.7% in the United Kingdom. Almost all of the less developed countries registered higher rates of growth than the world average during the same period.

3. The relative shares of the world's largest producers in 1971 were 20.7% in the case of the USSR, 18.7% for the United States, 15.2% for Japan, 6.9% for Germany, 4.1% for the United Kingdom, 3.9% for France, 3.6% for Mainland China, and 3.0% for Italy. Other nations which accounted for more than 1.0% of world production each were Belgium (2.1%), Poland (2.1%), Czechoslovakia (2.1%), Canada (1.9%), Spain (1.3%), Romania (1.2%), India (1.2%), Australia (1.2%), East Germany (1.0%), and Brazil (1.0%). The European Community members together produced 17.1% of the world total.

4. Table 2-2 shows the quantities of steel products exported by major steel-producing nations in 1969 and 1970. We find that Japan, Belgium-

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1/ Mueller and Kawahito, International Prices of Non-Flat-Rolled Iron and Steel Products: Review and Outlook, April 1973.

2/ This section covers the global steel production and trade up to 1971. Reliable figures for 1972 are not yet available.

3/ Unless indicated otherwise, figures hereafter in this Annex are taken from statistics of the Japan Iron and Steel Federation. The JISF statistics in turn are compiled from UN., Quarterly Bulletin of Steel Statistics for Europe; EC, Eisen und Stahl; W. Germany, Eisen und Stahl; AISI, Annual Report; IISI statistics and the official statistics of each country.

Luxembourg, Germany, and France were the major exporters in these years, accounting for well over half of world steel exports. During 1970, member countries of the European Community (EC) claimed 42% of world exports, but a little over half of this was for exports within the Community.

5. Major steel importing nations in 1970 were the U.S. (11.9 million tons), Germany (9.1), France (7.5), Italy (4.6), Netherlands (3.5), East Germany (3.1), Belgium-Luxembourg (2.2), United Kingdom (2.2), and Seitzerland (2.0). Other nations which imported more than one million tons in 1970 were South Korea, Denmark, Norway, Spain, Sweden, Yugoslavia, Bulgaria, Poland, Romania, Canada, and Argentina. It is interesting to note that in that year the EC imported a large quantity of steel products while at the same time it was the world's largest steel exporter. However, the tide of imports into the EC receded more recently. The export-import ratios of the EC in 1970 and 1971 were 1.3 and 1.5, including the intra-Community trade, and 2.3 and 3.4 excluding the intra-Community trade.

6. Table 2-3 shows exports of non-flat steel products by major nations in 1970. In the case of wire rods, the five largest exporters were France, Japan, Germany, Belgium-Luxembourg, and the USSR, in that order. In the case of bars and shapes, the five largest exporters were Belgium-Luxembourg, Germany, USSR, Japan, and France, in that order. Major importers of wire rods in 1970 were the United States (1.2 million tons), Germany (0.8), Belgium-Luxembourg (0.3), France (0.3), Italy (0.2), and Canada (0.2). Major importers of bars and shapes were Germany (2.3 million tons), the United States (2.1), France (1.9), the Netherlands (1.2), and East Germany (0.6).

7. Finally, Table 2-4 gives the ratios of domestic production and apparent consumption (production plus exports minus imports) of non-flat steel products in major nations during 1971. Any figure above 100 indicates that the country's exports were larger than its imports; any figure below 100 indicates that the country's imports exceeded exports. We find that Japan and the EC were the major net exporters, but also that, among the EC members, Germany was a net importer while Belgium-Luxembourg was a strong net exporter of the same products.

8. At the time of this writing, data on world steel trade in 1971 and 1972 are partially incomplete. But they indicate that the general patterns of steel trade discussed in this section have not changed significantly in these years, except that the Japanese share of world steel trade has further expanded and Germany has become a net importer of steel products.

Trends of Prices for Non-Flat Carbon Steel Products, by Broad Product Categories

9. Tables 2-5 and 2-6 show price indices of non-flat carbon steel products in the EC1/ and in Japan from 1960 to 1971. The figures in these

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1/ For the present and subsequent discussions, it should be noted that the intra-Community as well as export prices of the EC tend to reflect those of Belgium-Luxembourg producers, because of their large volume of trade.

tables are all based on actual transaction prices. The export prices are FOB for both the EC and Japan. The intra-Community prices of the EC are expressin in CIF terms, but do not include taxes. The domestic prices of Japan are expressed in FOB terms, including tax.

10. Because the composition within each product group may vary between home and export sales and from year to year, rigid interpretations of the indices should be avoided. However, at least a few general observations are possible. In the first place, the indices indicate that the prices of non-flat products fluctuate more widely over time than the composite price of all steel products. One explanation may be that in both the EC and Japan non-flat products, except wire rods, are produced by relatively large numbers of fairly small producers and sold to a large number of buyers. Another reason appears to be that these products to mostly to the construction industry, which is more sensitive to business cycles than other steel consumers.

11. Secondly, the declining trend of steel prices that began in 1956 continued during the 1960's until 1968, and then reversed itself sharply. The low prices that prevailed from 1962 to 1968 are generally attributed to the existence of excess production capacity and intense competition among steelmakers in all markets during the period. In addition, there is no doubt that the low price level was partially caused by productivity increases in Japan and a few minor steel-producing nations that continuously exceeded increases in factor costs during the period.

12. The sharp rise in the price trend from 1969 reflects new developments and needs close observation. The 1969 boom started in late 1968, peaked at the end of 1969 and continued until the spring of 1970. It was started by a strong demand for steel in Europe and spread quickly around the world. The home demand in Europe was so strong in 1969 that the EC did not even fill its steel import quota in the United States, while the latter, although the least-competitive among major countries, penetrated sharply into the European home market. As a result, serious doubt was cast over the "chronic-excess-capacity" theory.

13. More interesting is what happened after the world-wide boom ended. A recession developed about the middle of 1970 in Europe, Japan and the United States and continued until the autumn of 1972, but world steel prices dropped very little during this period, as they had done in earlier recessions. There seem to have been several reasons for this phenomenon.1/ First, the cost of steel production rose rapidly during the period due to inflation, wage hikes, and pollution control expenditures, particularly in

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1/ In addition to the listed factors, the 1971 figures were increased somewhat by the floating of major currencies during the fourth quarter of the year.

Europe. The profit squeeses resulting from these pressures played a role in motivating European producers to make several upward revisions in their list prices in 1970, 1971 and 1972 (see Table 2-7). Second, the producers in the EC began to take collective action to stop downward pressures on steel prices. Agreements to reduce production and to set minimum export prices in late 1970 are such examples. Third, Japanese producers also acted voluntarily and collectively to curtail production. In particular, from December 1971 to December 1972, they organized more effective "recession cartels" than at any time before, Fourth, during the 1970-1972 period, the Japanese productivity increase was exceeded by rising costs for the first time since 1962, although the difference was slight compared with those experienced by European and American steel producers. Fifth, the Japanese producers apparently opted to "align" their export prices to the European level when the latter went up sharply, even though the Japanese could have quoted lower prices. This tendency seems to have been a reaction to the voluntary export restraint agreements with the United States that started in 1969 and with Europe that started informally in 1971 and were formalized in 1972. In other words, when quantities are restricted revenues can be maximized by charging the highest possible price.

14. Table 2-8 shows absolute levels of steel prices in the EC and Japan, from which the indices in Table 2-5 and 2-6 were constructed. The table reveals that, until 1968, there was little difference between the home and export prices of Japan and the EC but that subsequently the picture changed drastically. European prices, both intra-Community and export, have risen sharply since 1969, while Japanese home prices have risen only slightly. As a result, Japanese domestic prices have been consistently and significantly below those prevailing in the EC; in the export sector Japanese prices also have remained below those of the EC but the differences here have been moderate.

15. The differences between Japanese and EC prices in recent years are presented in Table 2-9. We find that, in the case of home prices, Japanese prices in 1971 were lower by $15 for semi-finished products, $18 for wire rods, $32 for shapes, and $51 for bars. The actual differences in delivered prices should have been even larger because the European delivered prices would be about fifteen percent higher than the figures shown in Table 2-8 due to various taxes, while Japanese delivered prices would be only five to seven percent higher.1/ In the case of export prices, however, the differentials were much less than those in home prices, ranging from $5 in wire rods to $9 in bars. The smaller differences were apparently caused by the upward "alignment" of Japanese export prices to the European level, which was mentioned earlier.

1/ Belgium has an 18% transaction tax; France and Germany, value-added taxes of 23.1 and 11% respectively. All are passed on to the consumer. The Japanese tax is already reflected in the FOB price. Thus to obtain the delivered price, one should add only freight and distributor's commission, which comprise about five to seven percent of the FOB price.

16. While actual transaction prices for 1972 are not available at the time of this writing, the level of posted prices for the year indicated that the developments described above -- the increasing gap between Japanese and European home prices and the alignment of the Japanese export prices to the European level -- apparently continued. For instance, the export price of wire rods of the EC appraised by Metal Bulletin rose from $123 in March to $145 in December 1972, while the Japanese export price of wire rods quoted by a major trade firm increased from $117 to $136 during the same period (see Table 2-10). In comparison, at the end of January 1973, the domestic base price of wire rods was $166 in Germany, $157 in France, and $176 in Belgium, while the delivered price of wire rods in Japan was $130 (see Table 2-7). These have risen even higher since January.

Recent Prices of Non-Flat Carbon Steel Products, by Narrow Product Categories

17. Tables 2-11 through 13 show home and export prices of specific non-flat steel products in Japan and the EC. These tables were compiled for the purpose of supplementing Table 2-8, the product classification of which was somewhat broad, and providing information more relevant to the Las Truchas Project. Semi-finished products and wire rods are excluded because they are relatively homogeneous and Table 2-8 therefore should provide sufficient detail.

18. While prices of the narrow-classified product groups offer additional information in their own right, their comparability on a home versus export and Japan versus EC basis has been substantially weakened. This reduction in comparability has been caused in part by the unavailability of data on specific sizes and forms and also by the differences in product classification systems.1/

19. In general, the findings of the previous section still hold: firstly, world steel prices surged upwards after 1968; secondly, beginning about 1969, Japanese home and export prices have remained below European levels; and thirdly, the differentials between Japan and the EC have been wider in home prices than in export prices. In addition, it can be concluded that European export prices have been lower than home prices in most years, but that Japanese export prices have been higher than home prices since 1970.

Export Prices by Destinations

20. Table 2-14 shows Japanese FOB export prices of billets, wire rods, bars and shapes of carbon steel in 1970 and 1971 by destination, and Table 2-15 shows the EC's FOB export prices of wire rods and re-bars of carbon steel shipped to different countries for the same years. These and many similar tables covering a longer period were initially constructed to test two hypotheses: (i) that FOB export prices of a country or area very substantially according to destinations, and (ii) that there are consistent

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1/ The NIMEXE code used by the European Community classifies products mostly on the basis of their physical properties and does not reveal their sizes and forms.

patterns of price differentials on the basis of destinations. The second hypothesis was eventually rejected.

21. The tables clearly indicate that the export prices of specific products vary substantially according to destinations 1/. For example, the average export price of re-bars from European producers in 1972 was $116 per ton but the price to Iran was $128 and to Colombia $105. Similarly, the average export price of wire rods from Japanese producers in 1971 was $114, but the price to South America was $126 and to Europe $91.

22. In general, the FOB export price of a product from a country or region to a particular destination in a given period should reflect a host of factors, and the relative importance of each of these factors in that period is considered to determine price differentials. Some of the more important factors are:

(i) Supply and demand conditions at the destination (or in the importing country). The supply side of the markets in some countries is characterized by a tug-of-war between entrenched importers, traditional suppliers (sometimes former colonial powers), and new importers. The resulting price instability may be short-term if the newcomers are impelled primarily by temporary excess capacity in their traditional markets; it may be persistent if they plan permanent conquest of a significant share of the new market.

(ii) Import barriers in the importing country. Import barriers on steel products, mostly quotas, are usually imposed to protect a less-competitive domestic industry. When an import quota is set, exporters tend to increase prices to the maximum possible level. This maximum pricing often results from meetings of exporters which are officially intended to reach an agreement on the export quantity of each producer. Moreover, producers in the importing country tend to welcome higher import prices so that their own inefficiencies will not surface conspicuously. When anti-dumping laws are enforced strictly, prices also tend to increase.

(iii) Collusions among exporters and among importers. The stronger the unity is among exporters, the higher will be the price. The stronger the cooperation among importers, the lower the price.

(iv) Negotiating ability of the exporter and the importer, especially the latter. When the importer's acquaintance with prospective exporters and market conditions in the exporting country and the world is limited, the price he pays will tend to be higher. This factor obviously works against less developed countries. The fact that the American import price is relatively low in consideration of the domestic producers' higher prices and the existence of import quotas appears to reflect the excellent negotiating abilities of U.S. importers.

1/ While the time of transaction within a year can influence the annual average price, this factor appears insignificant in years 1970 and 1971.

(v) Geographical locations of the exporter and the importer. In order to absorb freight costs, exporters tend to reduce FOB prices as the distance to the buyers increases. On the other hand, exporters tend to charge higher prices in their "captive markets" (e.g. East Asian countries for Japanese producers).

(vi) Delivery terms and technical services. To the extent that an exporter can provide better delivery terms and technical services than his competitors, he may afford to charge higher prices. For example, a recent Japanese offer beat a British offer in Houston due to better delivery terms, even though the Japanese price for the standardized product was $10 higher.

(vii) The quantity and continuity of purchase. The price becomes lower as the quantity per order increases and if the contract involves continuing purchases over a period of time.

Conclusions Regarding Historical Price Trends

23. World steel prices, measured in terms of the home and export prices of Japan and the EC followed a declining trend until 1968. This is attributable to excess world-wide supply capacity, keen competition in all markets, and productivity increases in Japan. The trend took an upward turn in 1969, which has persisted until the present time.

24. The fact that world steel prices did not fall significantly during the recession of 1971 -- in the manner they had declined during previous recessions -- reflects cost increases due to inflation, wage-hikes, and pollution control expenditures, which surpassed productivity increases. It also reflects, in some degree, the success of deliberate efforts undertaken by Japanese and European producers to stabilize prices in domestic and international markets.

25. Home prices of non-flat steel products in Japan were $20 to $50 lower than those in the EC in 1971. Although more recent data are incomplete -- and the long-term effects of recent currency realignments are not known, it appears that the differences between European and Japanese home prices have widened further since 1971.

26. The differences between European and Japanese export prices were slight in 1971 and have remained more or less the same up to the present time. This phenomenon is partly explained by the lower export prices that have been quoted by European producers in relation to home prices, and partly by the tendency of Japanese producers to "align" their export prices to the European level. This finding, aside from its own significance, also shows that any attempt to assess an industry's unit production cost on the sole basis of its export prices is fraught with peril.

27. Finally, the study points out that "international prices" are not uniform, for it has been clearly demonstrated that both Japanese and European steel-makers have charged export prices which, when reduced to an FOB level, differ substantially according to destination.

Future Price Trends

28. To provide a basis for projecting long-term world steel prices, Mueller and Kawahito made forecasts of future production cost trends for certain major inputs to the steel-making process, with particular emphasis on non-flat steel production. Their analysis covered the three main raw materials (iron ore, coal, and scrap), labor, and capital. The anticipated effect of each factor on final steel costs was considered, and a comparison was made between the various cost trends expected for the two major steel exporting areas, Japan and the EC, in order to project which of the two would be the low-cost leader in 1985.

29. The Mueller/Kawahito projections of increased unit costs are shown in Tables 2-16 and 2-17; details can be found in their full study. Rising unit costs have been projected for both the EC and Japanese steel industries, but cost increases for coking coal, labor, and capital are less pronounced for Japan. The base costs, to which the projected increases must be added to give likely 1985 levels, have been taken as representative average list prices for domestic sales that prevailed in the EC and Japan during the last quarter of 1970 and the first half of 1971, a period that did not yield particularly high profits for EC producers and therefore provides a conservative basis for future projections.

30. The results of the analysis are shown in Table 2-18 and summarized below:

PROJECTED AVERAGE UNIT PRODUCTION COSTS
FOR LIGHT NON-FLAT PRODUCTS in 1985

(US$/ton at 1973 Exchange Rates)

	1970/71 Base Cost	Increase	1985 Cost
EC	156	35	191
Japan	154	29	183

31. The average EC unit production cost is shown to increase 22% in real terms by 1985 and that of Japan 19%. It should be noted that these are average full cost projections and cannot be taken necessarily to indicate the 1985 prices the EC producer will obtain. The latter will be a function not only of costs but of competitive conditions. These are difficult, if not impossible to forecast, particularly for international (export) prices, which no doubt will continue, as they have in the past, to be volatile, sometimes exceeding and sometimes falling below full unit production costs. Potential overcapacity in the industry still will be a problem and, as Mueller and Kawahito point out, labor pressures will continue to burden the industries of both the EC and Japan with high fixed costs. In recession years, this will tend to override any desire for "orderly" marketing and encourage marginal cost pricing of the type that led to Japan's export explosion of 1971. Over the long run, however, dissatisfaction with the past instability of home and international steel markets may result in some understanding between major

steel-exporting countries. Steel firms in the EC appear to have initiated some coordination of capacity expansion programs, and inclusion of the Japanese in such an arrangement would definitely have the effect of stabilizing international steel prices.

Conclusion for Las Truchas

32. To forecast the long-term opportunity cost for Mexican steel imports to be used in the economic evaluation of the Las Truchas project (Annex 16), the Bank has chosen to use an expected range of EC export prices based on the Mueller/Kawahito projections. This has been based on the following considerations:

(i) Japan most likely will continue to align its export prices to EC levels as it has in the past. Hence, the EC figures should be used as the basis for future projections.

(ii) The relatively high home market prices that have prevailed in Europe since late 1972 are beginning to yield reasonable profits to an industry that has not been characterized by profitable operations for some years. Accepting the proposition that some form of international cooperation to forestall future overcapacity is likely -- or at least that the depressed situation of recent years will not reoccur -- and recognizing the inevitable upward pressure on real costs that the industry will face, it can be concluded that average long-term real export prices from the EC are very unlikely to fall below the 1970/71 average home prices referred to previously.

33. On the above basis, the Bank's economic evaluation has assumed the average minimum real export price from Europe over the 1976-91 projection period will be US$156 per ton FOB Europe, the Mueller/Kawahito estimate of the home price average for 1970/71, adjusted for exchange rate changes. The maximum has been taken as their projected average unit production cost in the EC for 1985, US$191 per ton. 1/ The most likely average level within this range is difficult to project. On the one hand, obtaining supplies of upward of one million tons per annum from European exporters probably would have to be under long-term contract and, therefore, at prices somewhat closer to full production costs than would be paid by spot buyers of steel. On the other hand, the historical tendency of steel prices to deviate from full production costs makes it imprudent to expect that the upper end of the above price range would be likely as an average over the projection period. It therefore is concluded that the probable long-term price would fall in the lower third of the range, or US$156-168 per ton.

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1/ All at 1973 exchange rates.

TABLE 2-1

PRODUCTION OF CRUDE STEEL BY MAJOR NATIONS

(Million Tons)

Year	Japan	M. China	Germany	France	Italy	EC Total	U.K.	USSR	USA	Total of Eight Largest	Others	World
1961	28	12	33	18	9	74	22	71	89	282	72	354
1969	82	16	45	23	16	107	27	110	128	447	129	576
1970	93	18	45	24	17	109	28	116	119	460	135	595
1971	89	21	40	23	17	103	24	121	109	444	138	582
1972	97	23	44	24	20	113	25	121	121	475	155	630 1/

1/ Estimate

Source: Japan Iron and Steel Federation

TABLE 2-2

EXPORTS OF STEEL PRODUCTS BY MAJOR NATIONS

(Million Tons and %)

Country	1969	1970	1970 Share
Japan	15.5	17.6	20.0%
Germany	12.7	12.0	13.7
France	6.6	7.4	8.4
Italy	1.9	1.8	2.0
Belgium-Luxembourg	12.6	12.5	14.3
U.S.S.R.	7.0	7.5	8.5
	56.3	58.8	66.9
World Total 1/	82.2	87.8	100.0

1/ The total of reporting nations.

Source: United Nations, Economic Commission for Europe, Statistics of Trade in Steel.

TABLE 2-3

EXPORTS OF NON-FLAT STEEL PRODUCTS IN 1970 BY MAJOR NATIONS

(Million Tons)

Country	Wire Rods	Bars and Shapes
Japan	0.8	1.6
Germany	0.6	2.5
France	1.1	1.5
Belgium-Luxembourg	0.5	4.7
Italy	-	0.5
United Kingdom	0.1	1.0
U.S.S.R.	0.4	1.8
	3.5	13.6
World Total 1/	5.1	18.0

1/ The total of reporting countries.

Source: United Nations, Economic Commission for Europe, Statistics of World Trade in Steel.

TABLE 2-4

RATIOS OF PRODUCTION AND APPARENT CONSUMPTION OF NON-FLAT STEEL PRODUCTS IN MAJOR COUNTRIES DURING 1971

Country	Production/Apparent Consumption (%)		
	Wire Rods	Bars and Shapes	
		Light	Heavy
Japan	127.8	111.5	118.6
Germany	91.8	94.4	107.0
France	187.4	93.7	115.7
Italy	90.7	116.2	
Belgium-Luxembourg	117.4	613.3	445.7
Netherlands	143.8	83.0	
U.S.R.	106.4	104.3	
Canada	94.3	96.4	
U.S.A.	74.7	88.1	79.9

Source: JISF

TABLE 2-5

INDICES OF PRICES OF CARBON STEEL PRODUCTS, EUROPEAN COMMUNITY (1965=100)

Year	All Carbon Steel Products		Semi-Products		Wire Rods		Bars		Shapes	
	Intra	Export	Intra	Export	Intra	Export	Intra	Export	Intra	Export
1960	102.5	115.5	100.3	122.1	108.5	126.7	97.4	114.7	97.7	115.4
1961	103.4	109.2	103.2	113.7	106.6	110.8	98.4	108.1	100.8	107.5
1962	101.4	102.6	103.3	108.3	100.5	95.0	96.5	100.3	101.8	103.8
1963	99.2	96.5	100.0	91.2	96.1	91.6	95.4	94.1	99.5	95.8
1964	99.7	103.6	96.6	96.0	96.2	94.8	100.0	99.1	100.1	97.4
1965	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1966	98.3	97.0	97.2	95.0	96.4	91.7	97.8	97.4	99.9	96.8
1967	97.2	96.0	94.2	92.7	94.8	91.7	97.0	96.9	97.4	93.8
1968	94.4	94.4	90.5	93.5	94.3	91.4	94.1	95.3	74.1	92.9
1969	103.7	102.9	102.8	101.8	101.9	97.4	110.7	103.6	104.2	101.7
1970	129.9	132.5	108.8	136.5	134.0	143.7	138.5	138.0	139.6	136.5
1971	125.7	122.3	109.1	121.5	128.7	127.2	129.9	127.7	133.3	125.0

Source: Compiled from the Statistical Office of the European Communities, Iron and Steel.

TABLE 2-6

INDICES OF PRICES OF CARBON STEEL PRODUCTS, JAPAN (1965=100)

Year	All Steel Products		Semi-Products		Wire Rods		Bars		Shapes	
	Home	Export	Home	Export	Home	Export	Home	Export	Home	Export
1961	110.0	112.0	127.9		108.0	108.7	113.2	106.3	120.6	123.4
1962	101.4	99.0	113.3		106.4	91.3	99.7	89.5	100.2	98.5
1963	100.7	97.0	106.6		100.2	90.8	93.0	91.1	101.4	95.6
1964	101.5	99.9	106.0	112.7	103.8	94.8	98.0	94.3	107.8	98.4
1965	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1966	101.1	96.8	101.4	93.9	100.6	91.1	100.3	94.2	102.7	99.3
1967	103.5	100.0	98.3	99.1	103.2	95.1	108.0	110.9	107.3	110.2
1968	96.5	96.9	101.0	95.8	99.3	95.0	94.1	101.7	98.9	101.5
1969	102.4	100.2	94.8	108.0	104.5	101.4	102.7	104.6	104.6	108.5
1970	111.8	115.5	103.5	127.2	112.7	122.5	130.4	130.8	121.9	131.2
1971	102.2	107.7	100.3	109.3	110.3	112.7	93.6	112.6	107.5	113.1

Sources: All Steel Products - the Bank of Japan, Bukka Shisu Nenpo.
Other products - Home - Compiled from the Ministry of International Trade and Industry.
Export - Compiled from the Ministry of Finance, Japan Exports and Imports, and the Japan Iron and Steel Federation, Tekkogyo Sanko Shiryo.

TABLE 2-7

DOMESTIC PRICES OF NON-FLAT PRODUCTS IN GERMANY, FRANCE, BELGIUM[1] AND JAPAN,[2] 1970-1973

(US$ per ton)

		Wire Rods				Merchant Bars				Shapes (5x50x50)			
		G	F	B	J	G	F	B	J	G	F	B	J
1970	1/1	131	113	142	106	124	105	142	106	130	115	166	111
	3/12						115				124		
	4/1		122										
	12/24	137				130				135			
1971	3/1	122											
	3/15						122				130		
	4/1	129											
	6/16			148									
	10/4						119						
1972	1/1[3]	155	140	165	123	147	129	158	123	154	141	185	130
	4/1						130				138		
	5/10					158				165			
	5/29	166											
	6/1						132				141		
	7/1		148				136				149		
	7/13			176									
	9/1						147				153		
	10/1		157										
1973	1/31												

1/ Prices reported to ECSC, (base prices - rebates), for Germany, France and Belgium.
2/ Sales prices of major producers for Japan.
3/ Increases caused by revaluations of European and Japanese currencies.

Sources: Japan Iron and Steel Exporters' Association

TABLE 2-8

DOMESTIC AND EXPORT PRICES OF THE EUROPEAN COMMUNITY AND JAPAN, BY PRODUCT GROUPS

(US $ per ton)

Year	Semi's		Wire Rods		Bars		Shapes	
	Intra	Export	Intra	Export	Intra	Export	Intra	Export
(EC)								
1965	80.0	74.2	98.2	93.5	106.5	93.3	106.2	100.6
1966	77.7	70.6	94.7	85.6	104.2	90.9	106.1	97.4
1967	75.4	68.8	93.1	85.6	103.3	90.3	103.4	94.4
1968	72.4	69.4	92.6	85.4	100.0	88.9	99.9	93.5
1969	74.2	75.6	100.1	91.0	118.0	96.6	110.7	102.3
1970	87.0	101.3	131.6	134.2	147.7	128.7	148.3	137.3
1971	87.3	90.3	126.4	118.9	138.5	119.0	141.6	125.7
(Japan)								
1965	71.7	76.6	98.3	101.5	93.9	98.1	108.8	103.4
1966	72.7	71.9	98.9	92.5	94.2	92.4	104.5	102.7
1967	70.5	75.9	101.4	96.5	101.4	108.8	109.2	114.0
1968	72.4	73.4	97.6	96.4	88.4	99.8	100.7	105.0
1969	68.0	82.7	102.7	102.9	96.4	102.6	106.5	112.2
1970	74.2	97.4	110.8	124.3	122.4	128.3	124.1	135.7
1971	71.9	83.7	108.4	114.4	87.9	110.5	109.4	116.9

Notes: All figures show actual transaction prices. Exports are expressed FOB. Intra-Community prices are CIF at borders, but do not include various taxes. Domestic prices of Japan are FOB at producers.

TABLE 2-9

DIFFERENTIALS BETWEEN JAPANESE AND EC STEEL PRICES[1/]

(US$ per ton)

	Semi's		Wire Rods		Bars		Shapes	
	Home	Export	Home	Export	Home	Export	Home	Export
1969	6.2	-7.1	-2.6	-11.9	21.6	-6.0	4.2	-9.9
1970	12.8	3.9	20.8	9.9	25.3	.5	24.2	1.6
1971	15.4	6.5	18.0	4.5	50.6	8.5	32.2	8.8

1/ Positive differences indicate EC prices greater than Japanese prices.

Source: Compiled from Table 2-8.

TABLE 2-10

MOVEMENTS OF JAPANESE AND EUROPEAN EXPORT PRICES FOR NON-FLAT PRODUCTS, 1972-1973

(US$ per ton)

		Japan[1]				European Community[2]			
		Round Bars	Angles	Wire Rods		Re-Bars	Merchant B.	Shapes	Wire Rods
1972	3.15	107.0	115.0	115-120	March	99-102	110-116	124-127	122-125
	4.15	110.0	120.0	120-125	April	99-102	110-119	126-130	123-130
	5.15	110.0	120.0	125-130	May	99-104	115-119	130-132	127-131
	6.15	110.0	120.0	125-130	June	104-106	115-120	130-132	127-132
	7.15	110.0	120.0	130-135	July	106-108	117-120	130-132	128-132
	8.15	110.0	120.0	130-135	August	110-111	119-120	131-132	130-133
	9.15	110.0	120.0	130-135	September	110-114	120-124	131-137	130-136
	10.15	120.0	120.0	130-135	October	112-114	121-125	134-137	132-136
	11.1	124.0	130.0	132-135	November	112-114	122-126	134-139	132-138
	15	127.0	130.0	135-137					
	12.1	137.0	135.0	135-137	December	118-120	132-133	140-145	139-140
	15	140.0	140.0	135-137					
1973	1.1	150.0	150.0	135-137	January	125-140	133-145	145-155	140-150
	15	unquoted	150.0	135-137					
	2.1	160.0	147.0	135-137	February	150-171	155-171	160-183	155-178

1/ Export quotations of a major trade firm.

2/ Appraisal by Metal Bulletin.

TABLE 2-11

JAPANESE DOMESTIC AND EXPORT PRICES FOR SPECIFIC BARS OF CARBON STEEL

(US$ per ton)

	Round Bars				Squares and Hexagons			Flat Bars		
	Market Price (19 mm)		Sales Price (1625 mm)	Export 1/	Market Price (25 mm)		Export 2/	Market Price (6x50 mm)		Export 3/
1966	J	82.6	105.6	89.0	J	106.2	103.3	J	96.5	105.9
	D	115.3			D	143.1		D	126.4	
1967	J	104.9	105.6	108.8	J	126.4	124.9	J	111.8	114.1
	D	88.2			D	124.3		D	110.4	
1968	J	77.1	105.6	96.2	J	109.0	109.3	J	93.8	107.9
	D	82.6			D	109.0		D	96.5	
1969	J	95.1	105.6	107.8	J	120.8	115.8	J	109.7	108.3
	D	140.0			D	145.8		D	134.7	
1970	J	112.5	105.6	123.2	J	154.2	164.4	J	140.3	130.0
	D	110.4			D	134.7		D	118.8	
1971	J	86.1	105.6	104.8	J	123.6	126.4	J	98.6	119.2
	D	70.8			D	112.5		D	91.0	

Notes: Market prices -- monthly averages in January (J) and December (D) in Tokyo. Compiled from Tekko Shimbun Sha, Tekko Nenkan. Sales prices -- major producers' CIF prices. Compiled from Tekko Shimbun Sha, Tekko Nenkan, and Kinzoku Sangyo Kenkyu Kai, Tekko Shohin Kakaku Doko.

1/ SITC 673-221: "Small section round bars, less than 50 mm in diameter, of other than high baron or alloy steel." Compiled from the Ministry of Finance, Japan Exports and Imports.

2/ SITC 673-225: "Square bars of other than high carbon or alloy steel."

3/ SITC 673-226: "Flat bars of other than high carbon or alloy steel."

TABLE 2-12

JAPANESE DOMESTIC AND EXPORT PRICES OF SPECIFIC SHAPES OF CARBON STEEL

(US$ per ton)

	Angles[1]						Channels			
	Equal		Unequal							
	Market Price (6x65 mm)	Sales Price (6x65mm)	Market Price (10x75x125)	Sales Price (10x75x125)		Market Price (5x50x100mm)	Sales Price (5x50x100mm)	Export I[2]	Export II[3]
1966	J 86.8 D 137.5	102.8	J 110.4 D 167.4	111.1	89.4	J 109.0 D 238.2	113.9	103.8	116.6
1967	J 105.6 D 93.8	108.3	J 132.0 D 115.3	116.7	97.5	J 137.5 D 118.1	119.4	118.6	129.4
1968	J 89.6 D 88.2	108.3	J 103.4 D 103.4	116.7	90.1	J 104.2 D 104.7	119.4	107.8	126.5
1969	J 120.8 D 145.8	108.3	J 151.4 D 170.8	116.7	97.7	J 148.6 D 250.0	119.4	115.0	128.0
1970	J 109.7 D 107.6	108.3	J 156.9 D 140.3	116.7	127.4	J 143.0 D 117.4	119.4	150.1	148.0
1971	J 94.4 D 81.9	108.3	J 109.7 D 104.2	116.7	105.9	J 102.8 D 112.5	119.4	115.7	131.5

1/ SITC 673-511: "Angles, less than 80mm, of other than high carbon or alloy steel."

2/ SITC 673-511: "Channels, 80mm or more, of other than high carbon or alloy steel."

3/ SITC 673-519: "Sections, less than 80mm, of other than high carbon or alloy steel."

TABLE 2-13

THE EC'S HOME AND EXPORT PRICES OF SPECIFIC BARS AND SHAPES OF CARBON STEEL

(US$ per ton)

	Re-Bars		Other Bars		U, I, H Shapes		Other Shapes	
	Intra	Export	Intra	Export	Intra	Export	Intra	Export
1966	99.8	88.7	106.0	91.9	104.8	102.6	108.8	101.5
1967	98.0	87.4	106.4	91.5	103.3	97.0	108.8	96.0
1968	96.0	87.2	105.3	89.5	104.8	98.4	106.2	94.4
1969	123.0	96.5	112.8	98.8	115.9	106.8	112.2	103.4
1970	146.3	126.5	140.5	129.2	149.3	125.7	140.7	132.6
1971	139.9	115.5	133.6	121.0	139.1	125.0	141.1	126.9

1/ Re-bars: NIMEXE 7310.12 through 1969 and NIMEXE 7310.13 from 1970

2/ Other Bars: Bars, mass steel, hot-rolled or extruded. NIMEXE 7310.14 through 1969 and NIMEXE 7310.16 after 1970.

3/ U, I, H Shapes: U, I, or H, mass steel, hot-rolled or hot extruded, less than 80mm high, NIMEXE 7311.11.

4/ Other Shapes: Other shapes, mass steel, hot-rolled or hot extruded, less than 80mm high.

Source: Compiled from the Statistical Office of the European Communities, NIMEXE Analytical Tables.

TABLE 2-14

JAPANESE EXPORT PRICES BY DESTINATION, 1971 (1970)

(US$ per ton)

	Billets	Wire Rods	Bars	Sections and Shapes
World	82.9 (97.6)	114.4 (124.3)	110.5 (128.3)	116.9 (135.7)
Asia	85.4 (100.7)	108.3 (126.6)	103.5 (128.1)	108.1 (144.6)
Europe		90.6 (124.8)	125.7 (121.5)	117.5 (127.7)
North (and Central) America		125.5 (123.0)	121.4 (122.8)	124.7 (129.3)
South America	80.7 (90.0)	126.1 (144.6)	129.9 (156.1)	130.1 (155.0)
Africa		107.8 (112.2)	111.2 (137.1)	111.3 (135.3)
Oceania		126.1	112.4	117.3

TABLE 2-15

EC EXPORT PRICES BY DESTINATIONS, 1971 (1970)

(US$ per ton)

World	120.8 (134.1)	115.5 (126.5)
Greece	120.6 (150.7)	127.8 (133.1)
Nigeria	129.2 (178.5)	109.4 (140.1)
U.S.	118.6 (123.6)	111.6 (113.1)
Iran	105.1 (159.4)	127.8 (137.3)
Israel	125.5 (140.6)	108.0 (131.4)
Colombia	126.7 (112.5)	105.0 (120.8)

Notes: Wire rods: NIMEXE 7310.11 -- wire rods, mass steel, only hot-rolled

Re-bars: NIMEXE 7310.13 -- re-bars.

TABLE 2-16

PROJECTIONS OF VARIOUS INPUT COSTS FOR 1975, 1980 AND 1985

(In Constant US$/ton at 1971 Exchange Rates)

		Cost of factor 1971/1972	1975	1980	1985
Iron Ore	EC	11.50 CIF	11.50 CIF	11.50 CIF	11.50 CIF
	Japan	12.00 CIF	12.00 CIF	12.00 CIF	12.00 CIF
Coking Coal	EC	16.00/ton of steel	19.00	22.00	25.00
	Japan	18.00/ton of steel	18.40	19.70	21.00
[illegible]	EC	33.00/ton	33.00	33.00	33.00
	Japan	34.00/ton	34.00	34.00	34.00
[illegible]	EC	28.00/ton of steel	30.00	37.00	45.00
	Japan	18.50/ton of steel	20.00	24.00	29.00
[illegible]	EC	160.00/ton of cap.	162.00	168.00	176.00
	Japan	130.00/ton of cap.	131.00	135.00	140.00

[illegible] Mueller/Kawahito

TABLE 2-17

PROJECTED INCREASES IN THE UNIT COSTS OF VARIOUS INPUTS OF NON-FLAT PRODUCTS STEEL MILLS IN THE EC AND IN JAPAN FOR 1975, 1980, AND 1985

(In US dollars at 1971 Exchange Rates)

		Cost Increase per Ton of Non-Flat Steel Product		
		1975	1980	1985
Coking Coal 1/	EC	0.55	2.20	3.90
	Japan	0.22	0.96	1.70
Labor	EC	2.60	10.00	19.00
	Japan	2.00	7.75	15.00
Capital	EC	0.10	0.40	0.88
	Japan	0.05	0.25	0.75

1/ Calculated on the assumption that 40 percent of all non-flat products are produced from hot metal and that the ratio of crude steel to finished products is 1.0 to 1.4.

Source: Mueller/Kawahito

TABLE 2-18

PROJECTED UNIT COST INCREASES FOR NON-FLAT STEEL SECTORS OF EUROPEAN COMMUNITY AND JAPAN -- 1975, 1980, 1985

(US Dollars per Ton of Product)

	Incremental Cost Increases Over 1970/71 Levels (1971 Exchange Rates)					Base Cost 1970/71	Total Future Cost = (1)+(2) At 1971 Exch. Rates	Total Future Cost = (1)+(2) At 1973 Exch. Rates
	Coal	Labor	Capital	Diverse	Approx. Total (1)	(2)		
European Community								
1975	0.55	2.60	0.10	1.00	4	130	134	161
1980	2.20	10.00	0.40	3.00	16	130	146	176
1985	3.90	19.00	0.88	5.00	29	130	159	191
Japan								
1975	0.22	2.00	0.05	1.00	2	115	118	158
1980	0.96	7.75	0.25	3.00	12	115	127	170
1985	1.70	15.00	0.75	5.00	22	115	137	182

Source: Mueller/Kawahito

ANNEX 3

MEXICO - LAS TRUCHAS STEEL PROJECT

THE STEEL COMMISSION

DECREE ESTABLISHING MEXICAN IRON AND STEEL COORDINATING COMMISSION[1]

SECRETARIAT OF GOVERNMENT PROPERTIES

DECREE setting up an Intersecretariat Commission to be known as the Iron and Steel Industry Coordinating Commission.

In the margin a seal bearing the National Arms and reading "United Mexican States -- Office of the President of the Republic".

LUIS ECHEVERRIA ALVAREZ, Constitutional President of the United Mexican States, in exercise of the power conferred upon the Federal Executive by Article 89 (I) of the Political Constitution of the Republic, and on the grounds of the provisions of Article 23 of the Law governing Secretariats and Departments of State, and

W H E R E A S

It is appropriate and desirable to coordinate exploration for and production of iron ore, coal and coke, in view of the demand for these items and the expansion of the iron and steel industry, in order to contribute better toward the economic and social development of the country through production for consumption and for use by industrial centers;

To achieve the desired balance between the volume of mineral resources and the production capacity of the iron and steel industry, it is essential that programs be drawn up that will harmonize production and consumption in accordance with national requirements, in such a fashion as to bring about the sound development of these activities;

For the achievement of the foregoing objectives, the Federal Executive deems appropriate the establishment of an intersecretariat commission with members drawn from the competent federal agencies, hereby issues the following

D E C R E E

Article 1. An Intersecretariat Commission shall be set up, to be known as the Iron and Steel Industry Coordinating Commission, the members of which shall be the Secretary of Government Properties who shall act as Chairman, the Assistant Secretary of Nonrenewable Resources of that Secretariat and one representative each from the Secretariats of Industry and Commerce, Finance and Public Credit, and the Presidency. One representative of Nacional Financiera, S.A. shall also have a seat on the Commission.

When the Chairman of the Commission is unable to attend the Assistant Secretary of Nonrenewable Resources shall act for him, and if neither of them is able to attend, the representative of the Secretariat of Industry

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1/ Bank translation of Spanish original.

and Commerce shall act as chairman.

Article 2. An alternate shall be assigned for each regular representative and the emoluments of both regular and alternate members shall be covered by the agencies they represent.

Article 3. Members of the Commission may be freely appointed and dismissed by those empowered to do so.

Article 4. The purpose of the Iron and Steel Industry Coordinating Commission shall be to:

I. Propose to the Federal Executive the coordination of the production and expansion programs of all enterprises engaged in:

(a) The production of iron ore, coal and coke;
(b) The production of pig iron and steel;
(c) The production of rolled steel.

II. To act as advisory body to the Federal Executive in the formulation of the production programs, and, through the proper channels, of the expansion plans of the enterprises in which the Mexican State participates and which have as their purpose the activities referred to in the preceding paragraph.

III. Hear and, if appropriate, provide its opinion on reports formulated by the agencies of the Federal Executive in regard to the national iron and steel industry and especially with respect to the incentives which can or should be given to that industry.

IV. Provide assistance in the prospecting for natural resources carried out by the enterprises in which the State holds participations and other Federal Government agencies.

V. Coordinate, publicize and promote the development of iron and steel technology suited to the country.

VI. Prepare and update systematically and continuously national development plans for the iron and steel industry.

VII. Propose priorities for the establishment and implementation of new iron and steel plants in the country.

VIII. Contribute directly to the promotion of regional development, through the establishment of growth poles in the less prosperous areas of the country.

Article 5. For ensuring compliance with and execution of the decisions and resolutions of the Commission, a Director General and such technical and administrative staff as the Commission deems necessary shall be appointed.

Article 6. The Commission shall meet in ordinary session at least once every three months, when the Chairman, the Director General and the majority

of its members shall attend. The Chairman may call special sessions whenever he deems such advisable and whenever the Director General so requests.

Resolutions shall be passed by a majority of votes and the Chairman shall have a casting vote.

Article 7. Resolutions which, in the opinion of the Commission, so warrant, can be submitted for consideration by the President of the Republic, through the Commission.

Article 8. For the fulfillment of its purpose, the Commission may request the assistance of the technical staff of the agencies forming its membership, together with such studies and opinions as it may deem desirable from them, or from the partially State-owned or private enterprises represented in the Technical Committee referred to in Article 10 of the present Decree.

Article 9. For administrative purposes the Commission shall come under the Secretariat of Government Property, which by agreement with and through the intermediary of the Secretariat of Finance and Public Credit, shall request authorization from the President of the Republic for the budget amendments that arise from the fulfillment of its purpose.

Article 10. The Commission shall request each of the corporations listed below to appoint one member each, to form a Technical Committee, through which they will make known or explain their views on matters falling within the purview of the Commission: Altos Hornos de Mexico, S.A.; Fundidora de Hierro y Acero da Monterrey, S.A.; Hojalata y Lamina, S.A.; Siderurgica Lazaro Cardenas-Las Truchas, S.A.; and the National Chamber of the Iron and Steel Industry.

The Commission shall seek the opinion of the Technical Committee regarding all matters within its competence which are subjects for study and action by it.

To be able to perform its task, the Technical Committee shall be informed of the work carried out by the Director General and the other staff of the Commission.

T E M P O R A R Y P R O V I S I O N

Sole Provision. This Decree shall enter into force on the day following its publication in the Official Gazette of the Federation.

Done at the Residence of the Federal Executive Power, in Mexico City, D.F., May 31, 1972. Signed by President, Secretary of Finance and Public Credit, Secretary of Government Properties, Secretary of Industry and Commerce, Secretary of the Presidency.

MEXICAN IRON AND STEEL INDUSTRY COORDINATING COMMISSION

TERMS OF REFERENCE FOR STEEL INDUSTRY STUDY BEING CARRIED OUT BY BATTELLE INSTITUTE1/

Purpose of the Study

It shall be the object of the study to provide the Coordinating Committee for the Steel Industry with the basic data required for the drawing up of programs to enable that Committee to regulate the growth of the country's steel industry.

It will, therefore, be necessary to determine and analyze the present state of production in terms of existing capacity, to carry out a market study in respect of the whole decade, based on requirements of unfinished steel and rolled products, and to review, in terms of the foregoing, the investments needed to satisfy demand, on the basis of the plans of enterprises already established and any new plants that may be set up, so as to make it possible to determine the best sites for increases in productive capacity, in terms of the supply of raw materials and of the market. Similarly, the study shall consider the problem of the prices of inputs and finished products, with a view to devising a sound policy in this connection.

I. Present Production of Steel, both in the Unfinished State and by Groups of Products

1. The consultants shall make a technical survey of "existing capacity" to produce steel, both in the unfinished state and by groups of rolled products. The term "existing production capacity" shall cover:

(a) plants already set up and in operation;
(b) plants in process of design or construction, or which have already been ordered from the suppliers.

2. Estimates will have to be provided with regard to the probable dates on which the plants mentioned under (b) above will actually come into production.

3. The survey in question will relate, in the main, to Fundidora, Altos Hornos, HYLSA, Tamsa and SICARTSA (under construction) but will also need to include a representative selection of semi-integrated and rerolling plants.

The technical survey in question is intended to:

(a) indicate the levels of output attainable in practice (both of unfinished steel and of the main products);
(b) point out the production sites where idle capacity is available and the reasons for that state of affairs, and those sites where small-scale investment programs might increase productive capacity;
(c) examine closely those imports of inputs or finished products which are used to complement national production, explaining the reasons for this;

1/ Bank translation of Spanish original.

(d) evaluate alternative supplies of ore, fluxing agents, fuels, and other inputs, as also the FOB cost at source. An estimate shall be made of the cost of importing these raw materials whenever it is felt that there is a possibility of internal sources of supply becoming insufficient;

(e) estimate the current cost of transporting, to each of the plants, the inputs mentioned under point (d) of this paragraph, making clear the extent to which such costs reflect dislocations in the existing transport system or distortions of the relevant rate structure;

(f) prepare estimates of the production costs of each plant, based on its present technical efficiency, its planning, its potential efficiency, and the cost of inputs. For this purpose use should be made, for the most part, of whatever information may be supplied by the various steel-producing companies and other bodies.

II. Markets

1. The consultants shall prepare fresh estimates of Mexican demand for common grades of steel products during the years 1973-80, taking into account the data submitted by the National Chamber of the Iron and Steel Industry, the more important producers and others.

2. These calculations must include detailed information with regard to the main groups of products, so as to make it possible to ascertain the industry's requirements of rolling and other finished equipment for its expansion program.

3. Estimates of the demand for individual groups of products must be correlated, as far as possible, with data concerning the specific consuming industries, both existing and potential.

4. The study shall also include details of the present and potential regional distribution of demand for steel products, as also of the cost of transport between present or proposed sites for steel plants, and the main markets, both present and future. The survey shall take into account the cost of transport, with and without subsidies, by rail, highway or sea, so as to make it possible for well-balanced decisions to be taken with regard to the siting of productive capacity in terms of various products.

5. The consultants shall examine the prospects available for exporting Mexican steel products, based on marginal and absolute costs, capacity in excess of internal demand and the cost of transport.

III. Future Output

1. In the light of their findings in the two previous sections of these Terms of Reference, the consultant firms shall ascertain the investments required for steel production, including its conversion into flat and non-flat products, to satisfy national demand. This shall be done on the

basis of present and future investment programs of existing enterprises, due regard being also paid to alternative sites for new plants. The investment required for the infrastructure works called for in each case must be given separately. Similarly, an estimate must be made of the operating costs per ton (cost of production, depreciation and financial charges) involved in the said programs, once the investments in question, at one or more sites, have been completed.

2. When the studies referred to in the foregoing paragraph are undertaken, proper attention shall be paid to the following:

(a) the advantages that might be derived from utilizing idle capacity at existing plants;
(b) the costs involved in transporting the finished products to present and future areas of consumption. In order to assess the financial effect of such costs, both existing freight rates and any possible changes in them shall be taken into account;
(c) the costs connected with the transport, within the country, of the inputs that will be required for the various programs of investment;
(d) the supply of domestic or imported inputs.

3. An outline must be given of the impact of alternative programs of investment on the siting of the bases required for the future growth of the Mexican steel industry.

4. An appraisal will have to be made of the complete financial studies for each program of investment, and for the steel-making sector as a whole. These financial studies should contain, as a minimum, the following information:

(a) financial plan;
(b) pro-forma earnings statements and analyses of profitability;
(c) pro-forma balance sheets and analyses of the financial structure;
(d) analyses of feasibility.

5. On the basis of the findings with regard to operating costs and investments required for each program of the enterprises concerned, it will also be necessary to determine the foreign exchange cost of and the total cost per specific type of product, to the various producers, both at the plant and at the nearest port. In this connection, information will have to be obtained on the following points:

(a) the additional capacity required in the matter of equipment to transport raw materials to the various plants;
(b) export and import prospects for both coal and iron ore; and
(c) the cost of the alternative domestic uses for these raw materials.

In like manner, it might be advisable to ask for a preliminary estimate of how the total costs of production and the foreign exchange costs would vary, at long term, in relation to the various programs of investment.

6. There shall be a brief discussion of the technical and financial aspects involved in setting up an export-oriented steel industry. This would include an explanation of how export prospects would be affected by the quality of finished steel products and the performance observed in the existing plants.

IV. Prices

1. The firm of consultants will have to examine recent experience (five years) and the present structure of prices in Mexico for the more important steel products as also the institutional, legal and other factors affecting those prices, such as the price control mechanism, the internal tax structure, the system of tariff protection and export schemes.

2. The following data regarding prices will have to be sought in respect of the typical products referred to in paragraph 3 of this section:

(i) basic prices at plant;
(ii) extra charges under the heading of quantity, quality, etc.;
(iii) discounts for volume, Government purchases, etc.;
(iv) freight adjustments;
(v) adjustments in respect of sales and other taxes;
(vi) prices paid by distributors and consumers on typical markets;
(vii) terms and conditions of payment; and
(viii) export prices (FOB value).

3. The following types of products will have to be studied (a comparison being made with comparable historical data):

1. sheet;
2. plate;
3. hot-rolled (coils and sheets);
4. cold-rolled (coils and sheets);
5. galvanized plate;
6. tinplate and similar products;
7. ordinary bars for the reinforcement of concrete;
8. wire rod;
9. high resistance bars for the reinforcement of concrete;
10. wire;
11. medium and heavy structural products;
12. rails;
13. light structural and angle products;
14. billets;
15. seamless tubing;
16. black and galvanized pipes with seams.

4. The domestic prices, that is to say the actual and not the list prices, prevailing on other important markets will have to be studied, an indication being given of future trends in those prices. The markets in question are:

1. Brazil
2. EEC
3. Japan
4. The United Kingdom; and
5. The United States

It will be necessary for a separate examination to be made as far as possible of internal and export prices for these products; details of the prices ruling during the past three years will be sufficient for this purpose.

5. Part of the study will have to be devoted, once the foregoing data have been obtained, to the preparation and evaluation of the alternatives available in connection with a price policy to be adopted in future, which should provide a level of profitability sufficient to finance the development of the Mexican steel industry. This policy will have to cover both the more important products of that steel industry and the main inputs required.

V. Conclusions

ANNEX 4

MEXICO - LAS TRUCHAS STEEL PROJECT

TECHNICAL DESCRIPTION

MEXICO - LAS TRUCHAS STEEL PROJECT

TECHNICAL DESCRIPTION OF STAGE I OF THE PROJECT

1. The project is for the establishment and operation of a non-flat steel products plant with an initial capacity of about 1.1 million tons of raw steel per annum and 1.0 million tons of finished products. The plant flowsheet is shown in Annex 4-3 and the layout in Annex 4-4. The facilities have been laid out and designed in such a way as to permit an easy expansion and diversification of production capacity to more than 5.0 million raw steel tons per annum.

2. The process route adopted for the Las Truchas steelworks is detailed in succeeding sections of this Annex and is summarized below:

(a) Mining and beneficiating the Las Truchas iron ore with transport of concentrate in slurry form to the plant site;
(b) Agglomerating the iron ore fines to form self-fluxing pellets;
(c) Conventional coke making based on imported coals;
(d) Iron making by the blast furnace method;
(e) Basic oxygen (B.O.F.) steelmaking;
(f) Continuous casting of billets;
(g) Rolling of rod, bar and light sections in two finishing mills.

(a) Mining and Concentration Plant

3. The project is based on the exploitation of the Las Truchas iron ore deposits, which are located in the vicinity (20 km) of the plant site. The primary deposits are known as Ferrotepec in the south and El Volcan, El Mango, Las Truchas, and Santa Clara in the north (see map). The primary ores are of the skarn magnetite type with determined sulphides of iron and copper. The northern deposits have been weathered to variable depths, the effect of which has been to convert much of the magnetite in the upper layers to hematite (martite).

4. As of the end of July 1973, geological or in-situ reserves were estimated at 76 million tons of measured ore and 12 million tons of indicated[1/] ore with an average soluble iron content of 50.5%. These estimates are based on an average specific gravity of 4.0 and are considered conservative. They take no account of the float ore, which covers part of the deposits and which can eventually be used as a direct charge materials. Nor do they include potential reserves in some of the deposits which have not yet been fully explored. The quantities of ore presently in the measured category are sufficient for over 30 years' operation of the plant at the initial level of output, accepting the SICARTSA/BSC exploration team's contention that most of the geological reserves are likely to be economically

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1/ See Annex 4-5 for definitions of "measured" and "indicated".

recoverable. The reserve development program will continue through the end of 1973, and it is anticipated that an increase to as much as 100 million tons of recoverable reserves will result.

5. The Ferrotepec orebody contains magnetite and almost no hematite, and the company plans to start mining operations there, a procedure that will simplify the initial concentration and pelletizing operations. Later on, when this deposit is at the point of being mined out, the northern deposits will be exploited.

6. Reserves in Ferrotepec currently are estimated at 12 million tons of measured ore sufficient for the initial five to six years of operation of the plant.

7. Mining of Ferrotepec will be of the open-pit type using 6 cu. yd. electric shovels, 50 ton trucks and a variety of ancillary plant and equipment. The average stripping ratio during the first few years of operation is estimated at 2.5:1. As exploitation proceeds to a pit depth of 100 m, this stripping ratio will increase. Mining costs will depend largely on the consumption of drilling bits, explosives and spare parts and can be established finally only when mine development actually begins. In the meantime, however, operating costs have been based on a preliminary mining plan and conservative application of the Advisor's experience on similar mining operations in Mexico and elsewhere to the conditions prevailing at Ferrotepec. The estimates are considered reasonable and have been used in the financial projections (Annexes 14 and 15).

8. Concentration of the run-of-mine ore will be necessary to reject gangue, copper and sulphur, and this requires grinding to a very fine size. The resulting concentrate will be too fine for sintering, and it therefore will be necessary to install a pellet plant.

9. The reason for working the Ferrotepec deposit first is that the ore is primarily magnetite and can be most simply concentrated and pelletized. Provision will, however, be made in the design of the concentrator and pellet plant for processing, at a later stage, ore and concentrate containing up to 25% hematite.

10. A primary and secondary crusing plant will be located near the mine and some preconcentration also will be done. The crushed and screened ore will be transported by conveyor belt to the concentration plant, where one month's supply of ore for the plant will be stockpiled. The concentration plant will be sited as close to the mine as topographical conditions allow.

11. For the Ferrotepec ore body, a wet magnetic concentration flowsheet is proposed. When the northern deposits begin to be exploited, hematite circuits will be added.

12. The concentrate slurry will be pumped approximately 23 km to the main works. The design of the slurry pipeline has been entrusted to Bechtel Corporation of San Francisco, which is uniquely experienced in this field.

13. If and when it becomes necessary to supplement the local iron ore supply, SICARTSA will purchase pellets or high grade concentrate either dry or in the form of slurry suitable for pellet plant feed.

(b) Pelletizing Plant

14. The pellet plant will be of conventional chaingrate or grate/kiln design. It will have a capacity of 1.8 million tons of screened, fluxed pellets per year.

15. The design and operation of the pellet plant are directed towards producing the required quality and tonnage of hot metal at the blast furnace at the lowest overall cost. This policy has resulted in decisions to:

(a) produce fluxed pellets;
(b) add various 'waste' materials such as BOF slag, mill scale etc. to the pellet plant feed.

16. The addition of flux to the pellets gives the opportunity to operate the blast furnace with higher blast temperatures and reduces the fuel rate as a result of the pre-calcination of the limestone. A further cost benefit results from providing the bulk of the flux required in the form of BOF slag.

17. Computer studies have shown the optimum level of iron in the burden to be 59.5% and this allows the facility to incorporate various 'waste' iron-bearing materials into the pellet feed, thereby achieving:

(a) recovery of iron units, which would otherwise be lost;
(b) avoidance of the cost of disposal of these 'waste' materials;
(c) the ability to operate on a two-component burden (pellet and coke), leading to better control and higher operating efficiency of the blast furnace.

(c) Coke Oven Plant

18. A battery comprising approximately 64 ovens of medium height 5.3 to 5.5 m, will be installed. Initially, the ovens will be charged with wet coal incorporating 6% dry basis of recycled coke breeze, to produce 575,000 tons of run-of-oven coke per annum. Provision will be made to convert, at a later date, to pre-heated coal charging, which would raise the capacity of the ovens. The charging car will be designed to give smokeless charging by means of wet scrubbing of evolved gases and the coke pushing and

quenching equipment will incorporate the best proven means of pollution suppression. Provision will be made for the future incorporation of enclosed pushing and quenching equipment.

19. Run-of-oven coke will be screened and cut to yield a product fraction of -60 mm + 20 mm size in accordance with current practice. As there will be no sinter plant, the coke breeze will be partly recycled to the coal preparation plant and partly used as boiler fuel.

20. The by-products plant will remove the tar, ammonia and naphthalene from the crude coke oven gas which will be used as a fuel in the plant. The recovered ammonia will be incinerated.

21. All purified coke oven gas will be desulphurized to prevent air pollution by sulphur dioxide, while all liquid effluents will be treated to a high standard to permit safe discharge to water courses.

(d) Blast Furnace Plant

22. The blast furnace will be required to produce an annual output of 1.1 million tons of hot metal for delivery to the steelplant. This annual production will require a furnace with an average daily rated capacity of 3,300 tons, assuming a plant availability of approximately 91.5%. The furnace ancillaries have been designed to accommodate a maximum output rate of 4,100 tons per day or 1.37 million tons per year.

23. In order to achieve this output a furnace with a hearth diameter of 9.0 m and an approximate inner volume of 1,750 m^3 will be installed. This represents an output rating of 1.95 tons/m^3/day, which with the proposed burden is comparable with the better standards of operating throughout the world.

24. The burden for the furnace, which consists essentially of two components - pellets and coke, will be made up as follows:

Self-fluxing pellets	1,630 kg/ton	of hot metal
Manganese ore	17	"
Coke	470	"
Fuel oil	50	"

25. The furnace burden was optimized using a computer model and the heat balance, gas flows, fuel rates etc. derived from the output. The heat balance figures were in turn used in a second computer model to calculate hot blast stove design and operating parameters.

26. The furnace will have two tap holes and two cast houses, diametrically opposed. The iron, via the runner system, will be cast into 270 ton torpedo ladles and the slag into dry slag pits. Granulation facilities may be installed, if a market survey indicates a market for this product.

27. The furnace will be designed to operate at a top pressure of 1.5 kg/cm^2 and the furnace top will be such as to permit operation at this high pressure with a minimum of maintenance.

28. The blast temperature will be 1,200°C using 3 stoves with external combustion chambers.

29. The fuel injection system will be capable of a maximum injection rate of 120 kg/ton of hot metal, although the initial injection rate will be 50 kg/ton.

30. The furnace stockhouse will contain three rows of bunkers, one for coke, one for pellets and one for miscellaneous materials. The total storage capacity for coke, pellets and each miscellaneous material will be approximately 12, 16 and 24 hours respectively. Each row of bunkers will discharge onto a conveyor, which in turn discharges into the weigh hoppers after screening out the undersized fractions of pellets and coke. The weigh hoppers will discharge directly onto the main furnace charging conveyor which delivers the burden to the receiving hopper on the furnace top. The complete charging sequence will be automatically controlled.

31. The dirty top gases from the furnace will pass through a conventional dust catcher, to remove the larger fraction of dust particles, followed by a double wet scrubbing process. The system will clean the gas dust content to less than 8 mg/Nm^3 and reduce the gas temperature to within 5°C of the available water temperature. The noise level resulting from the pressure reduction and high gas velocities will be restricted to the maximum practical extent and is likely to be about 105 db at a distance of 1 m from the unit. The dry flue dust extracted will be recycled in the pellet plant.

32. The furnace will be equiped with instrumentation and control equipment for the measurement, logging and control of all operating parameters. This system will be capable of conversion into an automatic control system at a future date.

(e) Basic Oxygen Steelmaking Plant

33. The feedstock for the finishing mills takes the form of billets 115 mm and 125 mm square, and the most economical method of providing these is by continuous casting from liquid steel. For reasons discussed in the following section, each casting machine will be limited to a maximum of 6 strands. This decision, coupled with the attainable casting rates of 115 mm square billets, effectively determines the size of the B.O.F. vessels. The interaction of vessel heat sizes and casting times for a liquid steel production of 1.1 million tons per year leads to the selection of 100 ton vessels and 3 six-strand casting machines as the optimum facility combination.

34. The capacity of the BOF plant has been determined on the basis of 11,300 heats per year of 50 weeks, which should be readily attainable within 30 months of start-up. This gives a liquid steel production somewhat in excess of the required 1.1 million tons per annum. As further experience is gained, an increase to 13,000 heats per year can be expected.

35. The commissioning strategy for the BOF plant is designed to achieve as rapid a build-up of production of liquid steel as possible. This

will be achieved by operating a single B.O.F. vessel for the first eight months after start-up. At this point the second vessel may be introduced to blow alternately with the first vessel, thus maintaining a tap-to-tap time that would permit an early introduction of sequence casting on the continuous casting plant. When one vessel is out of production for relining, the cycle time of the operating vessel would be shortened to lessen the loss of steel production. The necessary additional facilities for this mode of operation will be installed.

36. With two vessels in operation, the lining lives of the vessels will be extended by gunning of castable refractories. Because of the long tap-to-tap times obtained with two-vessel operation, the gunning operation will not affect the vessel cycle times significantly. The use of this technique will reduce single-vessel operation to a minimum.

37. The gas cleaning and cooling system is designed to operate on suppressed combustion at an air factor of 0.1, as this is considered to be technically and economically more desirable than full or partial combustion. The waste gas will be cooled and cleaned by a venturi scrubber system.

38. The scrap, hot metal, slag and additions handling is of conventional character. The only unusual feature of the plant relates to the low tonnage of scrap arisings, which will necessitate the use of substantial quantities of oxide pellets (as charged to the blast furnace) as a coolant. The liquid steel will be poured from the vessel into 100 ton ladles and then transferred to the casting bay on ladle transfer cars.

39. While the plant will be built initially as a two-vessel shop, provision will be made for the installation of a third vessel at a later date.

(f) Continuous Casting Plant

40. The billets required for the finishing mills are 115 mm and 125 mm square. It has been demonstrated above that a 6-strand casting machine can be matched with a 100 ton BOF vessel to produce the necessary tonnage. Since two such machines would be fully utilized in servicing the steel plant, a third 6-strand machine is required to provide for mold changing, breakouts, etc.

41. The anticipated maximum casting rate for 115 mm square billets is 0.28 tons per minute per strand, which is equivalent to a casting time of 60 minutes for a 100 ton heat size. A rate of 0.28 tons per minute at 115 mm square is equivalent to 3 m per minute, which represents good current practice. Although certain plants during the recent past are known to have attained considerably greater casting rates, the risk of breakouts increases in direct proportion to the casting speed.

42. If two-vessel operation is introduced in the BOF shop, this will permit each vessel to be matched with a casting machine. At 11,300 heats per year the cycle time per vessel would be about 89 minutes, which

would be well within the capacity of the casting machines and permit sequence casting.

43. The decision to limit each casting machine to a maximum of 6-strands is based on considerations of temperature and expansion when casting sections of the required size. With the long tundish required to cover 8-strands, significant temperature differences arise between the inner and outer strands. The expansion which occurs in the long tundish creates problems in centering the nozzles in the molds, particularly for the smaller sections. The alternative of using a split tundish, which in turn requires twin-stoppered steel ladles, has its own problems and is not favored.

(g) Rolling Mills

44. Each casting machine will feed a forced draft cooling rack with provision for turning to ensure uniform cooling straightness. Billet handling will be designed to minize crane and vehicle movements. No in-line facilities for billet dressing will be provided, although space is available should billet dressing be found necessary.

45. Each mill will have an identical billet stockyard with a normal capacity of two weeks stock and a maximum of four weeks. Space is available for future expansion.

46. The reheating furnaces will each be 150 ton per hour, refractory hearth walking beam furnaces.

Rod and Bar Mill

47. This mill is designed to roll 0.5 million tons per year of rod and reinforcing bar in the range 5.5 to 12.7 mm (7/32 to ½ inch). It will be able to produce uncut coils of up to 1500 kg from 15 m billets. Smaller coils will be possible with shorter billets. In both cases 115 mm square billets will be used.

48. The billet cross-sectional area was selected as the maximum size of billet compatible with a guaranteed maximum finishing speed of 50 m per second and an acceptable entry speed at the first stand of 5.6 m per minute.

49. To meet the required product range, a 25-stand, three strand rod mill with three single strand no-twist finishing blocks will be installed. The mill will be divided after the 15th stand with forward running repeaters, into each of the three 10-stand finishing blocks. The rod will be cooled on a controlled type cooling conveyor before being coiled down into a reforming chamber. Provision will be made for in-line splitting to provide one half or one third coil weights.

50. Reinforcing bars rolled on this mill will be straightened and cut to length before bundling for despatch. Where necessary, the 12 m long bundles can be bent in half for shipment.

Bar and Light Section Mill

51. The mill will be designed to roll a total of 0.5 million tons per year from the following product range:

Rebar	12.7 mm - 40 mm
Other bar	12.7 mm - 50.8 mm
Equal angles	25.4 mm - 76.2 mm
Unequal angles	50.8 X 38.1 mm - 90 X 50.8 mm
Channels	76.2 mm X 28.1 mm
Flats	50.8 mm - 127 mm X 6.3 mm - 40 mm
Squares and Hexagons	12.7 mm - 50.8 mm

52. The billet size used will be 125 mm square x 15 m long for the full product range. An overlap with the rod mill down to 9.5 mm can be achieved by rolling 115 mm x 15 m billets, thus enabling rebar to be rolled into straight lengths onto the cooling banks and eliminating restraightening.

53. To roll the above product range, the mill will comprise 18 stands capable of twin-stranding on the lighter products. The provision of quick roll changing facilities is being considered to minimize roll changing delays.

54. Finishing facilities will be normal for a mill of this type, with a double-sided cooling bank. The output from the banks will be assembled into batches for shearing into multiples of customer lengths in three standard ranges of 5-7 m, 7-9 m and 9-12 m. Rebar will be supplied in 12 m lengths.

(h) Mechanical and Electrical Services

Electric Power Supply and Distribution

55. The major source of power is La Villita Hydroelectric Station on the Rio Balsas, some 15 km distant, which has a capacity of 300 MW. From there, two 230 KV overhead lines to be erected by Comision Federal de Electricidad (CFE) will run to a distribution substation on site, terminating at two 75 MVA, 230/34.5 KV transformers.

56. Primary site distribution will be at 34.5 KV with dual supplies to each of four substations strategically located near the main consuming centers and interconnected to the power station, where security of supply is essential. At each of the four substations the voltage will be stepped down to 13.8 KV for secondary high tension distribution and to 4.16 KV and 480 V transformers for local networks.

57. The mine and concentration plant will be supplied from the hydro-station by two 115 KV overhead lines erected by the CFE. Primary distribution will be at 13.8 KV subsequently stepping down to 4.16 KV and 480 V for local distribution and use.

Power Plant

58. The plant will initially include three high-pressure steam generators fired on blast furnace gas and tar with coke oven gas and fuel oil burning facilities, two blast furnace turbo-blowers and two 10 MVA, 8 MW pass out/condensing turbo-alternators.

59. In the event of a failure of the incoming CFE power supply the turbo-alternators will provide sufficient power to maintain essential works services. Non-essential power supplies will automatically trip and interconnectors for essential supplies close as the failure is detected.

60. Provision for distribution control of gases including air and oxygen, fluids, steam and electric power will be from a central control room at the power plant, ensuring maximum utilization and the efficient use of energy in alternative forms.

Water Supply, Treatment and Disposal

61. Industrial grade water will be abstracted from the Rio Balsas upstream of Lazaro Cardenas town and pumped, via two pipe lines, to the site for distribution.

62. Condenser cooling water will be used as delivered, while other plant cooling water is softened to reduce scale formation on heat transfer surfaces. Boiler quality water will be demineralized for use as make up on steel making and continuous casting closed circuit cooling systems and for steam raising.

63. Elevated raw water storage will be provided to ensure continuity of essential supplies under emergency conditions and for fire fighting.

64. Potable water will be drawn from local wells.

65. Condenser cooling water, clean process water, surface drainage and chemically and biologically treated effluents will be discharged to a common outfall in the harbor area.

Blast Furnace and Coke Oven Gases

66. Blast furnace and coke oven gases will be distributed via overhead pipelines with a gas holder floating on each system to cater for variations in both supply and demand.

Fuel Oils

67. Fuel oils will be stored at a tank farm in the dock area and distributed via pipeline to local service tanks at each major consumption center.

Compressed Air

68. A central air compressor station and ring main distribution system will provide general purpose air at all points throughout the works. Local compressors will supply air for instrumentation and control systems.

Oxygen

69. An oxygen plant will provide some 400 tons per day of gaseous oxygen from two equal-size air separation units. Each unit will be capable of liquifying 10% of its production to provide the necessary storage to meet fluctuating demands and to cater for reduced oxygen output when maintenance is being carried out on a separation unit.

Workshops

70. The central engineering workshops will be laid out and equipped to supply foreseeable engineering maintenance requirements, with facilities for rolling stock and mobile plant repairs, plating and welding, heavy and light machining and turning, electrical plant repairs, motor repairs and coil winding.

Industrial Projects Department
August 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

TECHNICAL DESCRIPTION OF TENTATIVE STAGE II

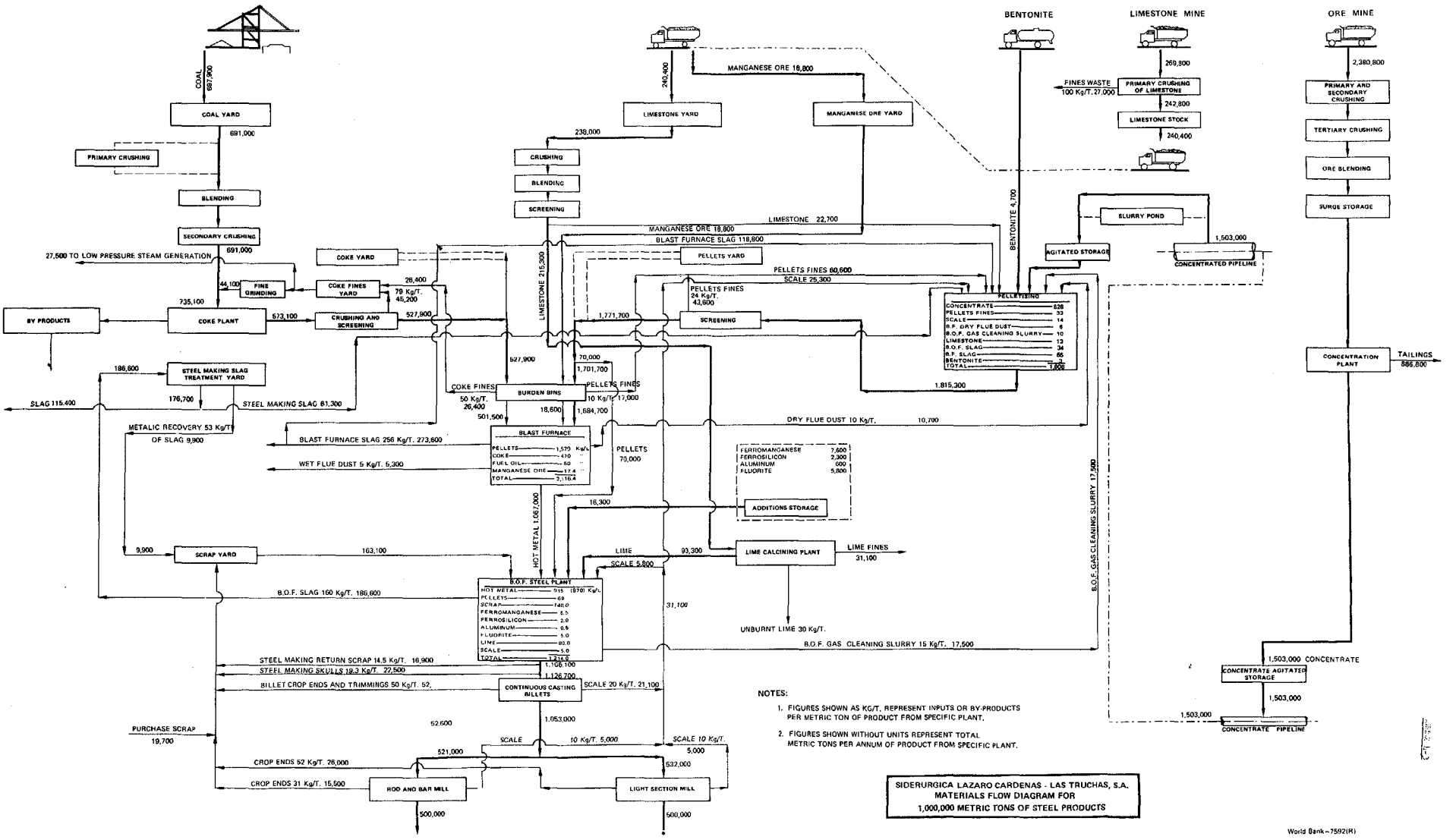
1. In the second stage of the Las Truchas project, as it presently is conceived, the plant would be expanded to a capacity of about 2.3 million tons of raw steel per annum, with the addition of a new product, heavy plate, to SICARTSA's product mix.

2. Thanks to the provisions made in the design of the first stage, the expansion could be carried out with the addition of only a single B.O.F. converter, the duplication of most of the other iron and steel making facilities, the addition of a slab caster and 132-inch plate mill complex, and corresponding increases in works services, ancillary and mobile equipment.

3. The major units to be operated at the completion of the second stage would be:

(a) Coke Ovens - A total of 128 ovens.
(b) Pelletizing Plant - Two pelletizing units.
(c) Blast Furnace - Two identical furnaces, each with an approximate inner volume of 1,750 m^3.
(d) Basic Oxygen Steelmaking Plant - Three 300-ton converters (two operating and one standby). The third converter would enable output to be increased initially to 20,000 heats and, following the expected learning curve, ultimately to 23,000 heats per year.
(e) Continuous Casting Plant - Two single-strand slab casting machines to be added to the initial three 6-strand billet machines. These machines would be capable of handling the rising output from the B.O.F. plant.
(f) Rolling Mills - In addition to the two non-flat product mills installed in the first stage, a heavy plate mill would be installed for the second. This would consist of a slab yard, two 200-ton-per-hour slab reheat furnaces, a 132-inch, 4-high reversing mill with slab descaler and hot plate leveller, walking beam cooling bank, and testing, inspection, shearing, piling and plate finishing facilities.

Industrial Projects Department
June 1973

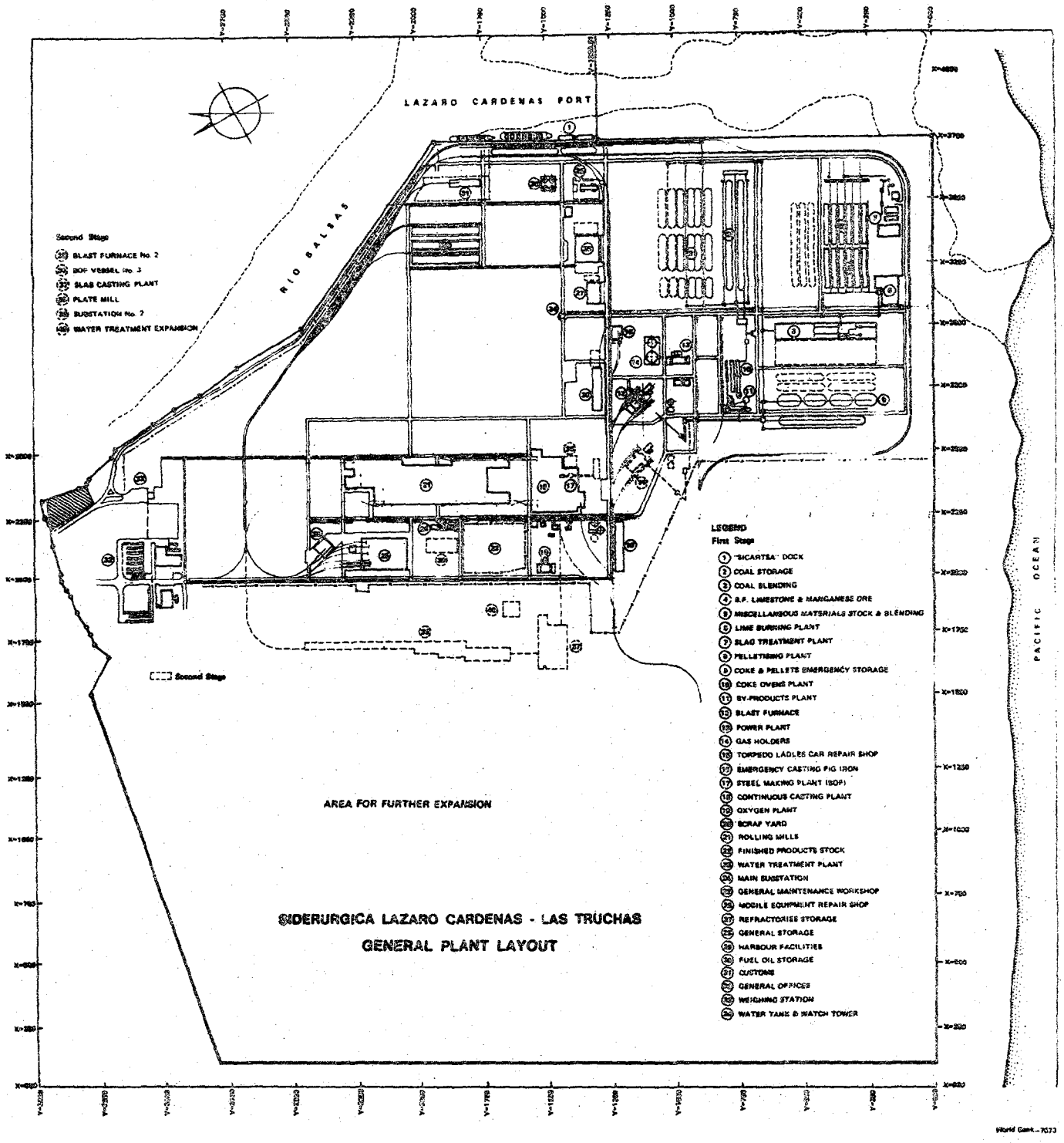


NOTES:

1. FIGURES SHOWN AS KG/T. REPRESENT INPUTS OR BY-PRODUCTS PER METRIC TON OF PRODUCT FROM SPECIFIC PLANT.
2. FIGURES SHOWN WITHOUT UNITS REPRESENT TOTAL METRIC TONS PER ANNUM OF PRODUCT FROM SPECIFIC PLANT.

SIDERURGICA LAZARO CARDENAS - LAS TRUCHAS, S.A.
MATERIALS FLOW DIAGRAM FOR
1,000,000 METRIC TONS OF STEEL PRODUCTS

World Bank-7592(R)



World Bank – 7073

DEFINITION OF RESERVES USED BY U.S.G.S. AND U.S.B.M.

MEASURED

1. Reserves for which tonnage is computed from dimensions revealed in outcrops, trenches, workings and drill holes, and for which grade is computed from the results of detailed sampling. The sites for inspection, sampling and measurement are spaced so closely and the geological character is so well defined that size, shape and mineral content are well established. The computed tonnage and grade are judged to be accurage within limits which are stated, and no such limit is judged to be different from the computed tonnage or grade by more than 20 percent.

INDICATED

2. Reserves for which tonnage and grade are computed partly from specific measurements, samples or production data and partly from projection for a reasonable distance on geological evidence. The sites available for inspection, measurement and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout.

INFERRED

3. Reserves for which quantitative estimates are based largely on broad knowledge of the geological character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition, of which there is geological evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geological evidence of their presence. Estimates of inferred reserves should include a statement of the spatial limits within which the inferred material may lie.

NOTE

The above definitions have been used by SICARTSA in their calculations of ore reserves, and have been accepted for the basis of calculations used in this appraisal.

Industrial Projects Department
June 1973

ANNEX 5

MEXICO - LAS TRUCHAS STEEL PROJECT

THE PORT OF LAZARO CARDENAS

1. The Las Truchas steel plant will need to import about 765,000 tons of coal per annum when its first stage reaches full production. This amount will more than double with implementation of the second stage. Provision for these imports, for the importation of plant and equipment, and for coastal shipment of a portion of SICARTSA's output by barge, is being made at the port of Lazaro Cardenas now under construction by the Ministry of the Navy (Marina) at the mouth of the Balsas River, adjacent to the plant site.

2. Although SICARTSA initially will be the principal user of the port, the Government does not intend this to be a special-purpose port. It is expected that increasing volumes of general cargo will flow through it, especially after rail shipment between Lazaro Cardenas and Mexico City is made possible with eventual completion of the Lazaro Cardanas/Nueva Italia rail line (see Annex 6). The Government's general traffic forecasts for the port are, however, felt to be inflated and the Bank therefore has recommended on several occasions that the port not be overbuilt in the beginning.

3. A forecast of SICARTSA's port needs for the period through 1983 is shown in Table 5-1. The required facilities comprise 200 meters of quay, an entrance channel to be dredged to 14 meters to accommodate bulk coal vessels of 50-80,000 DWT, navigational aids, a breakwater, buildings and general port infrastructure. Marina will have completed construction of these by 1976, plus an additional 400 meters of quay (two berths) for general cargos (which the Bank considers unnecessary in this first stage of port development).

4. Capital costs for the port total an estimated M$329 million (US$26.4 million), as shown in Table 5-2. This includes M$50 million (US$4 million) for the additional two general-cargo berths. The estimates do not include the resale value of reclaimed land.

5. Port charges are to be set so as to recover the economic costs of building and operating the port and will be levied according to gross registered tonnage, category of ship and type of cargo. Final agreement on a tariff has yet to be reached between SICARTSA and Marina. However, the Bank has been informed of the general levels being discussed, and considers them to be based on overestimates of general cargoes, which the proposed tariff assumes will cover the largest portion of the port's costs. Hence, much higher levels have been assumed in the economic evaluation of the steel project, details of which are shown in Annex 16.

Industrial Projects Department
May 1973

TABLE 5-1

MEXICO - LAS TRUCHAS STEEL PROJECT

PRELIMINARY FORECASTS OF STEEL-RELATED TRAFFICS THROUGH THE PORT OF LAZARO CARDENAS, 1974-83

(In 000 tons)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Phase 1										
Imported machinery	80	20	4	4	4	4	4	4	4	4
Imported coal	-	-	115	380	610	765	765	765	765	765
Domestic sales of steel coastwise	-	-	23	75	120	150	150	150	150	150
Total Phase 1	80	20	142	459	734	919	919	919	919	919
Phase 2										
Imported machinery	-	-	-	3	9	26	50	5	4	4
Exports of plate	-	-	-	-	-	-	-	-	50	220
Pacific sales	-	-	-	-	-	-	-	35	72	119
Imported coal	-	-	-	-	-	-	-	385	714	1061
Total Phase 2	-	-	-	3	9	26	50	425	840	1404
TOTAL SICARTSA TRAFFIC	80	20	142	462	743	945	969	1344	1759	2323

SOURCE: SICARTSA and Marina figures, modified by Bank.

Industrial Projects Department
May 1973

TABLE 5-2

MEXICO - LAS TRUCHAS STEEL PROJECT

CAPITAL COST ESTIMATE FOR PORT OF LAZARO CARDENAS

	M$ million	US$ million
Breakwater	14.5	1.2
Lighthouse, beacons and signals	4.0	0.3
Channel dredging to 14 meters	180.0	14.4
Land costs	23.0	1.9
Access roads	11.4	0.9
Open storage areas	3.8	0.3
Transit shed	4.8	0.4
Berths (600 meters)	75.2	6.0
Water and power supplies	7.5	0.6
Fishing installations	4.3	0.3
Administrative building	0.9	0.1
Total (1973 currency)	329.4	26.4

Source: Marina

Industrial Projects Department

May 1973

ANNEX 6

MEXICO - LAS TRUCHAS STEEL PROJECT

TRANSPORT OF FINISHED PRODUCTS

1. The transport of one million tons of Las Truchas steel annually from the coastal project site to markets in the center of Mexico -- principally the Mexico City region, Guadalajara, and Southern Mexico -- will be a major undertaking. Insuring it is carried out at the lowest economic cost has been of primary interest both to SICARTSA and the Government.

2. In April 1973, SICARTSA contracted a well-known consulting firm to undertake a thorough examination of all alternative methods of transporting the steel to markets. A linear programming model was constructed and data on construction, maintenance, equipment and operating costs and on the capacities of each route were obtained from the National Railways and the Ministries of Public Works, the Presidency, and the Navy. The results of the study took the form of conclusions and recommendations regarding:

(i) The mode or modes of transport to be used;
(ii) Equipment needed;
(iii) The required program for construction and improvement of needed infrastructure and its optimal timing; and
(iv) The total estimated cost and its breakdown.

3. The methodology on which the model was based aimed to minimize the discounted present cost of moving assumed quantities of steel to specific markets. The costs considered included operating, maintenance, equipment purchase, and any required construction or improvement of each route.

4. Basically there were five routes examined, although each of these contained sub-alternatives. They are as follows:

(i) By rail to Neuva Italia and from there by rail to Mexico City and/or Guadalajara (rail-rail);
(ii) By road to Nueva Italia and from there by rail to Mexico City and/or Guadalajara (road-rail);
(iii) By sea to Manzanillo and from there by rail to Mexico City and/or Guadalajara (sea-rail);
(iv) By road to Nueva Italia and from there by road to Mexico City and Guadalajara (road-road);
(v) By road to Mexico City through Altamirano (Mexico City demand only -- Guadalajara demand would use one of the other four routes) (road-road).

5. Sizable investments would be needed for four of the alternatives. The cost of the rail link from Las Truchas to Nueva Italia is estimated at $56 million, and investments of $16 million would be necessary to improve the road to Nueva Italia. The road through Altamirano does not exist yet, but construction to a standard high enough for use by heavily-loaded trucks would be more expensive than the mere tourist road to Zihuatanejo that has been planned (US$7.2 million). New investments for the sea-rail route through Manzanillo would be US$9.4 million, but the distance to Mexico City is much longer so that operating costs would be higher.

6. One of the failings of previous studies of the transport issue was to consider that once a route had been chosen there could be no changes over the life of the steel project. The final formulation of the problem allowed for changes of mode and routes within each mode -- e.g. sea-rail for 1976-80 and all rail through Nueva Italia from 1981 onwards.

7. For purposes of the economic evaluation of the Las Truchas project (Annex 16), the all-road alternative via Nueva Italia has been assumed. This is considered likely to be expensive, since it would involve much higher operating costs on the Nueva-Italia/Mexico City leg than those of the parallel rail route. Hence its use in the economic calculation is conservative. The actual decision of the Government, stemming from the above study, is that the railway link will be built and provide the primary mode of transport from 1978 onwards. During the 1976-78 period, road transport will be used as an interim measure.

Industrial Projects Department
August 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

THE NEW CITY OF LAZARO CARDENAS

1. The construction of a major steel plant in a hitherto lightly populated region naturally implies the concomitant development of a city to house and to provide services for the employees of SICARTSA and any ancillary industries growing up around it. Based on the experience of Monclova, in northern Mexico,1/ the eventual expansion of SICARTSA and the development of associated industries and services might be expected to result in a total population of 90,000 before the year 2000 (see Annex 17).

2. Planning for the new city of Lazaro Cardenas is well underway and a Trust Fund has been established to oversee its construction. The city initially will be economically and legally distinct from the small town of 10,000 persons (formerly known as Melchor Ocampo) which now exists near the plant site (see map). Detailed construction plans are only available for 1973, but a longer-term construction program is being prepared on the basis of a general scheme which the Bank has reviewed.

3. Available to the Trust Fund are 696 hectares of land in an oblong tract adjacent to and northwest of the plant site and about 3 km inland. About 521 hectares will be used for residential and service areas and 59 for parks and recreation. The final 116 hectares will be reserved for ancillary industries. At present, no central business district is planned; rather, service facilities will be located in clusters along the main artery of the city. It has been thought important to separate vehicular from pedestrian traffic; thus, the town will have vehicular circulation around its periphery, with sufficient penetration for services and a network of pedestrian walks, all linked together and leading towards the civic and shopping clusters. Since so many of the new residents will be from the countryside and used to sunshine and open spaces, the pedestrian walks also will serve as gardens, playgrounds and shopping malls. At the same time, a high dwelling density will permit cheaper town services and land costs per housing unit. There will be no concentration of high and low-income dwellings; housing for different income groups will be in close proximity. The Trust Fund believes that a mixture of income groups and of residences with services will give the city more vitality. The general plan appears well conceived, although the schedule for its implementation is very tight.

4. The annual housing construction program is shown in the following table:

1/ Monclova is the site of Altos Hornos de Mexico, the nation's largest steel producer. Construction began there in the early 1940's and its population has grown from about 10,000 in 1940 to over 80,000 in 1970.

HOUSING CONSTRUCTION PROGRAM

Year	Type of Construction and Number of Bedrooms: Barracks 3 br	Houses 3 br	Houses 2 br	Houses 1 br	Cumulative Total Rooms	Projected Workers On Site	Rooms Per Worker 1/
1973	180	148	220	130	1,554	1,750	0.89
1974	67	542	745	351	5,226	7,000	0.75
1975	17	142	196	84	6,173	9,300	0.66
1976	22	178	247	112	7,379	4,000	1.85

Source: SICARTSA, Trust Fund, and Bank calculations.

1/ As can be seen, most workers during the construction phase will be sharing rooms; only in 1976 will significant numbers be able to have their families with them.

5. Once SICARTSA is in operation, the Trust Fund will rent or sell houses, lots and commercial and industrial sites. The sales prices and rentals will be arranged so as to provide an adequate return on investment and to subsidize the housing of the poorest inhabitants of the city. Besides building houses, the Trust Fund also will install urban infrastructure -- water, electricity, sewerage, telephones and streets.

6. Total costs for the city through 1976 are estimated as M$455 million (US$36.4 million) as shown in the table below. This total includes provision for a 6 percent annual rate of increase in construction costs. Without price escalation, the cost in 1973 currency is M$422.5 million (US$33.8 million) and the present value, assuming a 10% cost of capital, is M$386 million (US$30.9 million). Using an estimated life of 30 years for the installations and houses and the 10% cost of capital, the equivalent annual cost for amortizing the city's capital investment if M$41.0 million (US$3.3 million). Since the total employment payments to be made by SICARTSA when the first stage of the steel project is in full operation is about M$175 million (US$14 million), there seems to be no reason to doubt the ability of SICARTSA's employees in the aggregate to pay for a large share of the costs of the city.

CAPITAL AND INITIAL ADMINISTRATIVE COSTS OF THE CITY OF LAZARO CARDENAS
(In M$000)

Year	Costs (Current Prices)	Costs (Constant 1973 Prices)	Present Value (1973 Prices)
1973	94,004	94,004	94,004
1974	207,900	196,132	178,301
1975	64,500	57,589	57,590
1976	88,250	74,788	56,232
Total	454,654	422,513	386,127

7. Although represented on the Trust Fund's Board of Directors, SICARTSA will have no special financial obligation to the City. The Trust Fund will receive an initial loan from Nacional Financiera and thereafter will be expected to be self-supporting. Complete financing plans are not yet available, but it seems likely that the Trust Fund also will receive funds from INFONAVIT, a new Government fund financed by a payroll tax for the purpose of financing workers' housing.

Industrial Projects Department
June 1973

ANNEX 8

MEXICO - LAS TRUCHAS STEEL PROJECT

ENVIRONMENTAL PROTECTION IN PLANT DESIGN

1. In drawing up the tender specifications and in finalizing the scope of the equipment supply contracts the Company has established the following objectives regarding pollution control:

(a) To incorporate good proven techniques;
(b) To examine any deferment options in the light of present local conditions;
(c) To reflect Mexican Law.

2. The layout of the plant will reduce the impact of residual pollutants; i.e. those emissions which remain after cleaning and control measures. The location of the plant close to the port area and the short internal transport lines for raw materials and materials in process will reduce the problem of dust control in relation to the surrounding region, while the location of the blast furnace, coke ovens and steelmaking plant will permit dust fallout to be confined to the plant area. The proximity of the sea simplifies drainage and reduces the cost of effective disposal of treated effluent. Main access to the steel plant will be designed to by-pass the town, with some resulting benefit so far as noise is concerned.

3. The pollutants which have the greatest frequency of occurrence in iron and steelmaking and which require control are summarized below. It is the aggregate emission levels which the pollution control devices are designed to restrict.

A. Sources of Water Pollution

Blast Furnace - cooling water, gas washing and dust removal from furnace top-gases, slag granulation.

Coke Ovens and By-Products Plant - cooling water for heat exchanges and direct washing, coke quenching.

Steel Plant - process water for BOF fume scrubbing and spray cooling for continuous casting.

Rolling Mills - cooling water for rolling mills rolls.

Ancillaries - boiler feed water, condenser cooling water, domestic water.

B. Sources of Air Pollution

Iron Ore Mines, Limestone Quarries

Coal Handling and Crushing - dust.

Coke Ovens - carbon monoxide, sulphur dioxide, sundry toxic gases, smoke, steam, dust.

Pellet Plant - sulphur dioxide, dust.

Steel Plant - carbon monoxide (flared), fume.

Power Plant - sulphur dioxide.

C. Sources of Noise Pollution

Blast furnace, power plant, oxygen plant.

Water Management

4. The source of water supply for the operation of the plant is the Balsas River. The rate of flow of the river is estimated at 450m^3/sec. and the intake to the steel plant is little more than 3 m^3/sec. Discharged water will be returned to the river or the sea via discharge canals. It will be subjected to treatment before disposal to reduce the content of suspended solids, scales, oxides, chemical residues, etc. After this treatment it will be carried by gravity through canals, in which it will be filtered and desedimented to arrive at the river or sea with an acceptable level of pollution.

Air Management

5. In order to control gas and dust emissions the stacks at the pellet plant, reheat furnaces and power plant have been increased in height beyond that necessary to obtain the required draft for combustion control. Stacks emitting sulphur dioxide will be high enough to give a maximum ground level concentration of 0.013 grams/m^3.

Noise Control

6. The main source of noise will arise from the blast furnace when high pressure steam, oxygen and air are blown off from the hot and cold blast systems. Discussions are currently going on with the equipment supplier to determine how closely the desired maximum noise level of 85 db at a distance of 1 meter can be approached.

Cost of Pollution Control Devices

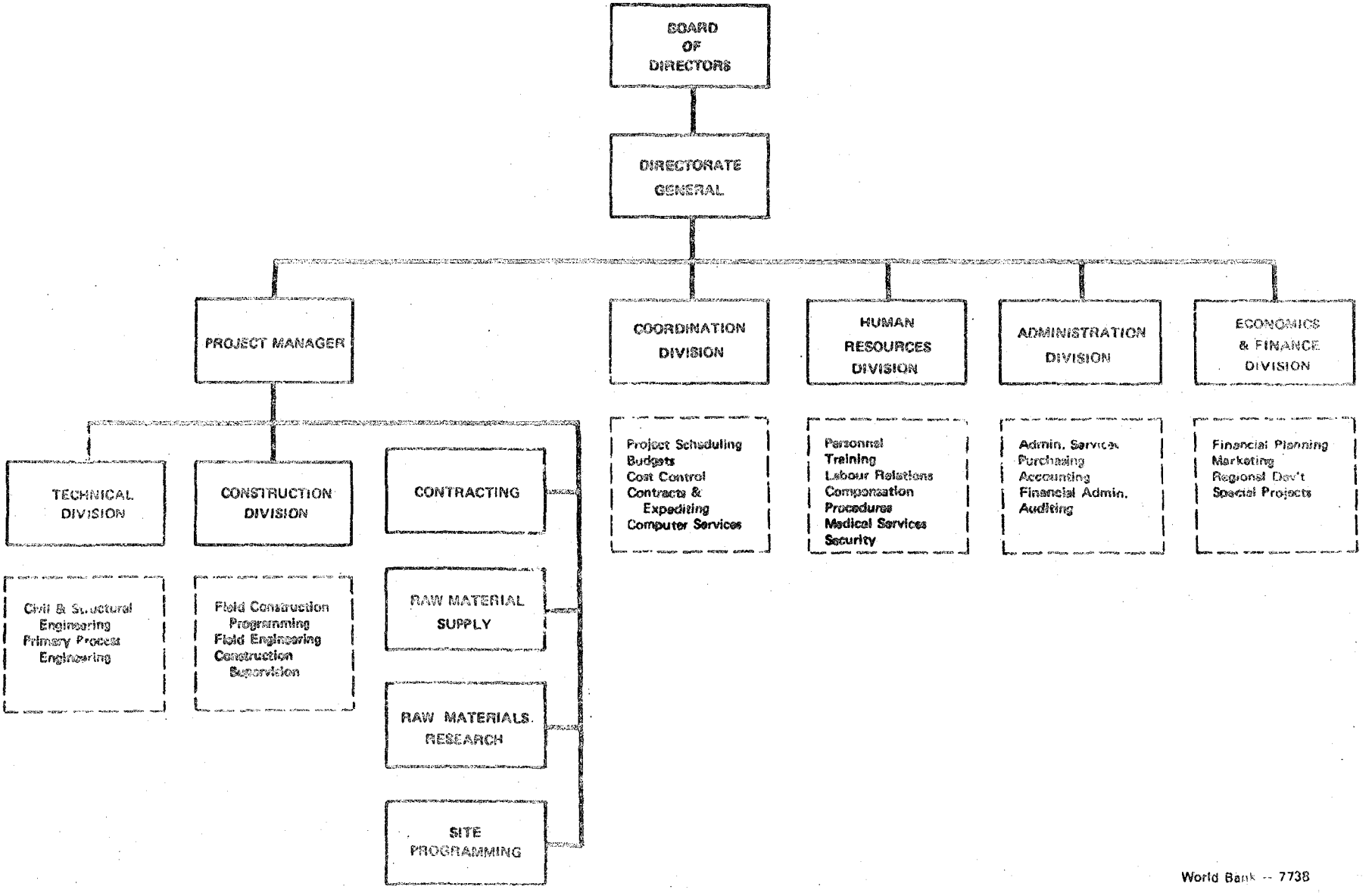
7. The cost of the main identifiable devices, whose functions are directly concerned with pollution control, is estimated at US$15 million. Most of these devices have by now been accepted as an integral part of 'dirty' process units and it is difficult to conceive of their not being installed in a modern plant. Furthermore, some devices are excluded from the US$15 million figure which also perform an essential technological role in steelmaking, or are essential for cleanliness and efficiency within the plant but which also contribute to pollution control. This is especially so in the rolling mills. Direct operating costs of pollution control devices are estimated at US$2 per ton of product.

8. A comparison with the cost of preventing or alleviating pollution in iron and steel works in other countries can at best be approximate,

because different steel industries have different attitudes as to what should be included in the term pollution-control device. Furthermore the cost of stacks varies considerably according to materials and local ecology. With these qualifications, SICARTSA's investment in pollution control appears to be in line with world-wide modern standards, and the company's definite attempt to minimize adverse environment effects of the plant is commendable.

Industrial Projects Department
June 1973

SICARTSA ORGANIZATION
DURING CONSTRUCTION PERIOD



ANNEX 6

MEXICO - LAS TRUCHAS STEEL PROJECT

TRAINING PROGRAM

1. Training appears to be recognized by all levels of SICARTSA's management as an essential step towards the efficient and profitable operation of the steel works, and the subject is receiving appropriate attention in the overall works program.

2. The Training and Development Department will provide training and development services to all functions within the works organization and will operate a formal training center. The department will be charged with responsibility both for off-the-job training activities and, together with the appropriate works departments, for all on-the-job training activities. The department will institute and maintain training systems as well as introduce new ones as and when needed. The department's program will cover the following types of training and development:

A. Craftsmen

Adults

i) Bricklayers will attend a short retraining course in refractory brickwork.

ii) Adults recruited for burning, grinding and drilling jobs will be trained for a period of one to three months.

iii) All other craftsmen will attend a short testing program to check their level of skill and knowledge before commencing a course in common steelworks practices. The craftsmen will then be allocated to a works area. The subsequent course will cover the skills and knowledge requirements of the plant and equipment within the allocated area.

iv) Ex-students of technical institutions who were not able to complete their course of study will be trained as electricians and instrument mechanics.

Apprentices

All craft apprentices will attend a two year program within the Training Center, followed by a one year program within a number of works maintenance departments.

B. Operatives

Adults

i) Applicants for mobile vehicle driving, overhead electric crane driving and rail transport jobs will be tested and screened before being placed into jobs.

ii) All production department operatives will be trained and tested in the skills and knowledge they will require in their jobs. In addition, at strategic positions in the promotion line, arrangements will be made for further training and testing before each operative is promoted.

Production Apprentices

Young employees direct from school, will follow a special training program of 12 months duration before being placed into a production department.

C. Technicians

Adults

All adults will attend a course which will give them an understanding of the work of other technicians and a knowledge of the production processes, routines and procedures associated with their job, and where necessary an up-dating of skills and knowledge required within their own discipline.

Younger Employees

Younger employees direct from technical institutions will attend a course which will include the topics listed for the adults plus for metallurgists and chemists, a period in the training laboratory, and for draughtsmen, a period in the training drawing office.

D. Clerical Personnel

Adults

All adults will be trained in standard office procedures and practices.

Younger Employees

The younger employees will attend a course in general clerical procedures, numerical accuracy, oral and written communication, document preparation, use of office machines and the procedures and practices.

E. Management, Technologists and Supervisors

The in-works training programs will include production processes; techniques of analysing jobs and training; management/supervisory practices; procedures and skills; general policies; and control and operating procedures and systems.

F. Graduate Apprenticeship Scheme

A short program for all new graduates of the training program will include policies and procedures, production processes, and appropriate technological knowledge allied to the needs of their future careers.

3. The British Overseas Development Association (ODA) has offered a grant in the amount of £230,000 ($575,000) for machine tools for the training center and the services of three senior instructors on two-year contracts. Moreover, ODA will contribute £70,000 ($175,000) towards the cost of sending

senior Mexican personnel to the U.K. for training. Other costs of training have been built into the project cost estimates, and total approximately US$4 million.

4. Recruitment and training will start in September 1973, although construction of the training center will not be completed until April 1973. It is intended that the entire training team (totallong some 77 instructors) will be in a position by the second half of 1975. Training requirements have been based on 40-hours per week working in the plant plus an allowance of 8 percent for absenteeism. Starting with 254 apprentices and 35 adult trainees in January 1974, the program will peak at 630 participants in the training center at any one time by early 1975 (see Table 10-1). In total, about 5,000 personnel ranging from management and staff to maintenance and production workers will require training of some sort through 1978. About 1,300 will receive training in the Training Center itself. It is recognized that the turnover rate will increase with rising levels of skills, and appropriate provision has been made to take account of this phenomenon.

5. Every process department initially will have assigned to it from the Advisor's U.K. staff one manager, two assistance, and anywnere from four to six shift foremen. The function of these expatriates will be to create an operating team and train their Mexican counterparts on the job site. They will be phased out in a manner consistent with smooth handing-over of the managerial and supervisory functions. For effective liaison with works departments, a member of each department's management team will be made responsible for training needs as an addition to his normal responsibilities.

6. The entire training program has been geared towards facilitating the successful start-up and initial operation of the plant. The need for in-depth training at all levels, including extended assignments of managerial and supervisory staff to the Advisor's or equipment suppliers' plants, has been fully accepted. The arrangements proposed are considered to be fully consistent with the assumed build-up of production and to be sufficiently flexible to take care of any, at present unforeseen, eventualities which may arise as the training program gets underway.

Industrial Projects Department
June 1973

Table 10-1

MEXICO - LAS TRUCHAS STEEL PROJECT

NUMBER OF TRAINEES IN THE TRAINING CENTER

	1974		1975		1976		1977		1978	
	1	2	1	2	1	2	1	2	1 1	2
APPRENTICES										
Mechanical Skills	161	270	270	270	158	158	98	98	98	98
Electricians	38	71	71	71	46	59	26	26	26	26
Instrument Mechanics	12	21	21	21	15	19	8	8	8	8
Structural	43	43	67	67	37	37	26	26	26	26
Total Apprentices	254	405	429	429	256	273	158	158	158	158
TECHNICIANS										
Group 1	10	13	32	29	8	11	15	18	15	18
Group 2	27	33	6	10	10	10	-	-	-	-
Total Technicians	37	46	38	39	18	21	15	18	15	18
ADULTS										
Mechanical Skills	39	47	56	25	35	46	44	-	-	-
Electricians	25	25	50	25	50	25	25	-	-	-
Instrument Mechanics	10	10	20	10	20	10	10	-	-	-
Structural	26	4	17	21	6	-	19	25	25	-
Bricklayer	12	12	20	20	-	-	-	20	20	-
Total Adults	112	98	163	101	111	81	98	45	45	-
GRAND TOTAL	403	549	630	569	335	375	271	221	218	176

Industrial Projects Department
June 1973

Table 10-2

MEXICO - LAS TRUCHAS STEEL PROJECT

MANNING SCHEDULE AT FULL PRODUCTION 1/

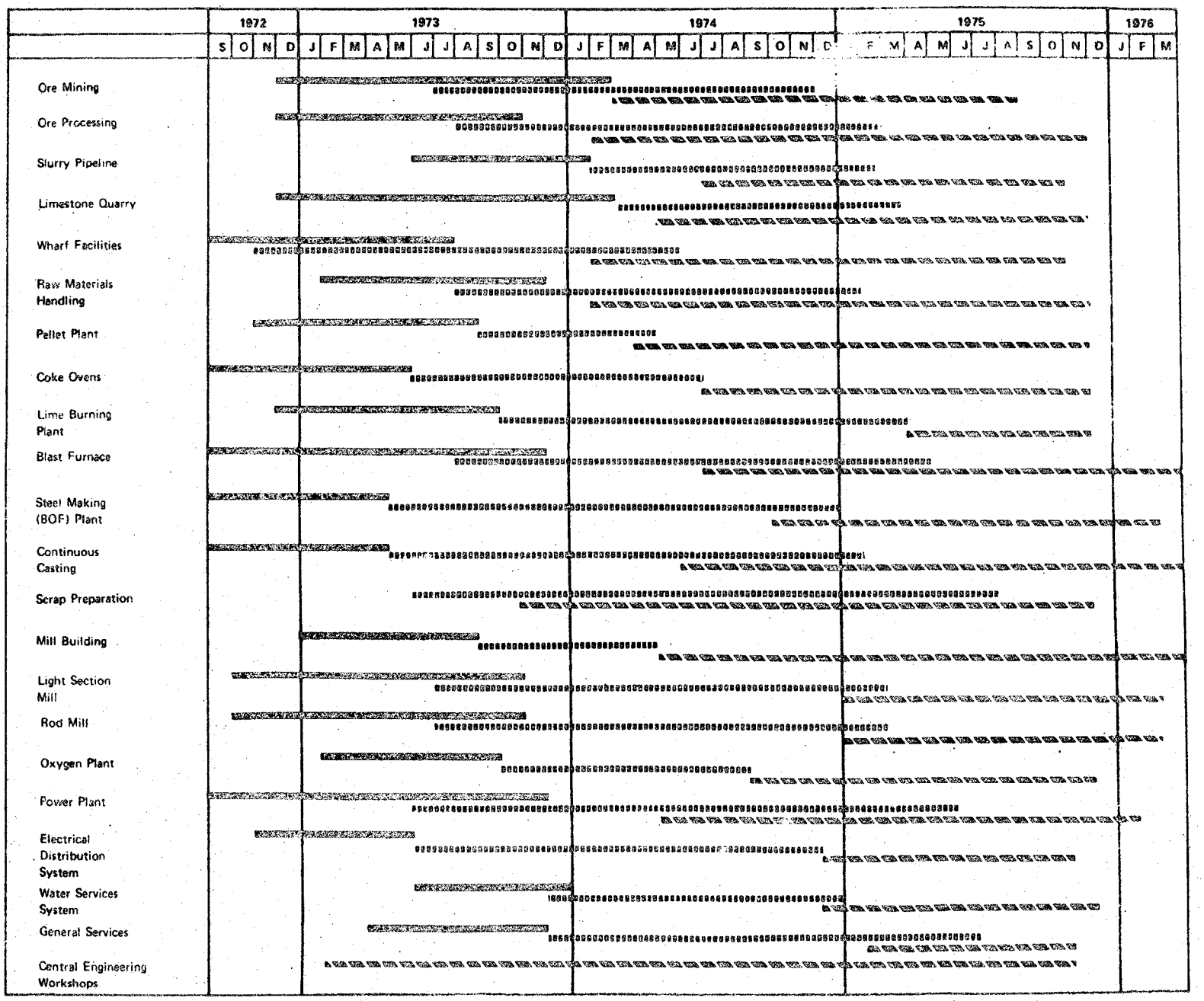
Department	Operating Personnel	Administrative & Supervisory Personnel	Maintenance Personnel	Totals by Department
Mine	112	22	78	212
Crusher/Concentrator	48	22	-	70
Pipeline	2	-	-	2
Quarry	31	5	10	46
Lime Kiln	16	4	-	20
Docks	24	4	4	32
Raw Materials Handling	42	4	8	54
Coke Ovens	97	15	37	149
Pellet Plant	42	16	35	93
Blast Furnace	71	13	16	100
B.O.F. Plant	96	33	72	201
Continuous Casting Plant	120	22	72	214
Rod Mill	200	35	90	325
Light Section Mill	200	40	100	340
Central Facilities	248	596	307	1151
Services	354	61	261	676
Total	1703	892	1090	3685

1/ Excludes head office and sales personnel

Industrial Projects Department
June 1973

ANNEX 11

SIDERURGICA LAZARO CARDENAS - LAS TRUCHAS
PROJECT IMPLEMENTATION SCHEDULE



World Bank – 7674

MEXICO - LAS TRUCHAS STEEL PROJECT

CAPITAL COST AND PROCUREMENT

MEXICO - LAS TRUCHAS STEEL PROJECT

ESTIMATED PROJECT COST
(US$ million)

	Plant and Spares	Plant Services	Insurance and Freight	Erection and Commissioning	Civil Works	Structural Works	Total
Mine and Quarry	6.8	0.1	0.1	0.2	0.9	0.1	8.2
Crushing and Concentration	10.6	0.9	0.8	2.5	6.0	0.9	21.7
Slurry Pipeline	0.8	-	0.1	0.5	0.9	-	2.2
Pellet Plant	10.8	1.7	0.8	3.5	3.2	1.5	21.5
Blast Furnace 1/	16.0	0.9	0.8	2.3	4.4	3.0	27.4
Basic Oxygen Furnace (BOF) 1/	17.9	4.3	1.7	7.0	5.7	4.0	40.6
Continuous Casting	11.7	1.1	0.3	1.9	4.4	2.2	21.6
Wire Rod and Bar Mill 1/	32.2	-	1.3	9.4	6.7	-	49.6
Light Section Mill 1/	33.4	-	1.6	9.8	10.9	8.5	63.3
Oxygen Plant 1/	4.3	0.2	0.3	1.1	0.4	-	6.3
Lime Kiln	3.4	0.1	0.2	0.9	0.4	-	5.0
Docks and Raw Material Handling	16.1	-	0.7	3.6	3.5	0.3	24.2
Coke Ovens 1/	19.2	0.7	2.0	5.1	4.4	0.1	31.5
Fluid and Electrical Services and Power Plant 1/	42.5	-	1.6	11.3	5.5	1.6	62.5
Transport, Workshops, Labs, Offices 1/	12.7	1.3	2.0	1.5	10.5	1.9	29.9
Site and Temporary Services	-	1.2	-	-	9.0	-	10.2
Insurance	-	-	2.9	-	-	-	2.9
Mexican Merchant Tax	2.3	0.4	-	2.5	3.7	0.7	9.6
Sub-Total	240.7	12.9	17.2	63.1	79.6	24.8	438.3
Design and Engineering							26.3
Physical Contingencies							34.5
TOTAL FIXED ASSETS							499.1
Pre-operating Expenses 2/							70.0
Initial Working Capital 2/							78.0
TOTAL PROJECT COST BEFORE PRICE CONTINGENCIES							597.1
Price Contingencies 3/							38.5
TOTAL PROJECT COST							635.6

1/ Fixed prices, not subject to escalation; others are June 1973 estimates.

2/ Includes money spent prior to August 1973.

3/ Representing escalation on non-fixed prices.

Industrial Projects Department
August 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

TOTAL CAPITAL REQUIREMENTS COMPARED WITH WORLD STANDARDS

1. Comparing the estimated capital cost of the Las Truchas project with the costs of other plants that appear in published literature can be misleading if a number of factors are not considered. First, published data appear to be based largely on idealized costs rather than on actual construction costs, and figures quoted usually are several years old, requiring escalation to reflect present-day costs. Second, the currency realignments of 1971 and 1973 have tended to increase equipment costs from Japanese and European suppliers expressed in dollar terms (although not in direct proportion to the changes in parities). Third, published cost data refer to plants from the raw material preparation stage onward and thus exclude the cost of mining and ore beneficiation facilities (such as the Las Truchas project contains). The cost of a pellet plant also would not be included normally in published data, but that of a sinter plant would. Since the cost of these two facilities is approximately the same, the comparison of Las Truchas with published data should be made on the basis of total fixed asset costs less the cost of the iron ore and limestone mines and the ore beneficiation facilities. Fourth, published figures probably do not fully reflect the cost of anti-pollution devices which are fast becoming standard features of modern steel plants. Fifth, insufficient or no allowance is made in most published data for pre-operating expanses, engineering fees, working capital, start-up costs and initial operating losses. Sixth, site conditions, specifically the need for piling, have a significant effect on total construction costs and cause wide variations in "standard" figures. Seventh, the capacity of a plant is somewhat subjective assessment which depends to a large extent on the skill of its management and labor force. Differences in estimating the capacity of a given plant can amount to as much as 20%, with a corresponding effect on unit costs.

2. As Annex 12-1 indicates, the total fixed asset cost of the Las Truchas project is US$499.3 million and the total project cost (without escalation) US$597.3 million. A modified estimate, which can be compared with published estimates for other plants, is developed as follows:

ADJUSTED PROJECT COST ESTIMATE FOR INTERNATIONAL COMPARISON

	US$ million
Total Fixed Assets	435.9 1/
Pre-operating Expenses	63.0 2/
Working Capital	12.5 3/
Total	511.4

1/ Excluding iron ore mine, limestone quarry, crusher/concentrator, ore conveyor, and slurry pipeline. Contingencies and design and engineering costs pro-rated accordingly.

2/ Changes pro-rated with changes to fixed assets.

3/ Working capital required to begin operations, plus 3 months inventory of iron ore pellet feed that would be needed if the local iron ore were not available.

3. Taking the achievable capacity of the plant as 1.3 million tons of raw steel per annum (as opposed to the more conservative planning figure of 1.1 million tons used elsewhere in this report), the modified total implies a capital cost for Las Truchas of about US$395 per annual ton of raw steel. This is considered very reasonable by world standards for a plant of this type -- particularly for one that will be remote from existing maintenance and repair facilities and will be operated by a comparatively inexperienced work force, both of which necessitate rather more conservative (and therefore more expensive) design, engineering, and construction practice than might be possible elsewhere.

4. The scale of the Las Truchas operation, particularly in its first stage, militates against the very high capital productivity achieved in some of the giant modern works of Japan and Europe. It is necessary, however, to view economies of scale in this context somewhat more closely than is normally done. Economies of scale in steel fall into two quite distinct categories. The first and more obvious category covers plant facilities having lower capacities than those currently being built in major steel producing countries. Since capital and operating costs do not increase in proportion to capacity, the cost per unit of output produced in the larger facility will, other things being equal, generally be lower than that of the smaller one. The second category covers the parallel operation of two or more similar facilities of maximum scale. Hence, economies derive from better production scheduling than is possible with single units and lower maintenance, overhead and administration costs per unit of output.

5. An analysis of SICARTSA's major production facilities along these lines shows that, in fact, only the blast furnace, with a maximum rated output of 4,100 tons per day, might be placed in the first category. Even though this is a large furnace, it will be appreciably smaller than a few blast furnaces in Japan and Europe, which have rated capacities of up to 10,000 tons per day (but are not part of non-flat steel works). The balance of the facilities fall into the second category; for example, the BOF and continuous casting plant which, for purposes of this analysis, can be considered a single entity. Given the present state of the art of continuous casting, 6 strands represent the upper limit for billet casters, if temperature and expansion problems are to be avoided. Also, current practice is to cast 115 mm square billets at a rate of 3 m per minute. Combining the maximum number of strands per machine with the maximum casting rate shows that the appropriate BOF vessel size is 100 tons. Therefore, although BOF vessels with a capacity of 300 tons are currently in operation, they are used only in conjunction with ingot or continuous slab casting, not with billet casting. Similarly, the two rolling mills -- the rod and bar mill and the bar and light section mill -- represent the largest mills of their respective type currently being installed world-wide. Given the projected product mix, rolling capacity could be increased only by the installation of a third mill.

6. It follows from this brief analysis that the proposed project is of an economic size for a non-flat steel works, even in the context of the latest developments in the iron and steel industry.

Industrial Projects Department
August 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

ITEMS TO BE FINANCED BY THE BANK

Package No.	Item	Estimated Cost		
		Mexican Component	Foreign Component	Total
		(US$ Millions)		
H1	Blast Furnace	8.1	14.3	22.4
H12	Boilers	3.1	1.0	4.1
S12	Mill Structures	9.4	-	9.4
V1-2	Locomotives	-	1.0	1.0
M13	Conveyors Control System	1.3	-	1.3
M8	Pellet Plant	12.4	7.3	19.7
	Total Equipment Cost[1/]	34.3	23.6	57.9
	Contingencies	2.7	1.8	4.5
	Interest During Construction	-	7.6	7.6
	TOTAL BANK LOAN	37.0	33.0	70.0

1/ Includes estimates of price escalation for each item except H1 and H12, for which firm prices have already been determined from tenders.

Industrial Projects Department
June 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

ESTIMATED SCHEDULE OF DISBURSEMENTS

Year	Quarter Ending	Estimated Disbursements	Estimated Amount Undisbursed
1973	December 31	3.4	66.6
1974	March 31	4.2	62.4
	June 30	8.6	53.8
	September 30	15.5	38.3
	December 31	16.1	22.2
1975	March 31	8.2	14.0
	June 30	3.1	10.9
	September 30	1.7	9.2
	December 31	1.3	7.9
1976	March 31	1.3	6.6
	June 30	1.3	5.3
	September 30	1.0	4.3
	December 31	1.0	3.3
1977	March 31	1.3	2.0
	June 30	1.0	1.0
	September 30	0.5	0.5
	December 31	0.5	-

Industrial Projects Department
August 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

PRODUCTION AND REVENUE BUILDUP

	Unit Value in 1973 Prices 1/	Sales Volume in 000 Metric Tons				
	US$/MT	1976	1977	1978	1979	1980
Wire Rod	185.0	26	87	140	175	175
Re-bar (5.5-12.7mm)	186.0	49	163	260	325	325
Re-bar (12.7-40mm)	186.0	27	90	144	180	180
Other Bar	176.0	21	70	112	140	140
Light Sections	171.0	20	65	104	130	130
Spring Flats	250.0	7	25	40	50	50
Total Tonnage	185.5	150	500	800	1000	1000
Capacity Utilization %		15	50	80	100	100
		(US$ Million)				
Gross Revenues (Constant Prices)		27.8	92.8	148.4	185.5	185.5
Less 1.8% Merchant Tax 2/		0.5	1.7	2.7	3.3	3.3
Less Discounts and sales service center costs 3/		0.9	3.0	4.7	5.9	5.9
Net Revenues (Constant Prices)		26.4	88.1	141.0	176.3	176.3
Net Revenues (Current Prices) 4/		29.6	100.8	164.7	209.9	214.1

1/ Delivered prices Mexico City.

2/ Preferential rate given because of project's location in designated development region. Nominal rate is 4%.

3/ Shown as a reduction in revenues rather than as an operating cost.

4/ Assumes 12% increase over 1973 prices by 1976.

Industrial Projects Department
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MEXICO - LAS TRUCHAS STEEL PROJECT

OPERATING COSTS FOR ONE MILLION TONS FINISHED PRODUCTS PER ANNUM OUTPUT
(1973 prices)

	US$/Ton	Percent of Total Operating Costs
FIXED COSTS		
Employment	12.7	21.5
Fuel and Energy	0.2	0.3
Maintenance Materials[1/]	1.3	2.2
Consumables/Sundries	0.4	0.7
Plant Insurance	1.0	1.8
Total Fixed Costs	15.6	26.5
VARIABLE COSTS		
Raw Materials - Coal[2/]	15.6	26.2
- Other	5.5	9.3
Fuel and Energy	3.6	6.1
Maintenance Materials[1/]	10.8	18.3
Consumables/Sundries	8.0	13.6
Total Variable Costs	43.5	73.5
TOTAL OPERATING COSTS	59.1	100.0
Administrative	2.5	4.2
Transport of Finished Products[3/]	8.2	13.9
TOTAL INCLUDING TRANSPORT	69.8	118.1

1/ Includes replacement of spares.

2/ Includes US$0.2 for port charges.

3/ Assumes quoted road haulage rate of US$13.60 per ton for shipments from plant to Mexico City, an approximate average haul. Of this amount, SICARTSA must absorb only transport costs for 60% of sales that actually go to Mexico City markets. Elsewhere in country, customer absorbs transport costs. Hence transport cost to SICARTSA = 13.6 x 0.6 = 8.2.

Industrial Projects Department
August 1973

ANNEX 15

MEXICO - LAS TRUCHAS STEEL PROJECT

FINANCIAL ANALYSIS

MEXICO - LAS TRUCHAS STEEL PROJECT

PRO-FORMA PROFIT AND LOSS STATEMENT
(US$ million)

Note 1/		1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	NET REVENUES	28.9	100.8	164.7	209.9	214.1	218.5	222.7	227.2	231.6	236.3	241.0	245.8	250.7	255.8	260.9	266.1
2	Production Costs	18.9	44.5	58.8	70.7	72.5	74.9	77.2	79.3	81.9	84.3	86.8	89.4	92.1	94.8	97.7	100.6
	GROSS PROFITS	10.7	56.3	105.9	139.2	141.6	143.6	145.5	147.9	149.7	152.0	154.2	156.4	158.6	161.0	163.2	165.5
3	Administrative and Transport Costs	4.1	7.4	10.5	12.8	13.2	13.6	14.0	14.4	14.9	15.2	15.7	16.2	16.7	17.2	17.7	18.2
4	Depreciation	14.7	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4
5	Amortization of Deferred Charges	5.4	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	5.4					
	OPERATING PROFIT	(13.5)	8.8	55.3	86.3	88.3	89.9	91.4	93.3	94.7	96.7	103.7	110.8	112.5	114.4	116.1	117.9
6	Income fromInvestments (+)	-	-	-	1.2	7.4	14.6	18.9	25.2	32.7	33.0	36.2	39.5	44.5	51.9	60.7	70.1
7	Interest Paid (-)	11.2	31.1	31.5	29.4	26.3	23.2	20.1	16.9	13.7	10.4	7.1	4.1	1.7	0.3	-	-
	PROFIT BEFORE TAXES	(24.7)	(22.3)	23.8	58.1	69.4	81.3	90.2	101.6	113.7	119.3	132.8	146.2	155.3	166.0	176.8	188.0
8	Taxes Paid	-	-	-	-	-	-	-	22.2	60.1	62.5	68.1	73.8	77.6	82.1	86.6	91.3
	NET INCOME	(24.7)	(22.3)	23.8	58.1	69.4	81.3	90.2	79.4	53.6	56.8	64.7	72.4	77.7	83.9	90.2	96.7
9	Dividend	-	-	-	-	30.0	30.0	30.0	30.0	26.8	28.4	30.0	30.0	30.0	30.0	30.0	30.0
	Transfer to Retained Earnings	(24.7)	(22.3)	23.8	58.1	39.4	51.3	60.2	49.4	26.8	28.4	34.7	42.4	47.7	53.9	60.2	66.7
	Operating Profit/Net Revenues	-	0.09	0.33	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
	Net Income/Shareholders Equity	-	-	0.09	0.17	0.18	0.19	0.19	0.15	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	Debt Service Coverage before Taxes	0.6	1.2	1.8	2.0	Greater than 2.0											

1/ See Annex 15-4

Industrial Projects Department
August 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

PRO-FORMA SOURCE AND APPLICATION OF FUNDS STATEMENT
(US$ million)

Note 1/		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
	SOURCES OF FUNDS														
1	Net Income	-	-	-	-	(24.7)	(22.3)	23.8	58.1	69.4	81.3	90.2	79.4	53.6	56.8
4	Depreciation	-	-	-	-	14.7	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4	29.4
5	Amortization of Deferred Charges	-	-	-	-	5.4	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7
	Total Cash from Operations	-	-	-	-	(4.6)	17.8	63.9	98.2	109.5	121.4	130.3	119.5	93.7	96.9
10	Increase in Accounts Payable	-	-	-	-	2.8	1.4	2.5	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	Equity Paid In	12.8	31.0	137.0	109.5	9.7	-	-	-	-	-	-	-	-	-
	U.K. Grant	-	-	0.4	0.1	-	-	-	-	-	-	-	-	-	-
11	Long Term Debt Drawdown - IBRD	-	3.4	44.4	14.3	4.6	2.3	1.0	-	-	-	-	-	-	-
	- IDB	-	2.0	22.7	21.2	7.3	0.8	-	-	-	-	-	-	-	-
	- Bilateral	-	6.2	68.0	59.6	39.6	5.2	-	-	-	-	-	-	-	-
	- Other	-	-	-	-	61.7	13.7	-	-	-	-	-	-	-	-
	Total Loans Drawn Down	-	11.6	135.1	95.1	113.2	22.0	1.0	-	-	-	-	-	-	-
	TOTAL SOURCES	12.8	42.6	272.5	204.7	121.1	41.2	67.4	98.3	109.7	121.6	130.5	119.7	93.9	97.1
	APPLICATION OF FUNDS														
12	Investment in Fixed Assets	-	35.1	251.9	164.9	61.1	15.6	1.0	-	1.4	14.5	-	-	-	-
10	Increase in Inventories	-	-	-	1.3	13.8	8.0	12.8	0.8	1.1	0.4	1.8	1.2	1.1	1.3
10	Increase in Receivables	-	-	-	-	16.7	8.0	14.3	0.8	0.8	0.8	0.8	0.8	0.8	0.8
10	Increase in Cash-in-Hand	-	-	-	-	1.8	0.8	1.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Total Increase in Current Assets	-	-	-	1.3	32.3	16.8	28.6	1.7	2.0	1.3	2.7	2.1	2.0	2.2
5	Increase in Deferred Charges	12.8	7.5	20.6	38.5	27.7	-	-	-	-	-	-	-	-	-
11	Repayment of Long Term Debt	-	-	-	-	-	8.8	21.8	35.4	35.7	36.1	36.6	37.1	37.6	38.1
9	Dividends Paid	-	-	-	-	-	-	-	-	30.0	30.0	30.0	30.0	26.8	28.4
	TOTAL APPLICATIONS	12.8	42.6	272.5	204.7	121.1	41.2	51.4	37.1	69.1	81.9	69.3	69.2	66.4	68.7
6	Surplus Cash to Investment	-	-	-	-	-	-	16.0	61.2	40.6	39.7	61.2	50.5	27.5	28.4

1/ See Annex 15-4

Industrial Projects Department
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MEXICO - LAS TRUCHAS STEEL PROJECT

PRO-FORMA BALANCE SHEET
(US$ million)

Note 1/		1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
	ASSETS														
10	Cash in Hand	-	-	-	-	1.8	2.6	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8
6	Surplus Cash for Investment	-	-	-	-	-	-	16.0	77.2	117.8	157.5	218.7	269.2	296.7	325.1
10	Inventories	-	-	-	1.3	15.1	23.1	35.9	36.7	37.8	38.2	40.0	41.2	42.3	43.6
10	Receivables	-	-	-	-	16.7	24.7	39.0	39.8	40.6	41.4	42.2	43.0	43.8	44.6
	Total Current Assets	-	-	-	1.3	33.6	50.4	95.0	157.9	200.5	241.5	305.4	358.0	387.5	418.1
12	Gross Fixed Assets	-	35.1	287.0	451.9	513.0	528.6	529.6	529.6	531.0	545.5	545.5	545.5	545.5	545.5
4	Accumulated Depreciation	-	-	-	-	(14.7)	(44.1)	(73.5)	(102.9)	(132.3)	(161.7)	(191.1)	(220.5)	(249.9)	(279.3)
	Net Fixed Assets	-	35.1	287.0	451.9	498.3	484.5	456.1	426.7	398.7	383.8	354.4	325.0	295.6	266.2
5	Deferred Charges	12.8	20.3	40.9	79.4	107.1	107.1	107.1	107.1	107.1	107.1	107.1	107.1	107.1	107.1
5	Accumulated Amortization	-	-	-	-	(5.4)	(16.1)	(26.8)	(37.5)	(48.2)	(58.9)	(69.6)	(80.3)	(91.0)	(101.7)
	Net Deferred Charges	-	20.3	40.9	79.4	101.7	91.0	80.3	69.6	58.9	48.2	37.5	26.8	16.1	5.4
	TOTAL ASSETS	12.8	55.4	327.9	532.6	633.6	625.9	631.4	654.2	658.1	673.5	697.3	709.8	699.2	689.7
	LIABILITIES														
10	Accounts Payable	-	-	-	-	2.8	4.2	6.7	6.8	7.0	7.2	7.4	7.6	7.8	8.0
11	Current Portion of LT Debt	-	-	-	-	8.8	21.8	35.4	35.7	36.1	36.6	37.1	37.6	38.1	38.6
	Total Current Liabilities	-	-	-	-	11.6	26.0	42.1	42.5	43.1	43.8	44.5	45.2	45.9	46.6
11	Long Term Debt - IBRD	-	3.4	47.8	62.1	66.7	66.6	62.4	56.9	51.0	44.6	37.7	30.3	22.4	13.9
	- IDB	-	2.0	24.7	45.9	53.2	51.4	34.9	30.8	26.7	22.6	18.5	14.4	10.3	6.2
	- Bilaterals	-	6.2	74.2	133.8	164.6	153.0	148.0	130.6	113.2	95.8	78.4	61.0	43.6	26.2
	- Other	-	-	-	-	61.7	75.4	66.7	58.0	49.3	40.6	31.9	23.2	14.5	5.9
	Total Long Term Debt	-	11.6	146.7	241.8	346.2	346.4	312.0	276.3	240.2	203.6	166.5	128.9	90.8	52.2
	U.K. Grant	-	-	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Paid in Equity	12.8	43.8	180.8	290.3	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
	Retained Earnings	-	-	-	-	(24.7)	(47.0)	(23.2)	34.9	74.3	125.6	185.8	235.2	262.0	290.4
	Net Shareholders Equity	-	43.8	180.8	290.3	275.3	253.0	276.8	334.9	374.3	425.6	485.8	535.2	562.0	590.4
	TOTAL LIABILITIES AND CAPITAL	12.8	55.4	327.9	532.6	633.6	625.9	631.4	654.2	658.1	673.5	697.3	709.8	699.2	689.7
	CURRENT RATIO	-	-	-	-	2.9	1.9	2.3	) Greater than 2.0						
	QUICK RATIO	-	-	-	-	1.6	1.0	1.4	)						
	DEBT/EQUITY RATIO	-	21/79	45/55	45/55	56/44	59/41	56/44	48/52	42/58	36/64	30/70	24/76	19/81	13/87

1/ See Annex 15-4

Industrial Projects Department
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MEXICO - LAS TRUCHAS STEEL PROJECT

NOTES TO FINANCIAL PROJECTIONS

1. Net Revenues - Shown net of taxes and average discounts; inflated at 2% per annum after 1976. See Annex 13.

2. Production Costs - Inflated at 3% per annum from 1973 figures shown in Annex 14.

3. Administrative and Transport Costs - Same as for (2).

4. Depreciation - Following rates used:

Fixed Plant	6% p.a.
Mobile Plant	20% "
Buildings	3% "
Office Equipment	10% "

5. Deferred Charges - Breakdown is as follows:

	1972	1973	1974	1975	1976	Total
Pre-operating Expenses	6.0	6.3	10.8	16.1	11.0	50.2
BSC Fees	1.8	5.4	5.5	4.7	2.4	19.8
Escalation on Above	-	-	0.8	2.2	2.2	5.2
Interest During Construction	-	0.8	3.5	15.5	12.1	31.9
Total Deferred Charges	7.8	12.5	20.6	38.5	27.7	107.1

Total is amortized over 10 years (10% p.a.)

6. Investments - Surplus cash generated but not required for day-to-day operations will be invested either in short-term securities or in plant expansion. In either case the return is assumed to be 10% per annum (simple).

7. Interest - Assumed average for all loans. See Note 11 below.

8. Taxes - SICARTSA normally would be required to pay income taxes at the rate of 42%, but since the project is located in a designated development area, the company can depreciate its assets for tax purposes at the most convenient rate possible. Hence, no income taxes are projected until 1983 since tax depreciation will be taken at the rate necessary to keep net taxable profits at the zero level until the plant is fully depreciated on the tax books.

9. Dividends - Although no dividend policy has been decided, it has been assumed for illustrative purposes that a dividend equal to 10% of paid-in capital, but not exceeding 50% of net income, will be paid out once the Debt/Equity ratio drops below 50/50.

10. Working Capital Assumptions -

	Weeks
Cash in Hand	1
Receivables	10
Raw Materials - Coal	12
Other	4
Semi-finished stocks	2
Finished Product Stocks	4
Accounts Payable:	
Trade Creditors	4 - 6
Admin. Salaries	1
Labor Wages	½

Price escalation is assumed at average 3% p.a.

11. Long Term Debt -

IBRD: US$70 million equivalent for 15 years, including 5 years grace, at 7¼% interest plus a 1-3/4% Government guarantee fee. Repayments of principal and interest in 22 equal semi-annual installments commencing second half of 1977.

IDB: US$54 million equivalent for 15 years, including 5 years grace, at 8% interest. Repayment of principal in 22 equal semi-annual installments commencing second half of 1977.

Bilateral Financing: US$178.6 million equivalent. Assumed average term of 15 years at 7% interest, with repayments to begin one year after startup, or the equivalent of 4 years of grace; first semi-annual payment in second half of 1977.

Other Loans: Unspecified sources, totalling US$75.4 million equivalent. Assumed term of 11 years, including 3 years grace, at 9% interest. First drawdown not until 1976 and first repayment 3 years later; repayment in manner similar to IDB loan.

12. Fixed Assets - See Annex 11 for complete breakdown. Escalation rates used are as follows:

Plant, Services, Freight and Insurance Erection and Commissioning	6% p.a.
Civil Works, Structures, Design and Engineering	5% p.a.
Contingencies	5-6% p.a.

Industrial Projects Department
August 1973

MEXICO - LAS TRUCHAS STEEL PROJECT

FINANCIAL SENSITIVITY ANALYSIS

Case	BASIC ASSUMPTIONS: Buildup to Full Production 1/	Equity (US$ million)	Price Decrease from Base 2/ (% p.a.)	Change in Capital Cost (US$ million)	Startup Delay (years)	Change in Op. Costs (%)	RESULTS: Real Rate of Return 3/ (%)	Net Cash Accum. to 1980 (US$ million)	Debt Service Coverage 1976	1977	1978	1979 (Times Covered)	Maximum Debt/Equity (Ratio)
A1 (Base)	2½	300	0	0	0	0	11	118	0.6	1.2	1.8	2.0	59/41
B1	5½	300	0	0	0	0	10	67	0.6	0.8	1.7	1.9	60/40
A2	2½	300	1	0	0	0	10	108	0.6	1.2	1.8	1.9	59/41
B2	5½	300	1	0	0	0	9	57	0.6	0.8	1.6	1.8	60/40
A3	2½	300	0	-60	0	0	13	131	0.7	1.7	2.4	2.7	49/51
B3	5½	300	0	-60	0	0	12	92	0.7	1.2	2.2	2.5	51/49
A4	2½	320	0	+60	1	0	9	20	-	0.1	0.7	0.8	67/33
B4	5½	320	0	+60	1	0	8	3	-	0.1	0.5	0.6	68/32
A5	2½	300	0	0	0	+15	9	80	0	0.9	1.5	1.7	61/39
B5	5½	300	0	0	0	+15	9	31	0	0.5	1.3	1.5	63/37

1/ Production Buildup (000 tons):

	1976	1977	1978	1979	1980	1981	1982
Cases A1 to A5	150	500	800	1000	1000	1000	1000
Cases B1 to B5	135	350	700	800	900	950	1000

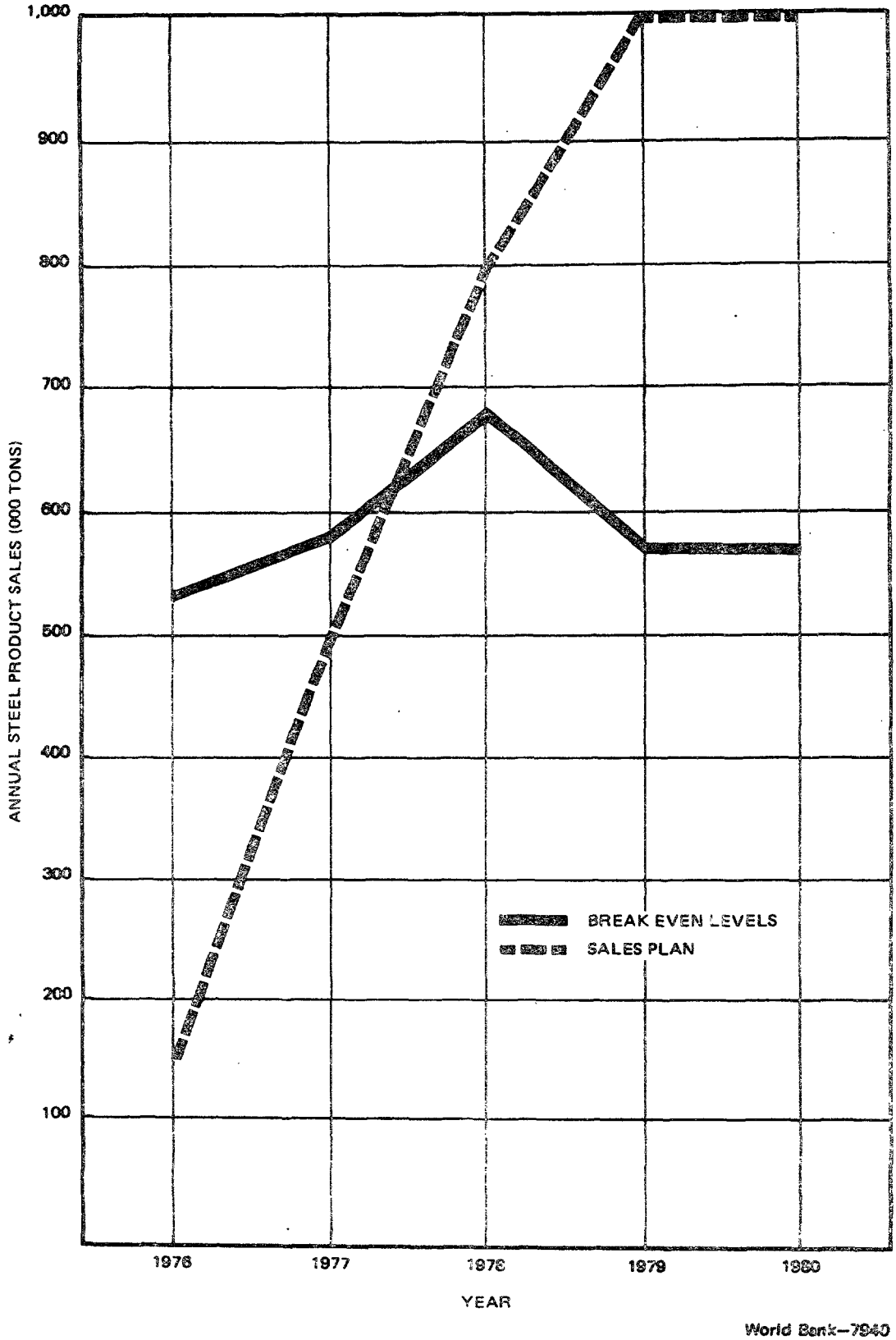
Case A1 is the basis for all financial projections in Annexes 15-1 through 15-3.

2/ Base case assumes prices to increase at 2% p.a. (see Note 1, Annex 15-4). Sensitivity cases A2 and B2 assume only 1% p.a. price increase.

3/ In constant dollar terms.

Industrial Projects Department
August 1973

MEXICO - LAS TRUCHAS STEEL PROJECT
CASH BREAK-EVEN SALES LEVELS



World Bank—7940

MEXICO - LAS TRUCHAS STEEL PROJECT

ECONOMIC EVALUATION

MEXICO - LAS TRUCHAS STEEL PROJECT

ECONOMIC EVALUATION

Introduction

1. The Bank's economic evaluation of the project addresses two basic questions: (i) Is the Las Truchas project the appropriate next major step in Mexico's steel expansion program, and (ii) will the project be economically viable in an absolute sense? The first question has been viewed in mostly qualitative terms insofar as detailed cost data on the existing industry have not been available. This situation is expected to improve with completion of the Battelle industry study for the Steel Commission (Annex 3-2). The second question has been viewed in traditional Bank terms, excluding the regional benefits of the project that clearly form a major part of the Government's rationale for undertaking this project in the chosen location. Our analysis considers the project simply in terms of its import substitution effect. The regional issue is not ignored, however, and is examined separately in Annex 17.

A. Las Truchas Versus Other Alternatives

Available Options

2. There are three basic routes that Mexico could have chosen to fill the steel demand/supply gap projected for the late 1970's (see Annex 1):

(i) Importation of semi-finished steel products (billets and slabs) for domestic rolling into finished products;

(ii) Production of steel in electric furnaces, based on sponge iron and imported scrap, followed by the rolling of products;

(iii) Fully integrated steel production using domestic or imported coal and iron ore.

3. It would not be practical for Mexico to attempt to meet future growth of demand on a long-term basis via imports of steel billets and slabs, since supplies on such a large scale would be both difficult to obtain and expensive. During the past several years, term contracts for semi-finished steel supply have not been easily available on the export market, even with price variation clauses, and fixed price contracts for more than 90 days have been unusual. Therefore, if Mexico is not to place a major sector of its economy at the mercy of highly unpredictable world suppliers, it has to produce raw steel in integrated or semi-integrated plants.

4. The electric furnace route presents difficulties for large increases in capacity because of the inherent volatility of the world scrap market -- particularly with regard to prices -- and the high economic cost of electricity in Mexico. Today, Mexico imports about 600,000 tons of scrap per annum for steel production, and no doubt there is a continuing role for scrap-based increases in production capacity of a marginal nature, particularly for specialty steel. As a long-term policy, however, Mexico's position as a net

importer if scrap and high-cost energy consumer makes this an unattractive alternative. This leaves fully integrated steel production as the favored method for Mexico to meet projected demand increases -- aside from importing steel products themselves, which the analysis in section B of this Annex demonstrates to be unattractive.

5. The integrated capacity now planned for Las Truchas could have been installed at a coastal location, or it might have been provided through expansion of the existing integrated mills, all of which are located inland. A further alternative would have been installation of new facilities adjacent to the existing mills. The Government's choice of a coastal location is justified largely because of raw material constraints in the country. It follows the dominant pattern established world-wide during recent years towards locating new steel facilities at coastal sites to utilize high quality imported raw materials transported from distant locations in large bulk carriers. While Mexico will not be importing much iron ore in the near term, its limited national reserves make this inevitable within the next 10-15 years.

Iron Ore

6. Mexico's primary integrated facilities are located in the Monterrey-Monclova area in the northern State of Nueva Leon and in Puebla, near Mexico City. The largest producer is AHMSA in Monclova, whose crude steel capacity is 2.5 million tons per annum. The company obtains its iron ore from the La Perla mine, 403 km away, but since only about five years of reserves remain at this location, AHMSA must obtain its subsequent long-term ore supplies from the Pena Colorada mine now under development in Colima 1520 km to the southwest on the Pacific coast. The second major producer is Fundidora in Monterrey, whose iron ore supplies come 661 km from Cerro de Mercado in Durango and the more recently developed Hercules mine in Coahuila, 464 km to the north. Fundidora plans to expand its annual capacity to about 1.5 million tons before 1976, at which rate these iron ore reserves would last for 25 to 30 years. The third major integrated producer is the HYLSA group, with plants in Monterrey and Puebla. These use a gas-based direct reduction process and electric furnace steel-making and have a total raw steel capacity of about 900,000 tons. HYLSA's iron ore presently is obtained from El Encino in Jalisco, but this reserve will be mined out soon, and the company, like Altos Hornos, must move its source to the Pena Colorada mine, 1043 km from Puebla and 1500 km from the Monterrey plant.

7. Substantial increases in steel production at the present locations would overload already-strained iron ore supplies. Even if sufficient reserves were available (Pena Colorada itself has only 90 million tons of reserves), the economic costs of their transport would be high due to the long distances involved, particularly for AHMSA and HYLSA, who are far from their long-term source at Pena Colorada. The Las Truchas project, alternatively, is located virtually next to iron ore reserves that will be able to supply more than 30 years of operation at the initial production level; and, in the long run,

the plant's location on a deepwater port will facilitate imports of high quality iron ore from elsewhere in the world. The existing companies could, of course, import iron ore, but their inland locations place them at a cost disadvantage vis-a-vis the Las Truchas site.

Coal

8. The coal situation is different. Altos Hornos and Fundidora use Mexican coal from reserves in the northern part of Coahuila, near the United States border. While abundant, this coal is low in quality. When washed its fixed carbon content averages 62% and ash content 16%, compared with 72% and 8% respectively for the Australian and/or Canadian coals that Las Truchas will import. The higher coking costs these quality differences imply for the northern producers must be weighed against the coal price advantages they obtain through closer proximity to the coal source -- the Las Truchas coal, of course, carrying substantial sea freight charges. Reliable cost figures for Mexican coal are hard to come by, but there is evidence that a long-term price delivered to the existing northern producers (assuming economic costs for rail transport some 25% higher than the present rail tariff) would be around US$18-20 per ton at 1973 prices, compared with US$20-22 for the coal to be imported by Las Truchas. The difference is roughly made up by the lower coking costs for Las Truchas.

9. Although cost differentials between the existing steel producers' use of domestic coal and the use of imported coal by Las Truchas probably are small, it should be recognized that the latter is vulnerable to possible future coal scarcity on export markets and, hence, possible long-term cost increases vis-a-vis the domestic resource. Furthermore, the use of imported coal represents a very substantial foreign exchange expenditure that should not be ignored. Under these circumstances, the coal situation clearly favors the existing producers; it is not, however, considered great enough to override Las Truchas' advantages in other areas.

Natural Gas

10. HYLSA's direct reduction process uses natural gas as the reducing agent instead of coal, with very important economic implications. HYLSA obtains the gas from the national oil company, Pemex, at rates which Pemex maintains are insufficient even to cover production and transmission expenses, let alone the opportunity cost of the gas itself, which has attractive alternative uses in Mexico. It is understood that Pemex has refused to increase HYLSA's gas supplies without a very significant increase in the price, and that this effectively has blocked HYLSA's recent expansion plans. At economic gas price levels, substantial increases in HYLSA's capacity seem to be out of the question.

Water

11. Las Truchas has a further advantage in its location alongside the Rio Balsas, which provides a virtually unlimited supply of process water. HYLSA/Puebla has no water problem, but the AHMSA, Fundidora and HYLSA plants in the arid northern region must pump water from depths of as much as 2000 meters, at high cost. Further expansion at these sites would only exacerbate this problem.

Electricity

12. Electricity for the Las Truchas project will come from the nearby La Villita hydroelectric plant, with insignificant transmission losses. This gives Las Truchas a further advantage over the other integrated producers -- principally HYLSA, which consumes large amounts of power in its electric furnaces.

Transport of Finished Products

13. The Las Truchas site is about 700 km from the main steel market in Mexico City, versus more than 1,000 km for the northern producers. Despite the fact that the project will hasten the need for improvements in the transport system linking the project region with the development and more-highly-populated center of the country, the long-term economic costs of transport from Las Truchas are certain to be lower than those of the more distant producers. Only HYLSA/Puebla is an exception, but this is unattractive as a major expansion alternative for other reasons.

Other Coastal Locations

14. The only other potential plant location in Mexico matching the primary conditions that exist at Las Truchas -- proximity to exploitable iron ore reserves and an existing or potential deepwater port -- is the city of Manzanillo, some 250 km up the coast. It is 60 km from the Pena Colorada iron ore reserves (versus 20 km from the Las Truchas plant site to its mine) and has an already-developed port and road/rail transport system connecting with Mexico City that would require less investment than is being put into the Las Truchas infrastructure. There are a number of operational disadvantages that would be associated with a Manzanillo site, such as no suitable open space for development directly adjacent to the port; but, primarily, Manzanillo was rejected in favor of Las Truchas as a conscious decision by the Government to use the steel project as the means of developing the comparatively poor coastal area along the Michoacan/Guerrero state border, adding a new development "pole" in a water-rich area and an improved outlet to the Pacific for Mexico City.

Conclusion

15. The above analysis obviously is not rigorous, for it does not include actual calculations of capital and operating costs for the various alternatives that might have been possible. A valid conclusion does not, however, require such rigor. If the Las Truchas project were viewed simply as a means of adding a million tons to Mexican steel product capacity, it probably would be a more expensive route than marginal expansions of the existing producers, whose capital expenditures per ton of additional capacity and start-up costs would be lower. When one views the situation over a long time horizon, however, and considers Las Truchas not simply as a million-ton steel producer but as one with an eventual output of several times that amount, the short-term capital cost advantages that might have been obtained at the alternative sites are overwhelmed by the higher operating costs that almost certainly would have resulted from their raw material and transport disadvantages.

On this basis, the Las Truchas project, as it has been conceived, is considered the appropriate next step to be taken in Mexico's steel expansion program.

B. Economic Return Calculations

Assumptions

16. The economic cash flow has been based on the financial projections of Annex 15, modified (i) to replace the commercial benefit stream with one based on the opportunity cost of steel imports to Mexico, (ii) to eliminate internal Mexican taxes from the cost streams, (iii) to adjust the costs of fuel and electricity upward to reflect the inadequacy in economic terms of present market prices for these inputs, (iv) to reflect the economic cost of SICARTSA's use of the port, and (v) to include the full economic cost of transporting SICARTSA's finished products. No shadow pricing of labor has been employed.

17. A summary of the adjustments made to the financial cost streams is shown in Annex 16-2. All are expressed in constant 1972 dollars, adjusted for the effects of 1973 exchange rate changes. Comments on the major adjustments are as follows:

(i) Fuel and Electricity Costs - These have been shadow-priced respectively at 30% and 40% above their current selling prices in Mexico, in line with the findings of the Bank's most recent Economic Mission.

(ii) Port Costs - As noted in Annex 5, the commercial port tariff assumed by SICARTSA allocates the largest portion of port revenues to general, non-steel-related traffics which may or may not materialize to the extent projected. In Annex 16-3, a calculation is made of the equivalent annual cost of building, operating and maintaining the port in perpetuity, assuming a 10% cost of capital. This comes out to US$2.5 million per year. If 85% is allocated to steel-related traffics, then SICARTSA should carry an annual economic cost of US$2.1 million for port services. This percentage is used in Bank's analysis, but it should be recognized as very conservative in view of the likely long-term growth of non-steel traffics through the port.

(iii) Transport Costs - In the base case of the economic analysis the transport costs for finished products used in the financial assessment have been increased by 12% to reflect the estimated full economic costs of transport to the project if trucks were used exclusively. The figures were based on road rates over the entire distance from the Plant to Mexico City (which is a reasonable average distance from the plant in addition to being the principal steel market) and estimates made during the course of the transport study carried out for SICARTSA and described in Annex 6. In using these figures, the implicit assumption is made that a more economic long-term form of transport than road will be possible and that the estimates therefore can be considered conservative. To provide a further check on the assumptions, a sensitivity test has been carried out assuming a 50% increase in the transport cost stream used in the base case.

(iv) Revenues - The benefit stream in the economic projection comprises the expenditures Mexico would have to incur to import similar quantities of steel products if it chose not to produce steel domestically at Las Truchas. The long-term projections for average European export prices, as developed in Annex 2, have been used for this calculation, with the addition of sea freight, port handling and inland transport expenditures to move the steel from Europe to Mexico City. The resulting range of delivered import proces is as follows:

LONG TERM STEEL IMPORT PRICES
TO MEXICO CITY (1976-91)
(1973 US$/ton)

	Probable Low	Probable High
Average Cost FOB Europe	156	168
Sea Freight	20	20
Port Handling	4	4
Inland Transport	8	8
Delivered Price Mexico City	188	200

The sea freight cost is based on the Mueller/Kawahito[1/] estimate of likely rates for Europe/Mexico charters in the early 1980's; port handling and inland transport costs are based on assessments of actual costs in Mexico today, and are considered conservative.

Results

18. The economic benefit and cost streams described above, have been subjected to a computer sensitivity analysis, the results of which are shown graphically in Annex 16-4. Two sets of projections have been made, one for the expected production buildup period of 2½ years (corresponding to the "A" cases of the financial sensitivity analysis in Annex 15-5) and the other for a slow buildup period of 5½ years (corresponding to the "B" financial cases). In each set, the sensitivity of the project's economic return is measured against variations in (i) the import price for steel, (ii) transport costs for finished products, (iii) operating and port costs, (iv) a completion delay and cost overrun, and (v) combinations thereof.

19. The results of the sensitivity analysis covering the probable range of import prices defined in paragraph 17 are as follows:

1/ See Annex 2.

SENSITIVITY TESTS OVER RANGE OF PROBABLE STEEL IMPORT PRICES

		Range of Rates of Return (min % - max %)	
		Expected Buildup	Slow Buildup
(1)	Base Cases	12-13	11-12
(2)	Trasnport Costs up 50%	11-12	10-11
(3)	Operating and Port Costs up 15%	10-12	9-11
(4)	Combination of (2) and (3)	9-11	8-10
(5)	Completion Delay of 1 year and US$50 million cost overrun	9-10	8-9

20. The probable economic return of the project can be seen to range from 12 to 13%, depending on the steel price. At the maximum possible price, the return rises to 15-16%. The return is fairly insensitive to a 50% increase in the assumed costs of transport, tending to diminish the importance of this input from an economic viewpoint -- although not from an operational perspective. The 15% increase in operating and port costs -- which is sufficient to cover most contingencies in this category -- reduces the return by up to two percentage points; taken together with the transport increase the return goes down by an additional percentage point. Similar results are obtained from the completion delay and cost overrun. In the worst cases, the return drops to 8%, but the combinations of adverse circumstances that these cases represent are considered unlikely.

21. Had full shadow pricing of all inputs been used in the above analysis, instead of the partial shadow pricing actually employed, the calculated returns no doubt would have been higher. Capital costs, for example, are made up mainly of imported machinery and local construction. Shadow pricing of foreign exchange would raise the costs of the former and shadow pricing of labor would slightly lower the latter, with the net result unlikely to be a significant change one way or another in the return. In operating the plant, the unskilled portion of labor costs will not be large, and using shadow prices for it would have little effect. Material costs would go up with the assumed premium on foreign exchange -- for coal and oil in particular -- but total materials costs would go up by less than this premium. Transport costs also might rise with higher fuel costs, but, as seen above, the return is not greatly sensitive to even a 50% increase in total transport costs.

22. The principal effect of shadow pricing would be on the value of the steel produced, which would rise by the full amount of the premium on foreign exchange. Since this increase would be greater in total than the sum of any similarly-caused increases in input costs, the net result would be a higher rate of return. Hence, the return estimates calculated above can be considered conservative.

Conclusion

23. It is concluded that the probability of an economic return exceeding 10% is very high, and, that on this basis, the project is economically viable in the Mexican context. Again it should be noted that none of these figures take secondary benefits of the project into account; nor do they consider the economies of scale that will be possible in the second and subsequent stages of the project, with resulting increases in the real return of the project to the Mexican economy over the long run.

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MEXICO - LAS TRUCHAS STEEL PROJECT

ADJUSTMENTS TO FINANCIAL COST ESTIMATES FOR ECONOMIC ANALYSIS[1/]

	Financial Cost[2/]	Adjustments	Economic Cost[3/]	Basis for Adjustment
	(US$/ton of Steel Product)			
Plant Operating Costs				
Salaries and Wages	12.7	(0.9)	11.8	Average income tax of 7% on salaries and wages
Raw Materials - Coal	15.4	-	15.4	
- Other	5.5	-	5.5	
Fuel and Electricity	3.8	1.1	4.9	Shadow Prices: Electricity 1.3, Fuel Oil 1.4 (less 10% tax).
Maintenance Materials	12.1	(0.8)	11.3	Turnover tax 4% plus 2% due to cascade effect.
Consumable/Sundries	8.4	(0.5)	7.9	Same as above.
Administrative and Insurance	3.5	(0.2)	3.3	Average income tax of 7% on employment portion.
Total Operating Costs	61.4	(1.3)	60.1	
Port Costs	0.2	1.9	2.1	85% of full economic cost of port - see text.
Transport of Finished Products	8.2	7.0	15.2	Full economic cost of 100% of products.[4/]
Grand Total	69.8	7.6	77.4	

1/ See Annex 11 for capital costs of project, which are assumed to be the same for both financial and economic analyses. Latter, however, uses unescalated figures.

2/ See Annex 14.

3/ 1973 prices.

4/ See Annex 16-1, para. 17 (iii).

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MEXICO - LAS TRUCHAS STEEL PROJECT

CALCULATION OF ECONOMIC COST OF PORT SERVICES

Item	Original Investment (M$ million)	Useful Life (years)	Perpetual Replacement Factor 1/	Present Value of Perpetual Replacement (M$ million)
Breakwater	14.5	75	1.0007	14.5
Lighthouse, Beacons and Signals	4.0	15	1.315	5.3
Dredging	180.0 2/	Indefinite	1.0	180.0
Land	23.0	Indefinite	1.0	23.0
Access Roads	11.4	15	1.315	15.0
Open Storage Areas	3.8	15	1.315	5.0
Transit Shed	4.8	30	1.061	5.1
Berths (200 m)	25.0 3/	50	1.009	25.2
Water and Power	7.5	30	1.061	8.0
Administrative Building	0.9	30	1.061	1.0
Total	274.9			282.1

	M$ million/yr	US$ million/yr
Annual cost of perpetually-replaced assets = 0.10 x 282.1	28.2	2.2
Add annual operating and maintenance costs 4/	3.3	0.3
Total Annual Cost	31.5	2.5
85% SICARTSA Portion	26.8	2.1

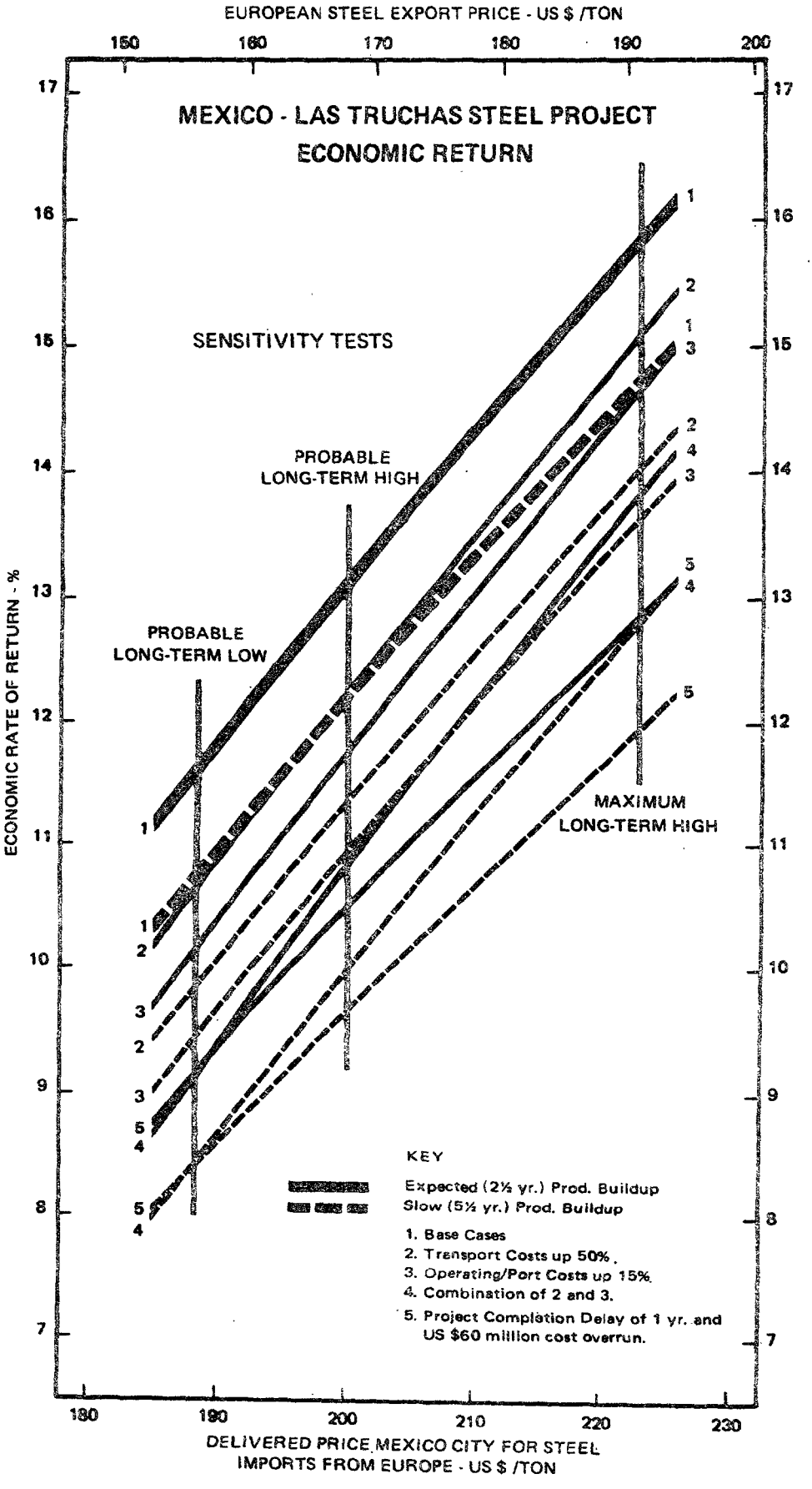
1/ $\text{Factor} = \frac{(1 + r)^t}{(1 + r)^t - 1}$ where r = rate of return = 0.10 and t = useful life

2/ No account is taken of the resale value of land filled with the dredged material.

3/ Excludes 400 m of berth planned for the port but not needed for SICARTSA traffics

4/ Marina estimate.

Industrial Projects Department
May 1973



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MEXICO - LAS TRUCHAS STEEL PROJECT
DIRECT FOREIGN EXCHANGE SAVINGS DURING OPERATING PERIOD

(Costs at 1973 Price Levels)
(Benefits at 1970/71 Price Levels Adjusted for 1973 Exchange Rate Changes)

		Foreign Exchange Content %	1976 (6 mo)	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Total 1976-91	Annual Average 1976-91
I	Gross Foreign Exchange Savings[1]	100	26.4	88.0	140.8	176.0	176.0	176.0	176.0	176.0	176.0	176.0	176.0	176.0	176.0	176.0	176.0	176.0	2543.2	164.1
II	Foreign Exchange Expenses																			
	Coal	100	2.3	7.8	12.3	15.4	15.4	15.4	15.4	15.4	15.4 b	15.4	15.4	15.4	15.4	15.4	15.4	15.4	222.6	14.4
	Maintenance Materials	50	0.9	3.0	4.8	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	86.7	5.6
	Employment Expenses	5	0.1	0.4	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	10.2	0.7
	Interest on Long Term Debt[2]	100	7.6	24.1	24.1	22.2	20.2	18.0	15.8	13.5	11.1	8.8	6.3	3.9	1.2	0.4	0.2	-	177.4	11.4
	Amortization of Long Term Debt[2]	100	-	12.3	24.3	24.5	28.7	29.1	29.6	30.2	30.7	31.2	31.9	32.6	19.4	3.8	3.6	-	331.9	21.4
	Total Foreign Exchange Expenses		10.9	47.6	66.1	68.8	71.0	69.2	67.5	65.8	63.9	62.1	60.3	58.6	42.7	26.3	25.9	22.1	828.8	53.5
III	Net Savings in Foreign Exchange (I - II)		15.5	40.4	74.7	107.2	105.0	106.8	108.5	110.2	112.1	113.9	115.7	117.4	133.3	149.7	150.1	153.9	1714.4	110.6

1/

	US$/ton
FOB Europe	156
Sea Freight	20
Value Mexican Port	176

Above price is lowest in range assumed in economic analysis.

2/ Excludes portion attributable to price escalation (i.e. assumes capital costs at 1972 prices).

Industrial Projects Department

ANNEX 16-5

MEXICO - LAS TRUCHAS STEEL PROJECT

REGIONAL IMPACT OF THE PROJECT

1. The project is located at the mouth of the Balsas River on the border between the States of Guerrero and Michoachan. Both states have been identified by the Government as development areas based on the potential of their natural resources. The Government is becoming increasingly concerned with the concentration of wealth and economic activity in the traditional central triangle of the country defined by Mexico City, Guadalajara, and Monterrey, and a strategy of decentralization is being effected (i) to direct public investment towards non-traditional regions, and (ii) to give incentives to firms locating away from the three largest cities. As part of this strategy, the Government intends for the Lazaro Cardenas zone to serve as a "growth pole" which will (incrementally) attract steel-related industries and other activities away from the traditional centers.

2. An inventory of the natural and man-made resources of the region gives grounds for believing that the growth objectives for Lazaro Cardenas can be met.

Natural Resources

(i) Iron Ore: It was, of course, the Las Truchas iron ore resources of the region, in close proximity to the sea, which first suggested Lazaro Cardenas (then Melchor Ocampo) as the site for a major steel project.

(ii) Forests: Extensive areas of both Guerrero and Michoachan are covered by forests. The Guerrero reserves are the basis for a forest industries project presently being prepared for possible Bank financing.

(iii) Water: The Balsas River, one of the longest and most voluminous rivers in Mexico, runs the length of Guerrero. It is used extensively for irrigation and power.

(iv) Dolomite: This is a clay used principally for refractories; deposits are located in Guerrero.

(v) Other Minerals: Barium oxide, optical calcite, copper, limestone, silica sand, bentonite.

Infrastructure

1. Roads: Lazaro Cardenas is connected to other centers by a coastal road which soon will connect with Zihuatanejo and Acapulco to the southeast and, eventually, with Manzanillo to the northwest. Another road leads inland through Playa Azul to Nueva Italia and Mexico City through Morelia. Plans are far advanced for a road from Zihatanejo to Mexico City through Altamirano and Toluca, which will provide another (and more direct)

road link from Lazaro Cardenas to Mexico City and will pass through the forestry of Guerrero (see map).

2. Railroads: No through railroad from Lazaro Cardenas to Mexico City exists at present, but it is likely that within four or five years of the beginning of SICARTSA's operations the missing link between Lazaro Cardenas and Nueva Italia will be constructed (see Annex 6 for further discussion). Manzanillo is already linked by rail to Mexico City through Guadaljara and much of inland Michoacan is served by a rail network.

3. Power: Two large dams on the Balsas River at La Villita, 15 km from the project site, and at Infernillo, further upstream, make the region a major supplier of power to the central triangle of the nation.

4. Ports: The port of Manzanillo, 250 km up the coast from the project site, is Mexico's main port on the Pacific. Recent capital investment there, financed by the Bank, as well as a reorganization of port services, has greatly stimulated its use. The port of Lazaro Cardenas (see Annex 5), when completed, will be closer to Mexico City than Manzanillo (800 km by rail compared to 1,100 km), and therefore eventually can be expected to become a primary Pacific outlet for the capital.

5. Agriculture: The varied climatic zones of the two states permit cultivation of many different fruit crops, particularly melons and strawberries, and the present value of agriculture production in the two states is US$160 million annually. Cattle raising also is important.

6. Tourism: A new Pacific coast tourist center, including a jet airport is under construction at Zihuatanejo, 100 km down the coast from Lazaro Cardenas. This project is being financed in part by the Bank and is expected to draw thousands of foreign tourists and residents into this hitherto underdeveloped area.

Backward and Forward Industrial Linkages

3. An industry which stimulates the growth of other industries as suppliers is said to have "backward" linkages; one which stimulates industries using its output has "forward" linkages. Knowledge of which industries can be expected to generate forward or backward linkages (and under what circumstances) is very sketchy and is based almost entirely on comparative transport and factor costs. Some approximations for the Las Truchas project can, nonetheless, be made. Since the non-flat steel output of SICARTSA in its first stage will be used principally in the construction industry, there is little doubt that the forward linkages of Stage I will be very weak, except to the extent that construction demand develops in the project region over time. Experience in Monclova, the site of the AHMSA steel plant, was that no forward-linked industry became established there until 1965, 18 years after AHMSA began full operation. Hence, during its initial years of operation, SICARTSA's principal impact is likely to be in generating demand for supplies and in the demand of its employees for consumer goods and services.

4. An idea of the strength of backward linkages is indicated in the following table by the incremental ratio of past AHMSA job creation to total employment in the city of Monclova and in the larger zone which includes Monclova:

AHMSA EMPLOYMENT EFFECTS

Year	AHMSA Employment (A)	Employment (B)		Employment Ratio (A) / (B)		Incremental Employment Ratio Increase in (A)/Increase in (B)	
		Monclova	Monclova Zone	Monclova	Monclova Zone	Monclova	Monclova Zone
1940	-	2,865	5,897	-	-	-	-
1950 1/	3,175	6,559	12,207	0.48	0.26	0.86	0.30
1960	6,190	14,072	22,185	0.43	0.28	0.40	0.30
1970	8,420	20,887	30,408	0.40	0.28	0.33	0.27

1/ AHMSA did not get into full operation until the late-1940's, so that 1950 can be taken as an approximate equivalent of SICARTSA's 1976 startup date.

5. There is reason to believe that the backward linkage effect at Lazaro Cardenas will be greater than in Monclova since the resource potential of the area is greater and more of the demand generated by SICARTSA therefore will remain within the region. Similarly, there is evidence that forward linkages, even though they most likely will have to await the production of flat products during Stage II of the project, will turn out to be greater in Lazaro Cardenas than in Monclova. Bearing upon both of these phenomena will be the following factors:

(i) During the early years of Monclova, wages generally were higher than those in Mexico City. The opposite is likely to be true for some time in Lazaro Cardenas since the development region is starting at very low income levels.

(ii) The greater agricultural potential of the Lazaro Cardenas region will tend to hold down living costs and, therefore, wages.

(iii) Transport costs from Lazaro Cardenas to Mexico City in the long run will be lower than those from Monclova because of the shorter distance involved.

(iv) Government incentives will be available to new industries locating in the Lazaro Cardenas region.

6. For the above reasons, it is considered reasonable to assume a somewhat faster growth in secondary employment at Lazaro Cardenas than was experienced at Monclova. This is shown in the following table:

PROJECTED EFFECT OF SICARTSA ON EMPLOYMENT AND POPULATION IN THE CITY OF LAZARO CARDENAS

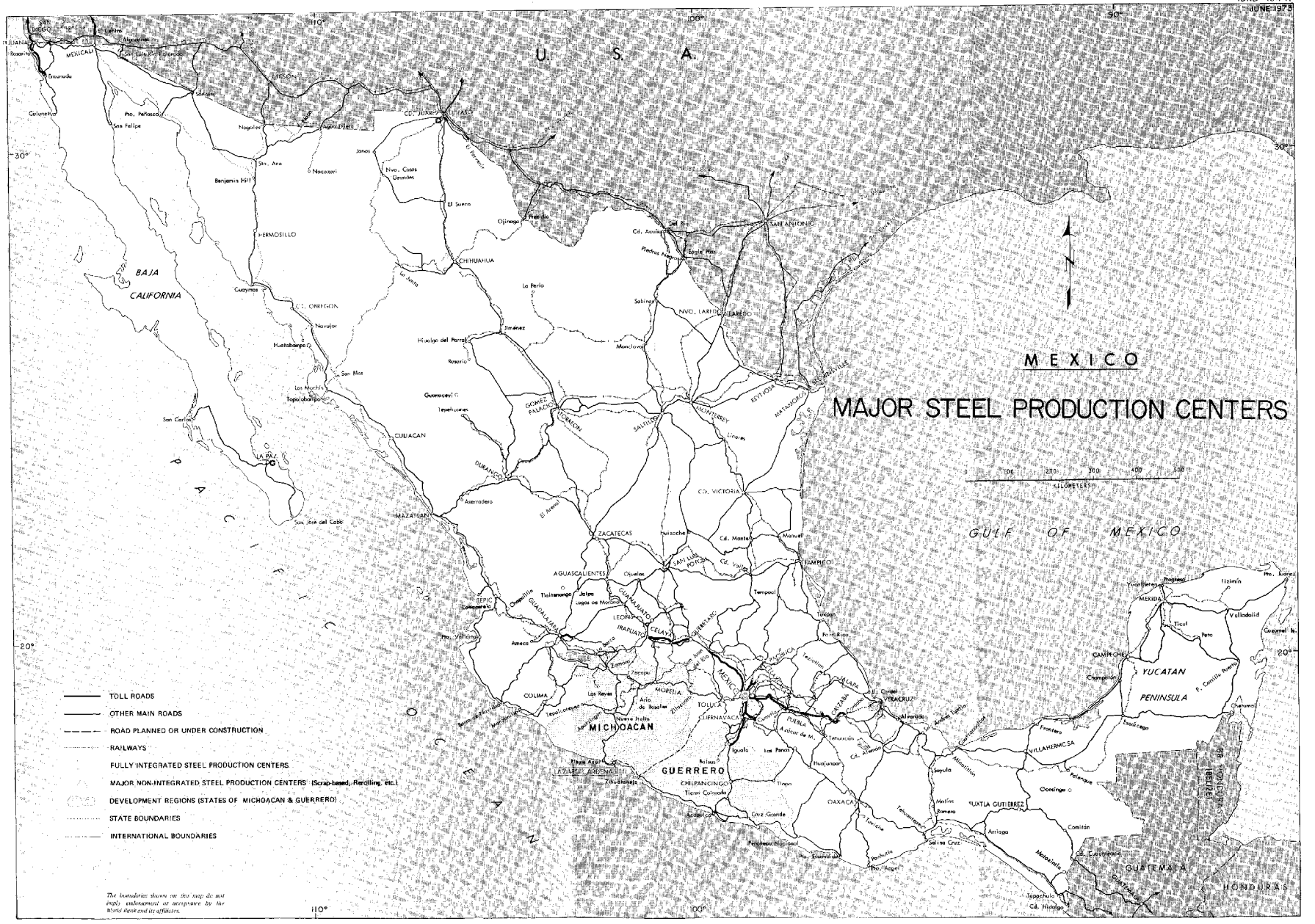
Year	SICARTSA Employment (A)	Total Employment (B)	Employment Ratio (A) / (B)	Incremental Employment Ratio Increase in (A)/Increase in (B)	Total Population 1/
1976	4,000	8,000	0.50(0.48) 2/	-	29,600
1986	6,500	16,333	0.40(0.43)	0.30 (0.40)	60,432
1996	8,000	23,833	0.34(0.40)	0.20 (0.33)	88,182

1/ Assumes a dependency ratio of 3.7 persons per employed worker, the Mexican national average.

2/ The numbers shown in parentheses are the actual ratios pertaining to AHMSA's effect on Monclova's development during equivalent time periods (from paragraph 4).

7. The projection indicates that by the end of 20 years of SICARTSA's operations roughly two out of every three jobs in the Lazaro Cardenas area will be outside the steel company itself, compared with six out of ten during a comparable period at Monclova. With substantial development of forward-linked industries using the flat-product output from the later stages of SICARTSA's development (the above projections have assumed a second stage of steel production -- yielding a doubled crude steel output -- by 1986 and a similar or larger third stage by 1996), this projection could be exceeded. In fact, one study done for SICARTSA some time ago argued for even higher job creation rates and projected total employment in 1985 at 42,400 and total population at 171,800. This estimate is considered excessive, but that does not detract from the strong evidence indicating that the impact of the Las Truchas project and other development programs in the surrounding area will be sizable indeed.

Industrial Projects Department
June 1973


U. S. A.
MEXICO
MAJOR STEEL PRODUCTION CENTERS
GULF OF MEXICO
PACIFIC OCEAN
BAJA CALIFORNIA
YUCATAN PENINSULA
MICHOACAN
GUERRERO
TOLL ROADS
OTHER MAIN ROADS
ROAD PLANNED OR UNDER CONSTRUCTION
RAILWAYS
FULLY INTEGRATED STEEL PRODUCTION CENTERS
MAJOR NON-INTEGRATED STEEL PRODUCTION CENTERS (Scrap-based, Rerolling, etc.)
DEVELOPMENT REGIONS (STATES OF MICHOACAN & GUERRERO)
STATE BOUNDARIES
INTERNATIONAL BOUNDARIES
KILOMETERS
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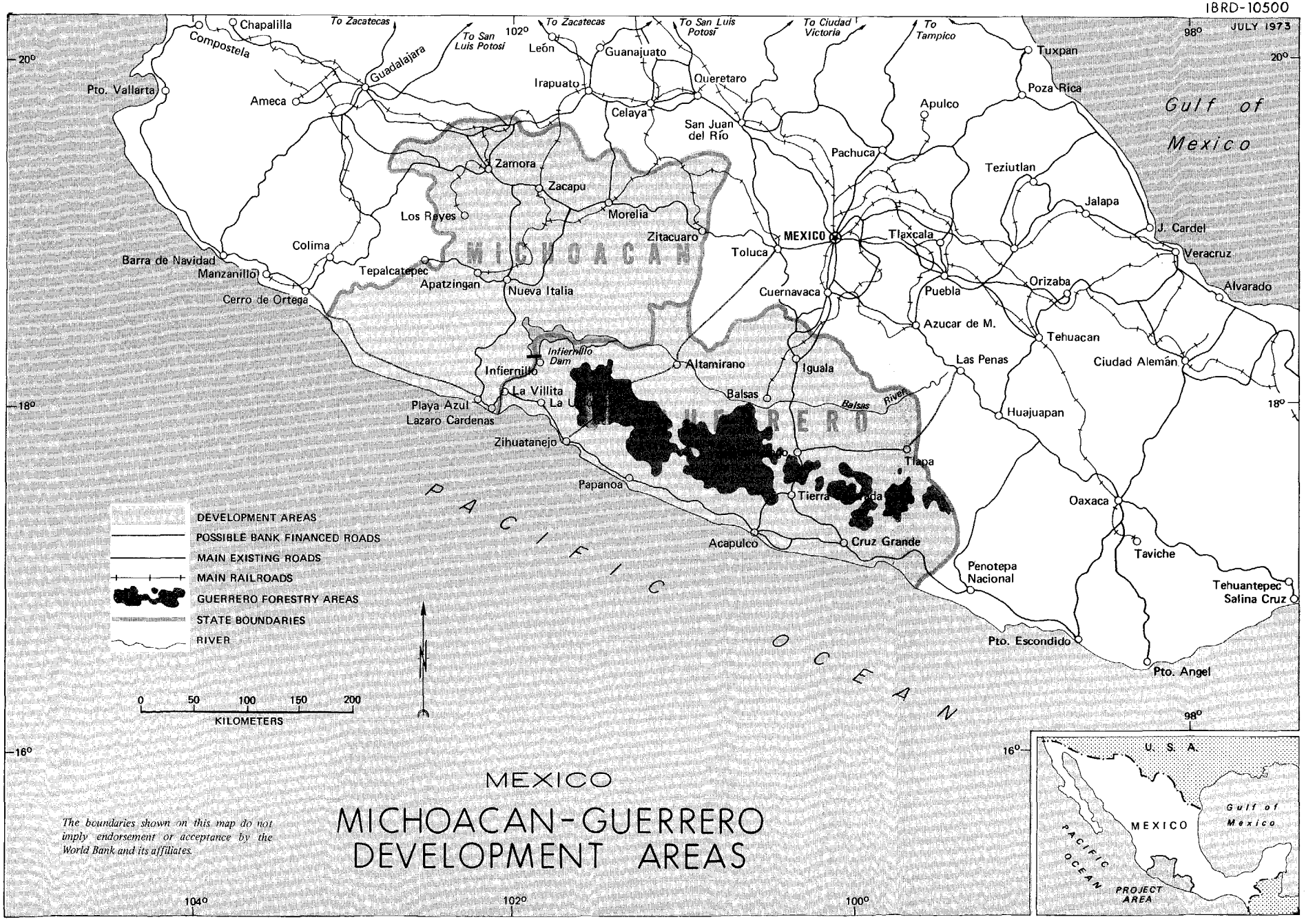

MEXICO

MICHOACAN-GUERRERO DEVELOPMENT AREAS

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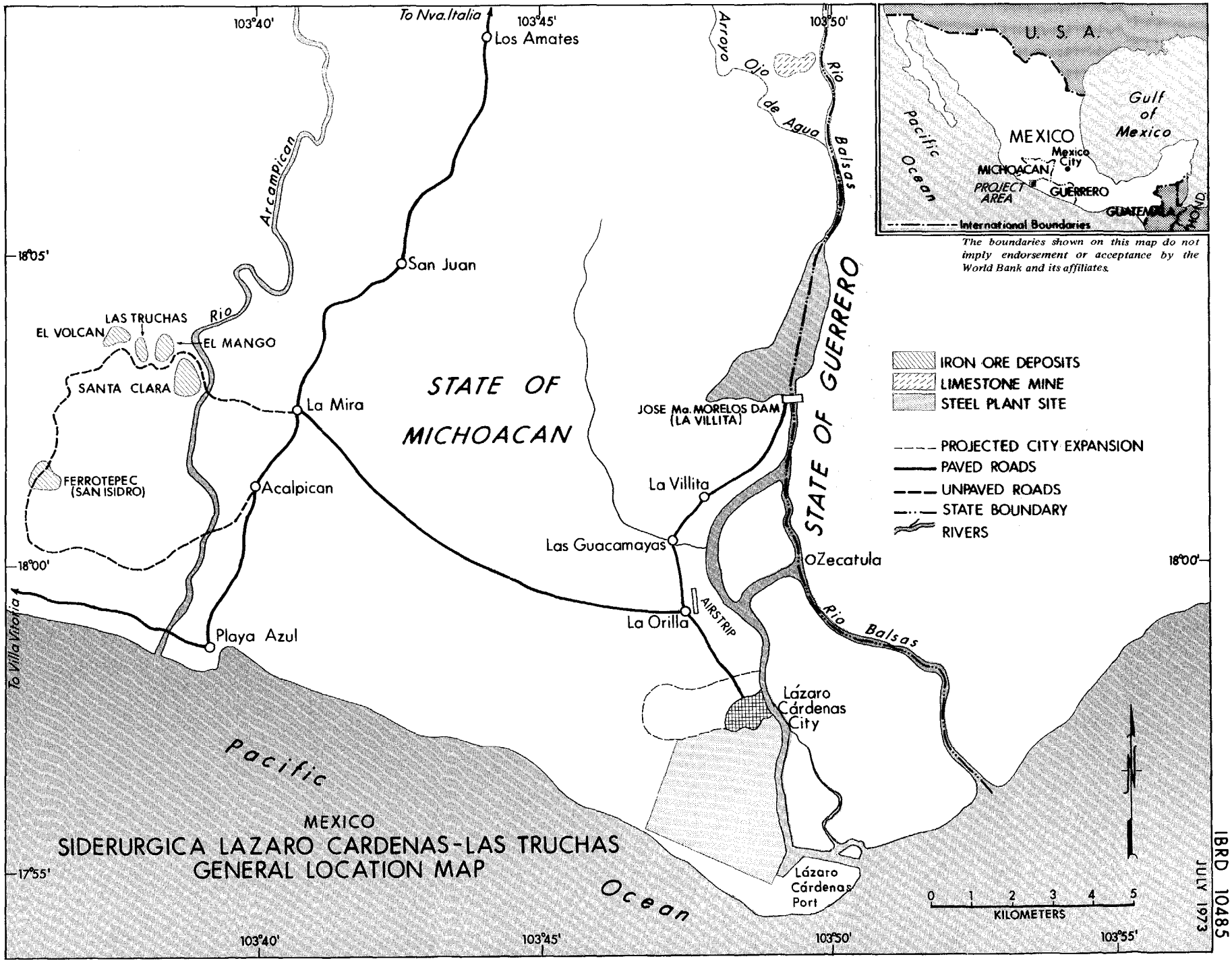

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