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**PROJECT PLANNING AND CONSTRUCTION - INTERMEDIATE SCALE
HUACHIPATO STEEL PLANT, COMPANIA DE ACERO DEL PACIFICO, S.A., CHILE**

by

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I. INTRODUCTION

November 25, 1950, is an important date in the industrial and economical development of Chile. On that day the first integrated steel plant, with a capacity of 236,000 MT of ingots per year, sufficient to provide the major steel requirements of the country, was inaugurated in the presence of the President of the Republic and other civil authorities. The Huachipato Steel Plant, as it is commonly called, is located on San Vicente Bay, close to the city of Talcahuano, Chile.

Prior to that date steel production in the country was limited to between 40,000 and 50,000 MT annually, divided among a number of small producers who melted steel scrap and one small integrated plant that operated with antiquated facilities and was not well located.

The new Huachipato Plant fulfilled a long felt need to assure an adequate and permanent supply of this basic material for construction and for a developing metal fabricating industry, using primarily the native raw materials that were available.

The steel plant which was inaugurated on that date came into being with the full sanction of the Central Government, and essentially through the efforts of the Corporación de Fomento de la Producción (CORFO), an entity of the Government created to foster industrial development in the country. CORFO was responsible for enlisting the public and private resources that were necessary to form the Compañía de Acero del Pacífico, S.A. (CAP) and obtaining necessary financing through the Export - Import Bank of Washington D.C., U.S.A.

To-day the Huachipato Steel Plant, through expansion and improvement of the initial installations, has increased capacity to 500,000 MT of ingots per year. At present a programme is under way to increase capacity to 600,000 MT through the application of more modern techniques and some additional facilities.

The Company is thereby fulfilling its primary objectives, which were to assure a supply of steel products sufficient to meet demands and of a satisfactory quality and price.

Prior to the installation of this plant, steel users in Chile were required to import most of their needs at an average price, including freight and duties, about 70% higher than prices prevailing in the U.S.A. These importations represented a constant drain on available foreign exchange and contributed generally to an unfavourable trade balance. To-day the consumer is assured of a constant supply of steel which permits him to plan the activity and growth of his enterprise in a rational manner, thereby contributing further to the country's industrial and economical development. At the same time, he is paying a price for steel products that is only 19% higher than the average U.S. price, which is equivalent to only 4% more than the imported price from the U.S.A., including freight to a Chilean port and without customs duties.

A further step in the development is that Chile to-day is the only country in Latin America that is a significant exporter of steel products, which has a special importance in view of the Common Market plans for the continent that are beginning to take form. Consequently, the industry to-day not only makes possible a substantial savings in foreign exchange, but is also a considerable source for same.

It is the purpose of this paper to explain how it was possible to bring about the formation of the Company from its inception to the present day, and also something of its plans for the future.

As a first step, we will give you a brief résumé of Chile, her economic and industrial problems, and her plans to overcome them.

II. DESCRIPTION OF CHILE

Chile is situated on the west coast of South America, in what is commonly called the extreme Austral region. It is bordered on the east by Argentina and Bolivia and on the north by Peru. It is a long narrow country stretching from latitude 18°S to 56°S, between the Andes Mountains and the Pacific Ocean. Its area is 742,000 km².

The population of the country is 7.4 million persons or a density of approximately 10 inhabitants per square kilometer. Rate of increase, in population is 2.5% annually. It is estimated that 32% of the population is actively employed. The rural population is 2.5 million and the urban is 4.9 million.

The economy to-day is still that of a developing country in spite of the major strides that have been made in the last 20 years in industrialization and economic advancement, principally based on plans projected and concluded by the Corporación de Fomento de la Producción.

In the last 20 years electric power output has tripled; the petroleum industry, of rather recent development, is to-day supplying practically all domestic needs; a considerable part of the sugar consumed is produced in the country; a combination of forest products, metallurgical, electrical, chemical, mining, and smelting industries round out a fairly well balanced national economy.

Personal income equivalent to US\$ 550 in 1962 is one of the highest in Latin America.

Principal exports are minerals and metals, of which copper is the most important and the source of 62% of the foreign exchange. High grade iron ore (67% Fe content) exportation is also rapidly increasing and in 1961 amounted to 4.1% of the foreign exchange.

The Chilean Government, through CORFO, has prepared a 10-year National Economic Development Programme for the period 1961 to 1970 as a master plan to expand the country's economy and to raise the standard of living of the people. This programme contemplates a 5.5% annual increase in the Gross National Product, which represents an increase of 2.9% per capita based on the estimated population growth of 2.7%.

The increase of Gross National Product during 1961 and 1962 was of 4.4% and 5.2% per annum, respectively. These figures indicate that the goal fixed by the 10-year Plan of 5.5% was met 80% in 1961 and 95% in 1962.

The basic projects, that are being concentrated on, are the following:

- Agriculture: To increase soil productivity and the cultivation of new areas to make the country self sustaining in food products, and the possibility of some exportation.
- Housing: To construct new housing at a rate commensurate with the increase in population and reconstruction of the areas devastated by the 1960 earthquakes.

Industry: To further develop present industries, with particular emphasis on those producing products that may be exported, such as: metals, paper, cellulose, lumber, fish, etc.

Mining: To increase capital investments in the production of copper and iron ores to double the present output.

Electric Energy, Fuels and Transportation: To increase electric power output from 1,100,000 kw to 2,570,000 kw; the production of petroleum from 1,300,000 cubic meters to 4,230,000 cubic meters; and to increase the production of coal.

To improve existing land, maritime, and air transport facilities.

During the two-year period 1961-1962 the national investments in fixed assets were E⁰ 1,360 millions (1960 exchange rate was US\$ 1: E⁰ 1.05) or 94% of the goal set in the 10-year Plan.

It is estimated that the investment goal for 1963 will be met and that the same favourable situation will continue in the following years.

Total investment needed to complete the programme is calculated to be US\$ 10,000,000,000 for the 10-year period.

III. HISTORY OF THE STEEL PRODUCTION IN CHILE

At the turn of the century, information about the excellent quality of the iron ores and other raw materials that were available in Chile prompted the idea of developing steel manufacture in the area. Consequently, a wood burning Blast Furnace was placed in operation in the year 1910, but the operation was not successful due to the type of fuel employed. Subsequently, the furnace was enlarged and again placed in operation using wood charcoal as a fuel.

In 1939 the Chilean Government created the Corporacion de Fomento de la Produccion (Industrial Development Corporation - CORFO) to promote industrialization. Four basic projects were included in the programme of this new organization, namely, the development of Electric Power, Petroleum, Steel, and Agriculture.

Production of steel in the country at that time amounted to about 20,000 MT per year and consisted chiefly of reinforcing bars that were produced in four small plants, one of which was integrated and the other three used ferrous scrap as the basic material.

Imports at the time amounted to approximately 120,000 MT of finished products annually, but varied widely depending on conditions in the international market and the availability of foreign exchange.

Lack of private capital and the uncertainty of a satisfactory return on the investment had retarded the development of the steel industry, in spite of the availability of excellent raw materials. Even though the market was small, the possibility of growth was evident if a constant supply of steel products could be made available. This prompted CORFO, in collaboration with North American experts, to make preliminary studies to confirm the technical feasibility of developing the industry on a larger scale.

In the year 1942 and based on CORFO's preliminary report, the Government appointed a Commission to review the studies and to report on each aspect of the project and the most effective way to carry it out. The Commission was composed of representatives from private industry, from other Government institutions, and from CORFO.

In its report the Commission advised the establishment of an integrated steel plant, but emphasized the necessity for making thorough technical studies to arrive at the best solution for the country. It also suggested the formation of a stock company with the participation of CORFO and recommended specifically that:

" Its main characteristic should consist in the incorporation of private capital and Government resources, under the administration and responsibility of the former, with the Government maintaining certain fundamental rights to safeguard national interests."

The Chilean Government also entrusted CORFO with the development of the technical and economic studies necessary to determine plant size, location, recommended metallurgical processes, etc. At the same time, the Government appointed a Steel Committee to co-ordinate functions and to establish the financial and legal bases for the creation of the Compañía de Acero del Pacífico, S.A. (CAP).

To carry out the studies recommended by the Commission CORFO organized a Steel Department in its New York Office, comprised of a group of North American technicians and experts, in the different aspects of steel making and Chilean engineers, assisted by certain specialized firms.

These studies resulted in a Preliminary Project Report which was presented to the Export-Import Bank of Washington in 1945 in order to obtain a credit for the purchasing of the necessary equipment and machinery. The Eximbank assigned a group of experts to make a thorough review of the technical and economic bases for the project.

On receipt of a favourable report from these experts, the Eximbank granted a credit for US\$ 28 millions, with the stipulation that a North American company with experience in the steel industry was to participate in the administration of the plant. Koppers Company, Inc., of Pittsburgh, Pa. was offered the assignment. Before accepting, Koppers Co. made a careful analysis of the project in U.S.A. as well as in Chile.

Based on the above, it can be said that the project was thoroughly analysed and that the end product resulted from the collaboration of North American know-how and Chilean engineers who contributed greatly with their knowledge of local factors.

The Steel Committee, meanwhile, was instrumental in obtaining the passage of a special law which granted the steel industry certain rights and privileges which made possible the long term financing of the funds needed for its construction and development. This law, which was passed on October 2, 1944, grants exemption for 20 years from all taxes, duties, mortgages, bounties, or other fiscal contributions to those industries whose main purpose is the production of steel ingots or the manufacture of steel products derived from native iron ores. The law also includes certain dispositions regarding operating profits, contracting of foreign personnel, etc

IV. THE INITIAL PROJECT

1. The Market

Studies made for the purpose of designing the Machipato Plant indicated a domestic market for steel products amounting to about 150,000 MT annually, of which 25,000 MT were currently being produced in the country.

In the years 1935-1940, the relationship of imports and local production to total consumption was as follows:

	Steel Imports (MT)	Local Production (MT)	Total consumption (MT)
1935	117,700	10,000	127,000
1936	127,000	12,000	139,800
1937	132,100	14,500	146,600
1938	120,900	18,000	138,900
1939	112,600	22,000	134,600
1940	132,600	23,000	155,600

A further analysis of the steel consumption indicated that certain items in small demand and isolated importations, such as rails and structurals, should not be considered in determining plant capacity, reducing the tonnage of steel products that it was felt could be economically produced in the country to about 130,000 MT.

This tonnage consisted of the following:

Merchant Mill products	85,000 MT
Plates	8,000 MT
Sheets, hot & cold rolled	22,000 MT
Tin plate	15,000 MT

Considering a growth rate of 2.5% per year, it was calculated that the time operations were beginning consumption of steel products would reach 170,000 MT, of which about 155,000 MT could economically be produced in Chile.

The plant was initially projected to satisfy this demand; although it is not likely that a plant will normally arrive at capacity production until two or three years after starting operations.

Although thorough studies were made during the development phase of the project on the types and quantities of steel products currently required in the country, it was not possible to predict the specific product mix that would be needed to satisfy a regenerated market. Consequently, it was necessary to plan on the installation of equipment and facilities that were adaptable to the manufacture of a fairly wide range of products.

2. Raw Materials

At the time the Huachipato Steel Plant was being designed, proven iron ore reserves were estimated at only 47 million MT, at the "El Tofo", "El General", and "El Algarrobo" deposits. Unproven reserves were estimated to be more than 100 million MT.

Present iron ore reserves are estimated to be far above these figures. Although "El Tofo" has been almost depleted, proven reserves at "El Romeral" are currently estimated at 30 million MT, while probable reserves may be well over 75 million MT. "El Algarrobo" reserves were estimated at 70 million MT a few years ago, but mining operations at that location, presently being conducted by CAP, indicate that actual reserves may be much higher.

In the meantime several other deposits have been discovered, such as "San Vicente", "El Laco", and other smaller ore bodies, a number of which are currently being exploited for export.

Thus, the country's ability to satisfy its own iron ore requirements has not only been strengthened but also iron ore of excellent quality is being exported in increasing quantities.

The original plans for the installation of Huachipato were based on using iron ore from "El Tofo", a mine belonging to Bethlehem Steel Corp., located 700 km north of the Plant, close to the seashore. This ore contained about 59% Fe with P content then estimated at 0.06%, but was expected to last for only a short time. Subsequently, ore was to be obtained from "El Romeral" deposit, located not far south of "El Tofo". The P content of this ore was expected, however, to be in the range of 0.20 to 0.30%. Consequently, it was planned to install Bessemer converters and open hearth furnaces for the initial operations, but plans were projected to switch entirely to the open hearth process as the P content of the ore increased.

At the time the project was being studied it was necessary to find out if Chilean coals could produce metallurgical coke of satisfactory quality. Analyses of Chilean coals from the Lota and Schwager mines were made in the U.S.A. early in 1943, with the co-operation of Koppers Company, Inc. and the United States Bureau of Mines.

Preliminary tests were made by Koppers Co. in its Kearny New Jersey Laboratory, and tests on an industrial scale were made in the Coke Plant of Kaiser Co., at Fontana, California. Investigations on the coking properties of Chilean coals were conducted at the same time in the laboratories of the United States Bureau of Mines.

These tests showed the feasibility of using Chilean coals mixed with imported coals to produce blast furnace coke.

Bituminous coal reserves in the country were estimated at about 75 million MT prior to the installation of Huachipato. These figures have also proven to be conservative. At the present time bituminous coal reserves at the Lota and Schwager mines, which provide coal to Huachipato, are calculated to be 146 million MT. There are also other reserves of suitable coals not presently being mined.

3. Choice of Reduction, Refining, Rolling, and Finishing Processes

A matter that was given careful consideration was the selection of the process best suited for the economic reduction of iron ore, between the blast furnace and the electric smelting furnace.

Studies made with the assistance of H.A. Grassert and Co. and Det Norske Aktieselskabet for Elektrokemisk Industri, a Norwegian firm specialized in electric smelting furnaces, indicated that the blast furnace was technically and economically more advantageous than the electric smelting furnace, which at first had appeared to be the more logical process.

Studies were also conducted to determine the most suitable refining process.

As mentioned before, it was decided to install both Bessemer and open hearth facilities, with plans to revert entirely to open hearth refining when the P content of the ore made it advisable.

The selection of the rolling equipment also deserves considerable comment.

At that time the only satisfactory method of producing the semi-finished products needed was in a blooming mill. Consequently, this was the method adopted.

The choice of flat product rolling equipment was also limited at that time. One alternative was the so called "hand mill", with limited capacity and high operating costs, but with low initial investment. The other alternative was the continuous strip mill, with a large minimum capacity and high investment.

The practical solution was to install "hand mills", since the market was too small at that time to warrant a larger investment. To further minimize the initial investment, it was decided to buy second hand equipment to roll plates, sheets, and tin plate, with the idea of eventually changing to more modern equipment when the market justified such a move.

Finishing equipment for annealing, cold rolling, tinning, galvanizing, etc., was also purchased second hand for the same reason.

For the rolling of bars and small shapes it was necessary to design a mill that could, with a comparatively low investment, produce the wide variety of merchant mill products required by the market. The equipment purchased is described later on in this paper.

4. Plant Site

The location was selected taking into consideration the following factors:

- a) Raw material availability and costs: iron ore, coal, limestone.
- b) Proximity to principal markets.
- c) Availability of electric power and water supply.
- d) Harbour facilities and transportation costs.
- e) Satisfactory land area for future expansion and locating allied industries.
- f) Climatic conditions, labour supply, and housing requirements.

The site chosen by the Steel Committee for the Plant is on San Vicente Bay, near the cities of Concepción and Talcahuano, and about 500 km south of Santiago, capital of Chile.

The geography of Chile and the fact that raw materials are widely dispersed along its coast, coupled with the necessity for importing a great deal of equipment and operating supplies, dictated that the site be close to the ocean.

The coal mines at Lota and Schwager are close by.

The "Abanico" hydroelectric plant and, in general, the hydroelectric resources of the river Laja provide ample electricity for the area. The Biobío river which is close to the site assures an ample supply of fresh water for the steel plant and its allied industries.

Existing highways and railroad lines afford good access to markets. Maritime shipping serves areas in the extreme north and south of the country.

The cities of Concepción and Talcahuano provide housing, medical services, educational and recreational facilities, and a good labour market.

Weather conditions in the zone are, in general, satisfactory, with a mean high temperature of 16.3°C and a mean low of 7.4°C.

Finally, the selection of the site strengthened the position of Concepción as one of the more important producing centres, thereby aiding population dispersal from the north central area, which is so necessary in Chile.

5. Plant Description

The original Plant consisted of the following major units:

- a) An open pier 270 m long, with facilities for unloading iron ore at the rate of 600 MT per hour and limestone at a rate of 400 MT per hour. The pier is provided with two railroad spurs for handling of inbound or outbound cargo.
- b) Raw material bedding and handling facilities for ore, limestone, and coal.
- c) A Coke Battery of 57 ovens, with coking capacity of 600 MT daily, complete with Tar and By-Products plants.
- d) A Blast Furnace with 6.33 m hearth and capacity of 600 MT daily.
- e) A Steel Shop with two 75 MT open hearth furnaces and a Bessemer converter of 15 MT capacity, to produce a total of 236,000 MT per year.
- f) A 32" Blooming Mill with complementary 26" 3 Hi mill, with 200 MT soaking pit capacity, to roll billets, slabs, and sheet bar.
- g) A Merchant Bar Mill with one furnace of 25 MT per hour capacity, an 18" 3 Hi roughing mill, a 24" edger, five stands of 14" two stands of 12", and two stands of 10" mills, with six additional stands of 10" for the production of wire rod. Principal products are round, square, and flat bars; angles, narrow strip, and wire rod. Capacity was estimated at 100,000 MT per year.
- h) A complement of used Hand Sheet and Tin Mills for pack rolling sheets, and tin plate from bar stock. Main units were a 3 Hi roughing mill and three 2 Hi finishing mills, complete with furnaces, for sheets and tin plate. Finishing equipment included pack shears, picklers, annealing furnaces, normalising furnace, temper pass mills, hot dip tinning and galvanizing lines. Included also was a 2 Hi plate mill with a normalising furnace, leveller, cooling beds, and shear. Capacity was estimated to be 15,000 MT of tin plate, 20,000 MT of black and galvanised sheets, and 25,000 MT of heavy plates.
- i) A Yoder Forming Mill with welders to produce line pipe of 6.5/8", 8.5/8, and 12" diameters.
- j) Chemical and Physical laboratories.
- k) Service facilities such as light, water, and power lines; Machine Shops, General Repair Shops, Boiler Plant, Water pumping station, Oxygen and Acetylene plants, Compressed Air equipment, Sulphuric Acid Plant, Electric Shops, Warehouse, railroad system gas distribution system, etc.

The equipment and processes to be used were selected to afford maximum flexibility in the future expansion and development of new products. The Plant was erected allowing adequate space for growth and with suitable foundations for heavier loading in the future.

Facilities should generally be planned with higher capacities than those currently needed. The Huachipato Blooming Mill was projected with a capacity double of that which was actually necessary at the time, and this was fully justified within five years after operations began.

V. FINANCING OF THE INITIAL PROJECT

The total investment for the project was estimated to be US\$ 60 millions, a sum that could not be financed from Chilean sources only. Consequently, CORFO applied to the Export-Import Bank of Washington for financial assistance.

Upon approval by the Eximbank of the US\$ 28,000,000 credit which was requested by CORFO for the construction of the Plant, the total resources available to proceed with the programme were the following:

Common Stock -- 1,500,000 shares, US\$ 10 share	US\$ 15,000,000
Eximbank - Credit	US\$ 28,000,000
Central Bank of Chile - Credit	US\$ 10,000,000
CORFO - Credit	US\$ 2,381,000
Amortization Bank in Chile - Credit	US\$ 1,096,700
Equipment Suppliers U.S.A. - Credit	US\$ 3,122,531
	<hr/>
TOTAL	US\$ 60,100,231

The Eximbank named a Committee composed of specialized engineers from the Reconstruction Finance Corporation together with engineers from the Bank, to make a thorough study of the preliminary project and to acquaint themselves with conditions in general in Chile. The final report of the Committee was eminently favourable to all aspects of the project, including its economic justification.

On May 3rd, 1946, the Compañía de Acero del Pacífico was incorporated to carry out the programme, and the capital stock of this corporation was subscribed as follows:

CORFO	- Series A Shares US\$	5,000,000
Amortization Bank	- Series B Shares US\$	2,000,000
Private Shareholders	- Series D Shares US\$	3,000,000

On making a careful evaluation of the bids for the construction and equipment that would be required, and based on certain technical modifications that were found to be necessary and indispensable to a successful operation of the Plant, it became evident that the initial credit of US\$ 28,000,000 would be insufficient.

After a review of all details on the enlarged proposal, the Eximbank increased the initial loan to US\$ 43,000,000.

A total of US\$ 76,000,000 was spent in the construction of the Plant, of which US\$ 54,000,000 was spent in the U.S.A. for equipment and services and the equivalent of US\$ 22,000,000 was spent in Chilean currency for local purchases and labour.

It should also be remembered that the lapse of time between the initiation of a project and the eventual completion of the same is a factor that may seriously affect the original budget due to monetary inflation, which can result in higher costs for imported equipment and services at time of purchase than was originally estimated. At the same time monetary inflation within the country itself can result in considerable revision to budgets.

These are factors that should be carefully evaluated in the initial planning.

VI. DEVELOPMENT AND EXPANSION

1. Construction and Initial Operation

It was estimated that construction of the Plant, which commenced in January of 1947, would take about three years to complete. Special emphasis was placed on early completion of such service units as the Machine Shops, General Repair Shops and the pier, to facilitate the overall construction programme.

Operations actually started during the first quarter of 1950, essentially on schedule.

The sheet mills started limited operations in November of 1949, using imported sheet bar, and the Merchant Mill in May 1950, with imported billets. Integrated operations started with Coks Plant coming on stream in April 1950, Blast Furnace in June 1950, Steel Shop in July, and the Blooming Mills in August 1950.

The Company had sent a sizeable group of engineers and technicians to the U.S.A. for training, and these, together with experienced operators who were contracted abroad, were responsible for start-up operations and for the general training of the Chilean workmen.

The original plant was designed to produce 236,000 MT of ingots for conversion to 160,000 MT of finished products. Local market requirements were estimated to be 126,000 MT, which left a surplus of 34,000 MT for export or eventual domestic consumption.

The unusually strong demand for steel products in Chile provoked by assured availability, coupled with favourable conditions for exporting to neighbouring countries, indicated an early need for expanding capacity. At the same time, a certain imbalance was evidenced between the capacity of some facilities and the product mix required.

Production of iron from the Blast Furnace was better than expected and greater potential production was evident if additional and improved raw materials could be provided.

It was decided after careful study to project an expansion based on full utilization of the Blast Furnace capacity and the installation of the steelmaking and rolling equipment necessary to process the additional product.

2. First Expansion

A preliminary project was submitted to the Eximbank for the expansion of the Plant and also a project to develop a new ore mine, "El Romeral", together with Bethlehem Chile Iron Mines Co., who are the owners of the property. A credit of US\$ 10,000,000 was granted for the Plant expansion and an additional credit of US\$ 2,750,000 for development of the mine.

The main items that constituted the Plant expansion were the following:

- a) Increase raw material bedding (four additional beds)
- b) Addition of 13 ovens to existing Coke Battery.
- c) Installation of medium size sintering plant.
- d) Installation of No.2 Bessemer converted and No.3 open hearth furnace, to increase steel making capacity.
- e) Installation of additional rolling mills for production of sheet and tin products.
- f) Some additional handling facilities, railroad equipment, and improvements to mould foundry.

Completion of the programme increased Plant capacity to over 200,000 MT of ingots at a relatively low cost, as can be readily seen by the production results obtained for 1951 and later (enclosed chart).

Shortly after this expansion was completed, it became necessary to go to the Duplex refining process (Bessemer-Open Hearth) because the P content of "El Tofo" ore increased to about 0.15%. This was possible because the original planning contemplated this probability.

At about that time CAP took over the operation of an old charcoal Blast Furnace, which made available an additional tonnage of pig iron. This, together with the increased production from the Hunchipato Blast Furnace, permitted the Plant to increase production to 380,000 MT of steel beginning in 1956 by increasing the capacity of the open hearth furnaces from 75 to 100 MT.

3. Second Expansion

The increased availability of flat rolled products stimulated a still greater demand in both the internal and export markets, and increasing emphasis was being placed by consumers on product quality. In 1955 it became evident that market requirements could not be met in 1959 without further expanding Plant capacity, and a three step expansion programme was projected for the years 1956 through 1959, constituted essentially as follows:

The first step contemplated partial replacement of existing Hand Sheet Mills by installing a slab heating furnace and a 3 Hi slab breakdown mill followed by a 48" 4 Hi reversing hot mill, to produce hot rolled coils. The 3 Hi mill was also satisfactory for the production of wide plate for which finishing facilities were also to be installed.

The second step was to construct an additional (1956) open hearth furnace of 200 MT, thereby making available three 100 MT furnaces and one of 200 MT.

The third and final step was to replace remaining Hand Sheet and Tin Mills with modern conventional equipment for the cold reduction of hot rolled coils to finished sheets and tin plate. These included a continuous pickler, three stand 48" cold mill (February 1960), cleaning lines, annealing facilities, temper mill, and cup up lines.

This programme was again carried out through receipt of an Eximbank credit for US\$ 19,550,000, plus the Company's own resources and suppliers' credits which amounted to another US\$ 19,660,000, for a total cost of US\$ 39,210,000. 60% of expenditures were made in the U.S.A. and 40% in Chile.

Completion of the programme early in 1960 increased the potential capacity of the Plant to 450,000 MT of ingots per year.

4. Third Expansion

At the present time another expansion programme is underway, with principal objectives being:

- a) Replacement of certain antiquated and overloaded facilities to permit retention of actual production rates.
- b) Increasing hot metal availability by introducing modern techniques, such as fuel oil injection in Blast Furnace.
- c) Increasing steel production capacity by enlarging open hearth furnaces and operating with basic refractories and oxygen injection.
- d) The installation of additional soaking pits and a second slab furnace, plus enlarging present billet furnace, will permit full utilization of all present rolling facilities.

The cost of this programme is US\$ 32,650,000, of which 35% will come from the Company's own resources.

It should be pointed out that part of this programme has already been put into effect. This has been the case particularly in the Blast Furnace where fuel oil injection was started in May 1962. Increased availability of metal plus improved operations in the Steel Shop through the use of a basic roof in No.4 Open Hearth, has permitted the plant to reach a production of over 500,000 MT of ingots.

Recommendations for the expansion of the Plant facilities originate generally with the Company's Permanent Committee for Technical development, comprised of the Manager of Operations, General Superintendent of Operations, Manager of Sales, Chief Engineer, and the Technical Advisor to the President of the Company.

VII. BENEFITS FOR CHILE

The operation of the Huchipato Steel Plant had an immediate and favourable impact on the general economy of the country. Natural resources such as iron ore, limestone, coal, electric power, heretofore not completely utilized or developed, were consumed in larger quantities. The needs of the industry motivated the production of

refractories, ferroalloys, industrial paints, spare parts, etc. By-products of the industry were utilized in the manufacture of cement, agricultural lime, and chemicals.

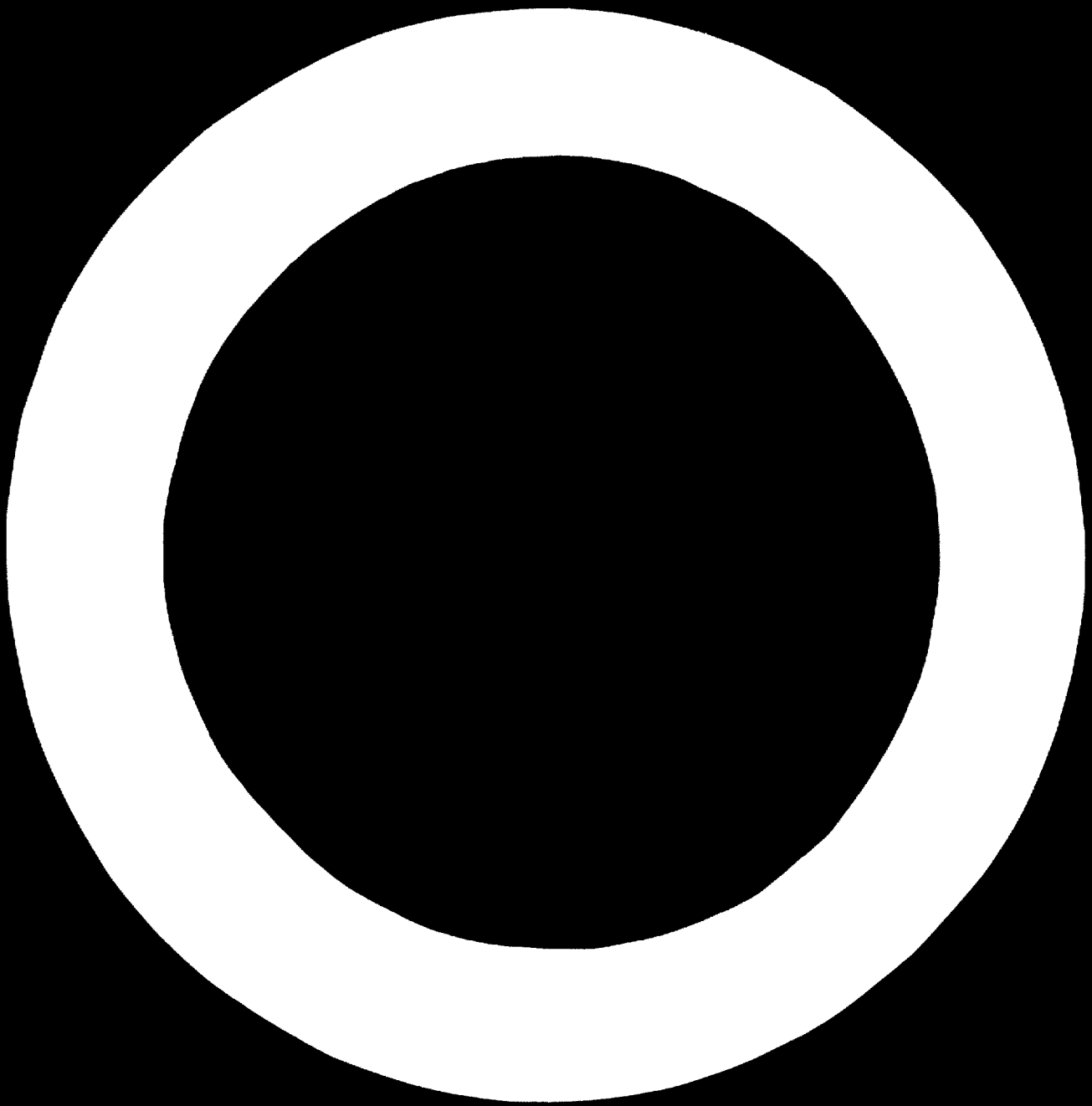
Of major significance has been the development of other industries closely allied to steel, made possible by the assurance of a constant and adequate supply of the basic material. Manufacturers of wire products, forged steel balls for processing minerals, enamelware, electric household appliances, metal containers, fabricated structures, steel tubing, etc. have all undergone major expansion programmes.

The savings in foreign exchange since the start-up operations directly attributable to CAP exceeds US\$ 250,000,000 which has permitted Chile, which normally had an unfavourable trade balance, to substantially improve that position.

CONCLUSIONS

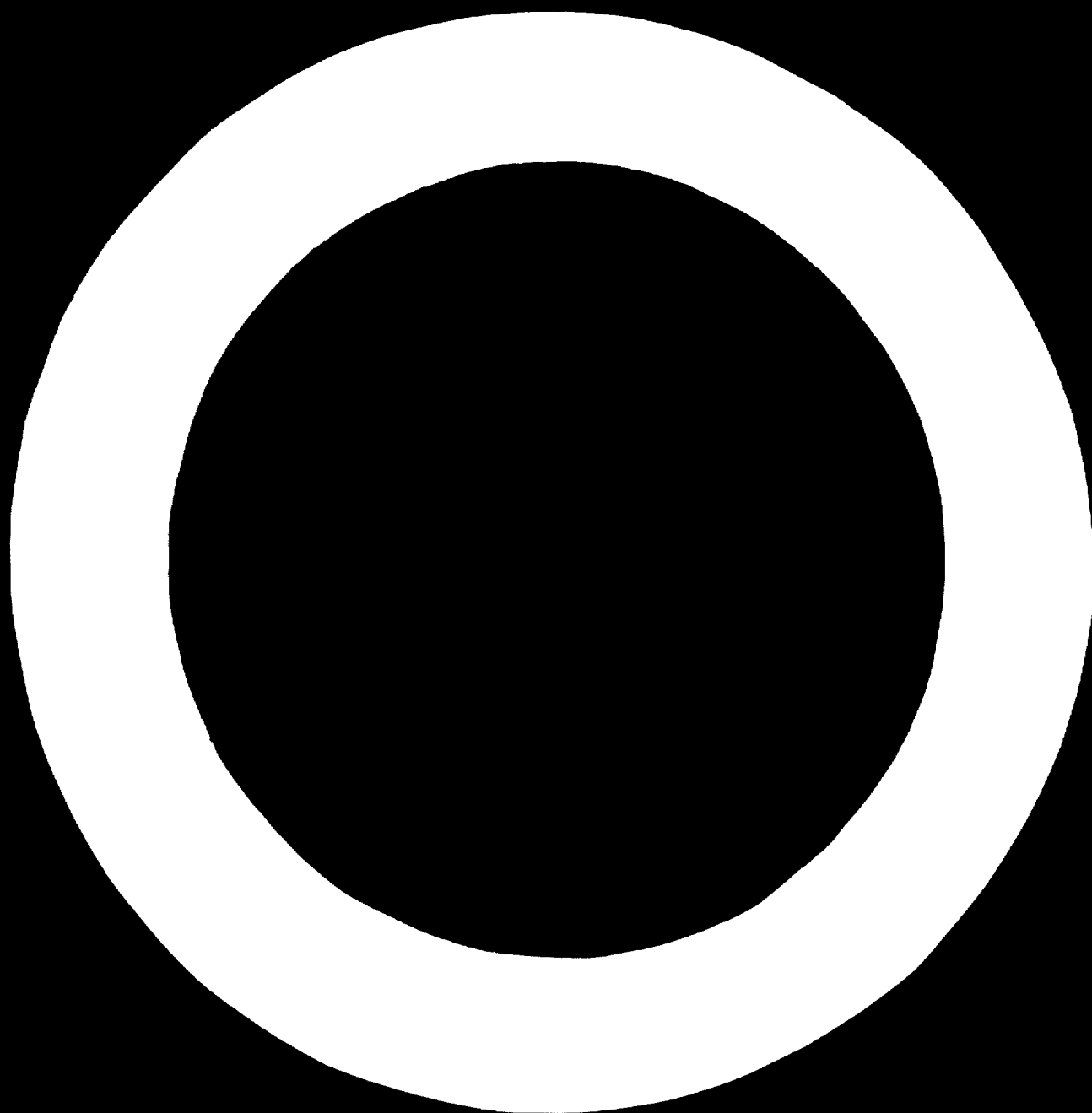
If thought is being given to the creation of new industries in developing countries, it is apparent from the experience obtained in the promotion and expansion of a steel industry in Chile, that the following factors deserve the utmost consideration:

1. Thorough survey of market requirements projected with sufficient imagination and foresight to evaluate the additional potential market that will be created when increased demands are quickly supplied.
2. Careful analysis of raw material availability and quality, together with the natural and human resources necessary to support economic production.
3. Studies in conjunction with qualified technicians and consultants to determine the most adequate technological processes for economic conversion of materials and most strategic location for the plant proper, in relation to transport facilities, natural resources, labour market, and markets for finished products.
4. Full consideration to the flexibility of facilities and capacity projected to meet estimated demands for 5 to 10 years in the future, even at the risk of higher initial costs.
5. Adequate estimates to determine final installed costs of the operating plant and careful evaluation of the probable price rises and monetary inflation that may distort estimates.
6. Assured source of the necessary funds and capital investment required to complete the project.



PRODUCTION

<u>1956</u>	<u>1957</u>	<u>1958</u> *	<u>1959</u>	<u>1960</u> **	<u>1961</u> *	<u>1962</u>
381,100	388,200	348,500	414,800	421,600	362,900	494,600
136,900	121,500	99,300	139,200	118,900	106,600	164,900
131,100	130,000	114,800	146,500	158,300	138,000	181,400
6,400	34,200	57,500	14,400	17,400	15,500	11,600
180,000	152,000	166,000	193,000	170,000	227,000	330,000
75,000	131,000	106,000	91,000	105,000	49,000	17,000
237	287	289	261	264	280	221



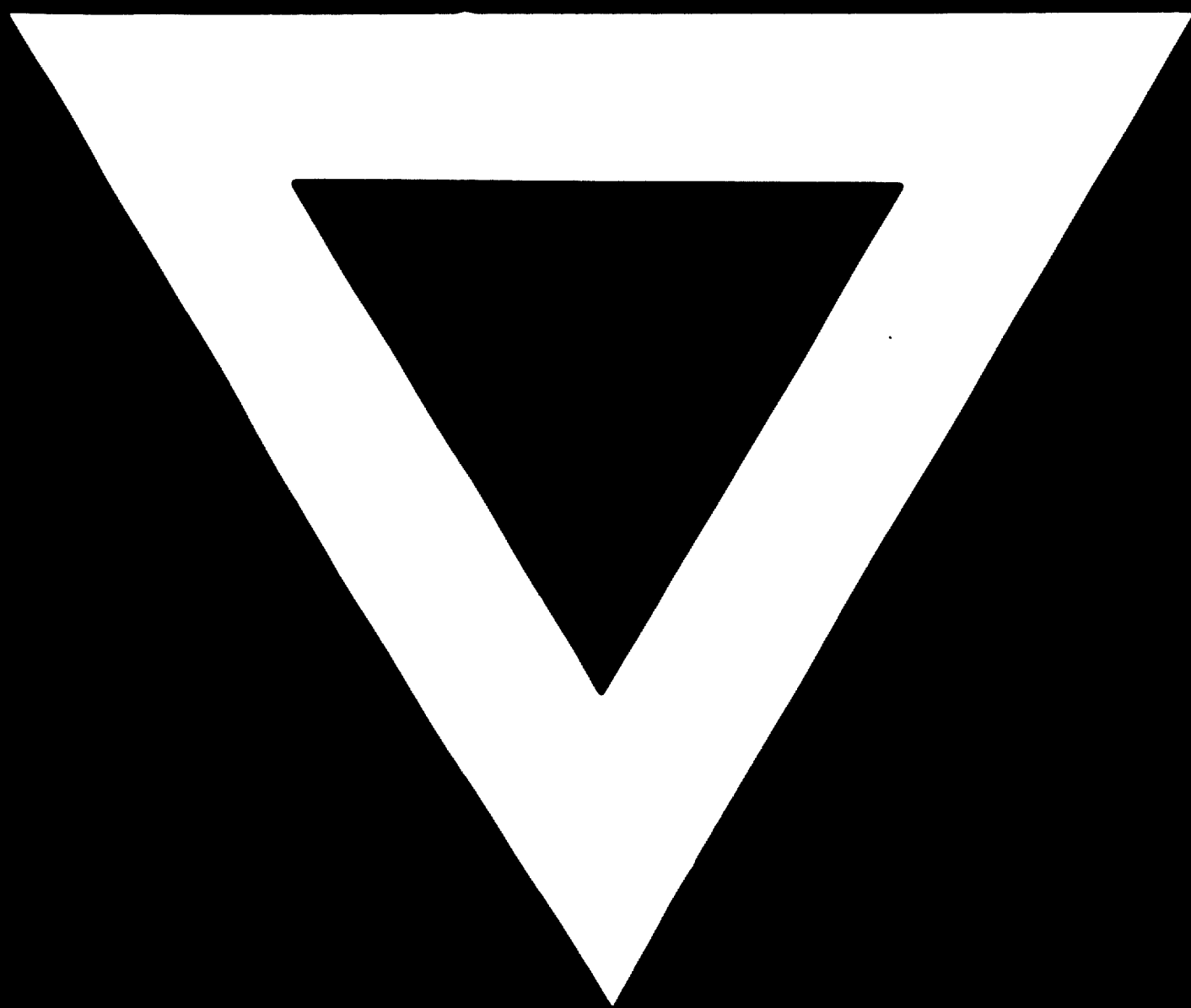
RECAPITULO I

	<u>1951</u>	<u>1952</u>	<u>1953</u>	<u>1954</u>	
Steel Ingots	178,300	246,900	313,100	321,000	28
Merchant Mill Products	74,700	102,800	102,300	124,700	11
Flat Products	51,700	78,300	100,400	95,800	9
Semifinished Products					
Domestic Consumption	102,000	137,000	116,000	173,000	18
Export	24,000	32,000	81,000	54,000	4
US\$ Investment per MT of Steel Ingots	446	345	280	278	

* Lower production due to strike.

** Lower production due to Blast Furnace Relining.





22 . 3 . 74